Resistance to Reforms, Inequality and Development

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Abstract

We provide a politico economic theory of resistance to reforms and long term development. We consider the endogenous adoption of productive reform opportunities. Innovations allow improving average income but are non neutral with respect to the returns to different production factors; hence inequality in the distribution of endowments induces conflict of interests. We study the emergence and the disappearance of vested interests and resistance to reforms in a subsequent generations framework. The gradual implementation of reforms changes the distribution of factor ownership. This implies that households’ dynastic attitude towards modernization may change. Economic and political inequality harms the development process. The dynamic evolution of the system is theoretically characterized. A simple simulation illustrates the ability of the model to study the role of economic and political inequality for the endogenous transition to modern growth, the disappearance of vested interests and to explain experiences of stagnations and fast development.

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"Persecution of great discoveries was due partly to mental resistance to new ideas and partly to the disturbance caused to entrenched authority and vested interest, intellectual and material. Sometime lack of diplomacy on the part of the discoverer has aggravated matters. Opposition must have killed at birth many discoveries.”

W.I.B. Beveridge

Introduction

1 Introduction

This paper provides a theoretical model of resistance to reforms and long term development based on the endogenous adoption of productive opportunities. The goal is to provide a dynamic framework to study the multiplicity of development paths experienced by different countries as a result of the continuous economic and political process of modernization. We concentrate attention on the role of economic and political inequality in creating vested interests which result in the resistance to reforms which are profitable for the economy as a whole. In fact, economic history is characterized by repeated episodes of resistance to innovations. Societies (or a part of them) often oppose and block the adoption of new technologies (or institutions) even when these innovations would improve the living conditions of the society as a whole. The argument is that when reforms (technological or institutional) are non neutral the presence of inequality harms the development possibilities of the economy.

A crucial and common characteristic of both technological and institutional innovations is that they need an explicit and active process of adoption. Therefore the process of development can be seen as a sequence of opportunities which, to become effective, need to be adopted by the population. We model reforms as productive opportunities which results in an enlargement of the production possibilities of the economy.

Reforms are costless but need an active process of adoption. Profitable and costless innovations may find opposition and resistance since they are non neutral with respect to the interests of different agents in society and, inevitably give rise to conflict of interests. In particular, we assume that productive opportunities may favor either the market oriented and ‘modern’ sector or the traditional ‘natural resources based’ one. Any reform changes relative factor prices both directly, by productivity improvements, and indirectly by inducing structural changes and sectorial shifts in the labor force. Depending on their factor endowments individuals tend to favor reforms in one sector and oppose reforms in the other. As a consequence, the distribution of factors of production (economic inequality), and of political rights (i.e. decision power) influence the development process. Nonetheless, and crucially, development fires back on individual interest and inequality. This bi-directional feedbacks change individual attitude towards modernization together with the structure of the economy.
The framework is applied to study the dynamic evolution of the economy. We consider a standard two sectors growth model with TFP dynamics resulting from the active process of innovation via reform implementation. We study how attitude towards reforms depends on the level of development, the inequality in the distribution of natural resources, and the increase in the stock of the factor of production alternative to natural resources.

This contribution is at the crossroad with several lines of research: (i) resistance to innovations, vested interests and status quo bias, (ii) theories of stagnation and transition to growth, (iii) the role of natural resource abundance and inequality in its distribution to explain the multiplicity of development experiences. We quickly locate our contribution in this landscape.

(i) A sparse literature provides different positive theories of resistance to technological innovation, institutional reforms and emergence of status quo bias. The struggle which characterizes any modernization process, and the resistance to reforms provided by the part of population whose (vested) interests may be harmed, has been recently at the earth of significative contributions. In a series of papers and book chapters, Joel Mokyr (2000, 2001, 2003) deeply analyzes the technological inertia. He suggests that this apparently irrational phenomenon is inherently politico-economic, in the sense that the economic development was often held back by political processes that arrested the diffusion of new technologies. Our contribution is in line with this idea that technological (or institutional) change is non neutral with respect to the interests of different agents in society and, inevitably give rise to conflict of interests.

Krusel and Rios-Rull (1996) focus their attention on the intergenerational effects of an innovation. In their model, agents invest in technology-specific human capital and as a consequence in such a framework "technological innovation may sow the seeds of its own destruction": the old generation opposes the adoption of new technology since this would reduce the value of their stock of human capital. In a related paper, Bellettini and Ottaviano (2004) consider the conflict which arises between the young and the old people in a society if technological innovation can be traded off against improvements in the old technology; the latter would be the choice of the old court while the young would push for new technologies. These analysis, which are inherently static, focus on the emergence of vested interests, and lobbying, as resulting from irreversible investments. In this contribution, in turns, we consider a simple reason for the emergence of vested interests: the inherited unequal distribution of production endowments. Our main focus is on the characterization of the dynamic evolution of resistance to reforms and on its implication for development. In fact, along the development path the attitude of the different social groups towards innovation can well change since the distributional consequences of technological innovation change with the economic structure and the distribution of income.

The paper is also closed to the literature on status quo bias and resistance to reforms. We concentrate attention to the fact that changes leads in most cases to an improvement in the welfare of some and to a deterioration in that of others. Hence, contrary to the contribution of Fernandez and Rodrick (1991) we do not consider any individual specific uncertainty and the status quo bias
(which in our case takes the form of blocking reforms in favor of the modern sector) emerges under certainty and full information.

(ii) Transition to modern growth. Recent contributions provide theories explaining the endogenous transition from economic stagnation to modern, sustained growth. Galor and Weil (2000) consider the endogenous change in fertility behavior and an endogenous demographic transition. Galor and Moav (2002) provides an evolutionary theory of long term development studying the role of human selection. In this paper we provide a complementary explanation for the endogenous transition to growth; the slow and incremental process of reforms implementation which allows modernization to break its way. The mechanism slowing down development has its roots, in our case, in the politico economic interactions. The vested interests of the elites prevents institutional and technological improvements and impose a cost on the economy as a whole. Eventually these vested interests disappear and innovations can be freely adopted. At this stage the process of modernization accelerates.

(iii) Natural resources abundance and inequality. A large number of hypotheses have been raised to account for the negative relation between natural resource abundance and dynamic performance with a common underlined denominator: the abundance of resources can distort the investment in growth enhancing forms of capital. Natural resource abundance may generate a false sense of security and lead governments to rest importance to the need of designing sound and growth-oriented economic policies. Another line of argument focuses on the global conditions of the natural resources industry. The famous hypothesis of Prebisch (1950) and Singer (1950) of a secular decline in terms-of-trade of primary commodities vis-a-vis manufactures can be put in this category. From a positive point of view, the presence of natural resources may lead to rent-seeking behavior at the expense of more profitable alternative allocations. For example, rent-seeking may breed corruption in business and government. In general, as long as rent-seeking represents a dead weight loss, anything that encourages rent-seeking will lower steady state income and therefore growth along the transition to steady state.

Recent contributions in development economics stresses the differential strategic role of different sectors for long run development which may lead countries that traditionally invested in the development of resource based sector to loose competitiveness on the international market. In fact the pillars sustaining the

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1 Cervellati and Sunde (2002) study the role of life expectancy and the interactions between the biological environment in generating the endogenous transitions. Other contributions on this topic considered transition which are driven by scale effects and population growth rather than an endogenous mechanism, like Goodfriend and McDermott (1995) and Hansen and Prescott (2002).

2 One of the first scholars who analyzed the phenomenon from this point of view has been in the 16th century the french political philosopher Jean Bodin (1962). Recently the argument has been stressed also by Holmes (1995) among the others.

3 The case studies in Gelb (1988) and Anty (1990) lend support to these political channels of influence. Furthermore resource abundance may lead to an overvaluation of the national currency. This is a symptom of the so called Dutch disease (Corden, 1984): a natural resource boom and the associated increase in raw materials exports may increase the real exchange rate, thus crowding out other exports.
wealth of nations changed dramatically with the growing importance of the 
production of differentiated industrial goods and services characterized by an 
intensive use of technology and human capital. Agricultural and primitive indus-
trial goods, produced with little variation in all countries and heavily relying 
on the use of natural resources and row labor, are clearly insufficient to sustain 
long run development in a world characterized by increased international mar-
kets integration and competition. Nonetheless, the shrinkage of the strategic 
importance of resource intensive sectors does not represent *per se*, a disadvan-
tage for richly endowed countries.

In this paper we concentrate attention in particular to the role of economic 
and political inequality in creating resistance to innovation. This implies, that 
natural resource abundance is not necessarily negative *per se* but only when it 
is associated to large inequality in its distribution. This is in line with the 
arguments, proposed by Engerman and Sokoloff (1994), that inequality in the 
distribution of land may lead to rent seeking and harm economic development. 
Galor, Moav and Vollrath (2003) consider the role of land inequality as a root of 
the episodes of economic divergence and overtaking. They consider the possi-
bility that the landlord elites delay profitable investments in education and, 
in this way, slow down development. In our contribution the stagnation does 
not result from the lack of investment in a costly education process. We rather 
concentrate attention on the resistance to innovations which despite being cost-
less affect the different (vested) interests in a non neutral fashion. Also the 
change in attitude eventually leading to modernization does not result from a 
single event but it is rather the result of a slow and almost undetected incre-
mental process. Vested interest provide a resistance to innovation which looses 
strength with the process of development. Also some profitable improvements 
are implemented throughout all history even if most of the profitable reforms 
are actively blocked. This slow incremental process of reform adoption leads 
to a progressive increase in the production possibility frontier. Eventually the 
productivity in the modern sector make the importance of natural resources 
negligible and vested interests disappear.

The paper is organized as follows. Section 2 lays down the model. Section 3 
studies the attitude toward reforms in the equality benchmark. Section 3 char-
acterizes individual preferences in a static framework with inequality. Section 4 
studies the dynamic of resistance to reforms and of vested interests while Sec-
tion 5 provides a simple simulation of the model to illustrate the working of the 
model overtime. Section 6 concludes. All proofs are collected in the appendix 
in Section 6.

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4 A problem with these argument is that large amount of imperfections and rigidities are 
needed to create large lock-in effects in the long run unless the strategic importance on non-
resource intensive sectors is somehow not fully recognized. The possibility of an undervaluation 
of the strategic importance of advanced sectors and investment in human capital is gaining 
ground among economist and can be related to the presence of “backward and forward link-
ages” stressed by Hirschman (1958) and Baldwin (1966) or, in the lines of the endogenous 
growth tradition, to externalities associated to the accumulation of human capital.
2 The Model

The economy is populated by an infinite series of subsequent generations of individuals. Each generation is denoted by subscript $t$ and is formed by a unit mass of individuals $i$. Each individual has a single parent and a single child so that population size $L_t = L$ is constant overtime. A unique commodity is produced in multiple sectors using natural resources $N_t$ and physical capital $K_t$ together with labor $L_t$. The capital stock fully depreciates after one generation.

By low case letters we denote per capita and individual variables, $y_t = \frac{Y_t}{L_t}$, $k_t = \frac{K_t}{L_t}$ and $n = \frac{N_t}{L_t}$. Preferences of individual $i$ who is born in period $t$ are defined over consumption, $c^i_t$, and transfers to the offspring $b^i_t$,  

\[ u^i_t = u(c^i_t, b^i_t) = (c^i_t)^{1-\rho} (b^i_{t+1})^\rho \]  

The timing of events is as follow. At the beginning of their life individuals are endowed with $b^i_t \geq 0$, and the stock of natural resources $n^i$, inherited from their parents. The bequest is not immediately productive and must be invested in physical capital $b^i_t = k^i_t$. Production takes place and individual receive the payment of the productive factors they supply to the market. Factor prices rates are determined in the macroeconomic competitive labor market and are equal to the marginal productivity. Denote by $\{w_t, R_t, z_t\}$, the equilibrium wages and rental rates of physical capital and natural resources.

Therefore the individual’s income $y^i_t$ is given by,

\[ y^i_t = w_t + k^i_t R_t + n^i z_t \]  

Finally, every individual decide how much to consume and to leave to the offspring under the constraint, $c^i_t + b^i_{t+1} \leq y^i_t$. The utility specification implies an optimal individual consumption choice for which the level of bequest is given by a constant fraction of the individual income so that,

\[ b^i_{t+1} = \rho y^i_t \]  

\[ B_{t+1} = \rho Y_t \]  

\[ \rho \]  

We abstract from leisure choices and assume that every individual supplies one unit of labor so that aggregate labor coincide with population size.

In principle land and capital could be sold on a competitive market. Nonetheless it can be verified that endowments are weakly optimal, i.e. no agents have incentive to sell or buy land and capital. Also, the existence of small transaction costs, status or political power linked to land ownership prevent its alienation. This is shown in appendix A.

In the following by $i$ we denote both the individual and the family to which he belongs.

There is agreement that even before industrial revolution different sectors were competing for labor and factor payments tended to reflect productivities. For the early 19th century see Magnac and Postel-Vinay (1997): “industry and agriculture competed for labor, even though labor was by no means scarce”.

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From the aggregate point of view the economy transfers \( B_{t+1} \) to the following generation which translates into aggregate capital \( K_{t+1} \).

The unique final good, used both for consumption and investment, is produced in multiple sectors of production. Production takes place in a traditional natural resources intensive sector, and in a manufacturing physical capital intensive sector. The output/income of the economy in period \( t \) is thus given by:

\[
Y_t = Y_t^A + Y_t^M
\]  

(4)

Both sectors produce with constant return to scale Cobb-Douglas technology. Denote by \( L_{At} \) and \( L_{Mt} \) the respective amount of labor employed in the two sectors. Be \( L_{At} = (1 - \lambda_t) L \) and \( L_{Mt} = \lambda_t L \) where \( \lambda_t \) is the fraction of total labor force employed in sector \( M \).

\[
Y_t^M = F(K_t, L_{Mt}) = K_t^\alpha (M_t L_{Mt})^{1-\alpha}
\]  

(5)

\[
Y_t^A = G(X_t, L_{At}) = N_t^\alpha (A_t L_{At})^{1-\alpha}
\]  

(6)

where \( M_t \) and \( A_t \) represent the (labor augmenting) total factor productivity in the two sectors of production.\(^9\) Equilibrium factor prices,

\[
w_t^A = G_L(N_t, L_{At}) = (1 - \alpha) (N/L_{At})^\alpha A_t^{1-\alpha}
\]  

(7)

\[
z_t^A = G_N(N_t, L_{At}) = \alpha (N/L_{At})^{\alpha-1} A_t^{1-\alpha}
\]

and

\[
w_t^M = F_L(K_t, L_{Mt}) = (1 - \alpha) (K_t/L_{Mt})^\alpha M_t^{1-\alpha}
\]  

(8)

\[
R_t = F_K(K_t, L_{Mt}) = \alpha (K_t/L_{Mt})^{\alpha-1} M_t^{1-\alpha}
\]

Denote by \( \tilde{K}_t = M_t^{1-\alpha} K_t \) and \( \tilde{N}_t = N A_t^{1-\alpha} \), the stock of effective capital and natural resources respectively available to each generation \( t \). Labor move freely between sectors to equalize wages,

\[
w_t^A = w_t^M = w_t
\]  

(9)

and from this condition we can uniquely compute the equilibrium share of workers in both sectors.

\(^9\)Equal \( \alpha \)'s in both sectors are chosen for simplicity since different intensities in the use of labor are not relevant for the results.
Remark 1 (factor market equilibrium). There exists a unique equilibrium division of labor $\lambda_t$ given by,

$$\lambda_t = \frac{\tilde{K}_t}{N_t + \tilde{K}_t}$$

which is increasing in the stock of effective capital and decreasing in the stock of effective land.

The equilibrium wage rate is therefore given by,

$$w_t^A = w_t^M = w_t = (1 - \alpha) \left[ \tilde{N}_t + \tilde{K}_t \right]^\alpha$$

3 Reform Opportunities

Consider now the possibility of (institutional/technological) reforms which result in an improvement of the productive possibilities of the economy. The benefits of a reform are measured in terms of increases in total factor productivity (TFP). Hence, improvements are seen as the realization of a reform which allows to reap the benefits of an extension of the technological frontier.\(^{10}\)

Reform opportunities are not identically profitable. The effects on the economy of an implemented reform depends on the characteristic of the specific reform opportunity, i.e. on its profitability $v_t$. From an ex-ante perspective, in each moment in time the incremental value of the reform opportunity $v_t$ is a random variable.

Our contention is that these reforms opportunities are not neutral. Some reforms favor the production in the traditional sector while others favor the productivity of the modern, capital intensive, one. An economy characterized by perfect equality in the distribution of endowments represents the natural benchmark. In this representative agent framework the community would implement the most profitable reforms, i.e. the reform which allows the larger increase in total income production. Nonetheless, with heterogenous agents individual income and total income may be effected differently by implementation of the reforms which favor different sectors. We model this non neutrality by assuming that each generation have the possibility to implement a reform which is profitable for either sector $A$ or sector $M$.

Each generation face the possibility to implement two reforms. One improves the traditional and one improves the modern sector. Hence, denote by $\{v_t^A, v_t^M\}$ the potential improvements faced by generation $t$. Improvements take value on a compact set $v_t^j \in (0, \overline{v})$ and distributed according to a density function $g^j(v_t^j) \geq 0$, for $j = A, M$. Once the possibility for a reform arises, the realization of $v_t^j$ becomes common knowledge.

\(^{10}\)This modeling strategy is similar to Messner and Polborn (2001). They model reforms as costly investment which pays off in the future. Since our focus is rather on the possible bias created by vested interest we assume that all reforms intail no implementation costs.
Reforms improve productivity as follows, \(^{11}\)
\[
\tilde{M}_t = M_{t-1} (1 + v_t^M)^{1-\alpha}
\]
and
\[
\tilde{A}_t = A_{t-1} (1 + v_t^A)^{\frac{1-\alpha}{\alpha}}
\]

Since each opportunity is productive and it entails no costs it is always profitable to implement a reform.\(^{12}\) Hence, individuals of each generation face the choice of which type of reform to implement.

Consider first the benchmark case in which there is no inequality in factor endowments. No conflict of interests arise in the community and, since population size is normalized to one, aggregate and per capita variables coincide. Therefore a reform is implemented in the economy if, and only if, it increases the average income. Figure 1 displays the production possibilities frontier, PPF, of the economy for given \(A_t, B_t\) and \(K_t\).

![Figure 1 about here](image-url)

For the economy as a whole the choice between \(v^M\) and \(v^A\) amounts at selecting the reform that moves the PPF outwards the most. The change in total production depends on the profitability of the reform \(v^j\) together with the stock of effective capital and land. The effects of reforms are amplified by the effective capital/natural resources available in the community which implies that a reform favoring \(A\) can be preferred to a reform favoring \(M\) even if \(v^M > v^A\). This is the case if the TFP and the installed capital in the \(M\) sector are small compared to the effective natural resources available in the community. In this only extremely reforms with very large \(v^M\) are profitably implemented. Any reform triggers a sectorial shift in the labor force. By comparing the final income produced in the economy after the implementation of any reform agents can make their choice. Denote by \(v \equiv v^M/v^A\) the relative profitability of reforms. We have the following,

**Lemma 1 (Profitability of reforms: Equality benchmark).** For any \(\{A_t, B_t, K_t, N\}\) there exists a unique \(v_t\),
\[
v_t = \frac{v_t^M}{v_t^A} = \frac{N}{K_t} \left( \frac{B_t}{A_t} \right)^{\frac{1-\alpha}{\alpha}}
\]

\(^{11}\) We generically denote by \(\tilde{M}_t\) and \(\tilde{A}_t\) the TFP after the choice of the implementation of the reform without distinguishing if the reform was implemented or not, so that \(\tilde{M}_t = M_{t-1}\) and \(\tilde{A}_t = A_{t-1}\) in the cases of non implementation of the reform. Also notice that this particular formulation is used for simplicity but it entails no loss of generality. Any formulation in which the TFP of a sector increases with the implementation of a reform would be equivalent.

\(^{12}\) Costly reforms would be implemented only if sufficiently profitable. For any constellation of parameters it is possible to identify a threshold level of profitability which makes any innovation profitable. This implies that not all generations implement reforms and thus delays improvements in time.
such that if $v_t > \bar{v}$ then reform $M$ is implemented while if $v_t \leq \bar{v}$ then reform $A$ is implemented.

A larger stock of physical capital $K_t$ makes, ceteris paribus, any reform in that sector relatively more profitable. This means that a community with a larger amount of resources available for investments faces a lower threshold $\bar{v}$ and tends to favor innovations in the modern sector. Larger $K_t$ means that a lower value of a reform $M$ is needed to make the reform the best choice. Since $M_t$ and $K_t$ are complementary, the larger is the capital in the economy the stronger will be the positive effect of an institutional/technological reform.

The availability of natural resources is crucial for the implementation of the reforms. Natural resources abundance make reform in the primitive sector more profitable for any level of effective capital in $M$. As the economy develops, and effective capital increases, the profitability of the different sectors changes but natural resources abundance always tends to slow down improvements in the $M$ sector and, therefore, it delays modernization. Nonetheless, it is worthwhile noting that this delay in modernization does not entail any static inefficiencies, since each generation maximizes the income possibility given the state variables.\textsuperscript{13}

In other words the bias towards the $A$ sector implied by natural resource abundance cannot be considered a form of resistance to profitable reforms or innovation although it slows down modernization.

In next section we study the case of heterogenous agents. If endowments are distributed unequally then natural resources abundance and inequality may create vested interests, distort the choices over reforms and induce resistance to profitable innovations. Hence, the argument implies that while natural resources abundance does not represents a limit to the institutional/technological change per se it may prevent modernization when the returns from these resources are unequally distributed.

\section{Individual preferences over reforms}

In unequal societies the choice of reform implementation is characterized by conflict of interests. If the distribution of productive factors is not perfectly equal, then the individual attitude towards reform implementation is different for different individuals. A reform changes the returns to different factors in a non neutral fashion both by bias institutional/technological change and by inducing structural shifts.\textsuperscript{14}

\textsuperscript{13}In this model individuals maximize the production opportunity for their generation only. In a world with altruistic and forward looking individuals (or infinitely lived agents) the concept of efficiency would entail the comparison of the infinite stream of income produced in the economy.

\textsuperscript{14}If there is a cost of implementation then the burden may be raised by imposing different costs on different agents. Also this fiscal collection distortion is absent in a perfectly equal world since no redistribution is associated to the funding of reforms. Having costless reforms allows to concentrate on the non neutral effects on the returns without having to make assumptions on fiscal collections.
In the following we first investigate the presence of vested interests as resulting from the unequal distribution of factors of production for a given generation. We then move to analyze the overtime (dynastic) evolution of the individual attitude towards modernization. In fact an important result is about the change of the dynastic attitude toward reforms. Eventually, as physical capital accumulates and the TFP in the \( M \) sector improves, resistance to innovations disappears.

Be \( b_i^t \) the non consumed income of generation \( t - 1 \) of dynasty \( i \) which is passed to generation \( t \) while \( n^i \) is the dynastic ownership of natural resources (which does not change overtime).

Denote by \( \gamma_i^t \in [0, \infty) \) defined as \( \gamma_i^t \equiv \frac{k_i^t}{k_t} \) the amount of individual capital in terms of average (per capita) capital and by \( \eta_i^t \in [0, \infty) \) defined as \( \eta_i^t \equiv \frac{n^i_t}{n_t} \) the relative amount of natural resources owned by dynasty \( i \).

An agent is in favor of the implementation of the reform which maximizes his income,

\[
y_i^t = w_t + k_i^t R_t + n^i_t z_t
\]

or equivalently,

\[
y_i^t = w_t + \gamma_i^t k_t R_t + \eta_i^t n z_t
\]

The implementation of a reform changes the amount of effective capital and land available in the economy and triggers a sectorial shifts. We have,

**Lemma 2 (Reforms and Factor Prices).** Following the implementation of reforms in the two sectors, factor prices change as follows:

\[
\frac{\partial w_t}{\partial v^M_t} > 0, \quad \frac{\partial R_t}{\partial v^M_t} > 0 \quad \text{but} \quad \frac{\partial z_t}{\partial v^M_t} < 0
\]

\[
\frac{\partial w_t}{\partial v^A_t} > 0, \quad \frac{\partial z_t}{\partial v^A_t} > 0 \quad \text{but} \quad \frac{\partial R_t}{\partial v^A_t} < 0
\]

Any reform increases the wages. Reforms \( v^M \) increase the effective capital leading to larger rents \( R_t \) and lower \( z_t \) while the opposite is true if \( v^A \) is implemented since this increase the effective amount of natural resources. This implies that, for any generation, the individual attitude towards the implementation of a reform depends on the individual ownership of production factors.

Using equilibrium factor prices (7), (8), and (11), express individual income, for given \( \gamma_i^t \) and \( \eta_i^t \), as,

\[
y_i^t = \left( \bar{N}_t + \bar{K}_t \right)^{\alpha - 1} \left[ (1 - \alpha) \left( \bar{N}_t + \bar{K}_t \right) + \alpha \left( \gamma_i^t \bar{K}_t + \eta_i^t \bar{N}_t \right) \right]
\]

Individual attitude towards reforms depends on \( y_i^t \left( v^A_t \right) \geq y_i^t \left( v^M_t \right) \). We have the following,
Proposition 1 (Individual preferences over reforms). For any given \{A_t, B_t, K_t, N\} and \{v^A_t, v^M_t\}, an individual characterized by the vector \((\gamma^A_t, \eta^A_t)\) is in favor of the implementation of reform \(v^M_t\) (respectively \(v^A_t\)) if, and only if,

\[
\gamma^A_t > (\prec) \left[ c + s\eta^A_t \right]
\]

where,

\[
S_t = \frac{[K_t (1 + v^M_t) + N_t]^{1-\alpha} - [K_t (1 + v^A_t)]^{1-\alpha} - [K_t (1 + v^M_t) + N_t]^{1-\alpha} - [K_t (1 + v^A_t)]^{1-\alpha}}{[K_t (1 + v^M_t) + N_t]^{1-\alpha} [K_t (1 + v^A_t)]^{1-\alpha}}
\]

\[
C_t = -\frac{(1-\alpha) [K_t (1 + v^M_t) + N_t] [K_t (1 + v^A_t)] [K_t (1 + v^M_t) + N_t]^{1-\alpha} - [K_t (1 + v^A_t)]^{1-\alpha}}{\alpha [K_t (1 + v^M_t) + N_t]^{1-\alpha} [K_t (1 + v^A_t)]^{1-\alpha}}
\]

An agent is indifferent between implementing \(v^A_t\) or \(v^M_t\) if \(y^A_t (v^A_t) = y^M_t (v^M_t)\).

The previous Lemma confirms the intuition that this is the case for those for whom larger natural resources endowments are associated to larger capital endowment.

Figure 2 displays the linear locus (20), denoted as LL, which has positive slope and which divides the space \((\gamma, \eta)\) identifying individuals in favor of \(v^A_t\) or \(v^M_t\). Those agents with endowments along the LL locus are indifferent between the two reforms. Those with endowments lying above LL, i.e. with large capital endowments relative to natural resources, are in favor implementing \(v^M_t\), while those with large endowments of \(N\) (below the LL locus) prefer \(v^A_t\). For future reference we refer to the group of agents supporting \(v^A_t\) and \(v^M_t\) as Group_A and Group_M respectively.

5 The dynamics of vested interests and resistance to reforms

We now turn to the study of the dynamic implications of this analysis. Denote by \(\delta_t \equiv K_t / N_t\) the effective capital, effective natural resources ratio. The position of the locus LL depends on the state variables \{A_t, B_t, K_t, N\} and on the actual values of the reforms opportunities \{\(v^A_t, v^M_t\}\}. This also implies that the dimension of Group_A and Group_M changes over the course of generations.

The dynamic evolution of the economy changes the dynastic attitude towards reforms. Since the production in the primitive sector is based on a non accumulative factor (natural resources) we observe a structural change. Both larger stocks of capital and improved productivity in the modern sector leads to a shift of the labor supply from the A sector to the M sector and leads to
an increase of the share of production realized in the modern sector. In this case, natural resources get relatively less important than capital as a factor of production. In the limit, if $K_t$ is very large relative to $N_t$, i.e. as $\delta_t$ gets larger, the main source of heterogeneity in individual income disappears as the rents from natural resources represents a negligible source of income. In this case all agents earn wages and rents from capital and income inequality vanishes. This is stated in the following,

**Remark 2 (Inequality in the Limit)** $\lim_{\delta_t \to \infty} \gamma_i^t = 1$ for all $i$.

The likelihood of a dynastic change in attitude towards reforms is crucially related to the level of profitability of the $M$ sector and to factor endowments.

Agents' attitude towards reforms depends on their endowments of factors of production $(\gamma^t_i, \eta^t_i)$ on the level of development $\delta_t$ but it also depends on the profitability of the reform in itself $v^M_t$. To investigate the role of modernization consider an economy in which initially the primitive sector is more productive than the modern one. If $K_t$ is low, individuals relatively rich in natural resources oppose the implementation of $v^M_t$ even for very profitable opportunities. On the contrary if $K_t$ is very large, relative to $N_t$, most individuals support reforms $v^M_t$. Clearly individuals belonging to Group $\_M$ with low $K_t$ favor, a fortiori, reforms profitable for the $M$ sector for large $K_t$.

Hence we concentrate attention to the change in attitude toward modernization which happens to those dynasties which (for low $\delta_t$) belong to Group $\_A$. As an example we depict the attitude towards reforms of such a dynasty in Figure 3.

![Figure 3 about here](image)

Panel (a) displays the case in which the reduction of rents from natural resources makes the individual income to be always decreasing in $v^M$. This is case when the profitability of the $M$ sector, and $\delta_t$, is too low. Panel (b) considers a case in which $\delta_t$ is large but the rents from $N$ are still an important source of income for dynasty $i$. No reforms on $M$ are supported but income is not monotonically decreasing in $v^M$. Panel (c) considers the case in which $\delta_t$ is even larger. The dynasty owns a certain amount of capital and may gain from improvements in the $M$ sector but only if these improvements more than compensate the reduction in rents $z_t$. In particular they may benefit from a reform $v^M$ only if it is sufficiently productive. In this case reforms on the $M$ sectors may not find the opposition of this dynasty provided they are enough profitable. In panel (d) the productivity of sector $M$ is large enough to safely

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15 The local concavity/convexity of the locus and its position is conditional on $\gamma^t_i$ and $\eta^t_i$ which change over the course of generations. Hence, Figure 2 is intended to be an illustration. What is crucial is that in the limit for $\delta_t \to \infty$ we do observe a change in attitude and that for intermediate level of $\delta_t$ the locus change monotonically.
induce dynasty $i$ to benefit from any reform $v^M_i$.\footnote{Notice that even when individual income is increasing in $v^M$, the actual choice depends on the comparison with the effect of the reform $v^A$. Hence even in this case reform $v^A$ can be preferred. Nevertheless, as shown later, only reforms $v^M$ will be implemented eventually as the modern sector is sufficiently developed.}

We now turn to study of the implementation of the reforms in the community over the course of generations. We observe distortions from vested interests and resistance to profitable innovations whenever reforms which would be implemented in the equality benchmark are not implemented due to the conflict of interests. In particular we are interested in the process of modernization seen as a progressive improvement of the TFP of the modern sector which is proxied by $\delta_t$.

The position and the slope of the locus $LL(\delta_t)$ reveals useful information about the implementation of reforms in the community. We have the following,

**Lemma 3 (Position of the locus LL)** The locus $LL(\delta_t)$ has positive intercept and infinite slope for $\delta \to 0$ and negative intercept and zero slope for $\delta \to \infty$

$$\begin{align*}
\lim_{\delta \to 0} S &= \infty \quad \text{and} \quad \lim_{\delta \to \infty} S = 0 \\
\lim_{\delta \to 0} C &= > 0 \quad \text{and} \quad \lim_{\delta \to \infty} C < 0
\end{align*}$$

Consider Figure 4.

In Figure 4 the dynasty with $\gamma^i = \eta^i = 1$ has balanced endowments and earns exactly average income and the preferences over reforms of this individual are in line with the equality benchmark. Hence by looking at the position of the $LL(\delta_t)$ locus with respect to the vector $(\gamma^i, \eta^i) = (1, 1)$ we can immediately realize which group has preferences in line with the efficient benchmark.

Consider first low levels of $\delta_t$. In this case the $LL(\delta_t)$ locus has positive intercept and large slope. This implies that most of the population, belonging to Group \_A, is in favor of implementing reforms which allows to improve the TFP in the primitive sector. At the other extreme for large level of $\delta_t$ the $LL(\delta_t)$ locus has negative intercept and small slope (and eventually zero slope). This implies that for high levels of developments, when the productivity of the modern sectors is substantially larger than the one of the primitive sectors, Group \_M collects all individuals. At this stage only reforms $v^A$ and $v^M$ respectively. In these conditions no resistance to profitable reforms are observed and no vested interests are at play.

This is not the case during the transition to a developed economy. For intermediate levels of development the locus $LL(\delta_t)$ splits the population in
two groups with opposite interests. The dynasties with endowments below that line (which are relatively rich in natural resources) oppose implementation of reforms in the $M$ sector. In this case the decision over reform implementation require the political aggregation of individual conflicting interests. To convey the main message we do not need to enter into the details of this political process. Nonetheless is clear that the actual distribution of political influence and power plays a crucial role. Consider, for simplicity, the case in which dynasties with large endowments of $N$ have the decision power. In this case, roughly speaking, the decisions over reforms are taken by agents belonging to Group $\mathcal{A}$, and if $(\gamma, \eta) = (1, 1)$ belongs to Group $\mathcal{M}$, we have that resistance to innovations and vested interests are at play since the most profitable reforms are blocked. This resistance to reforms gets weaker as $\delta_t$ increases for two reasons. In first place, the strategic importance of protecting the rents of the primitive sector shrinks. And second, the fraction of dynasties with vested interests is reduced.

In summary, resistance to reforms comes by part of the owners of factors of production which are harmed by an increase in the productivity of the modern sector. Things tend to change as the modern sector gets more productive. In the long run the importance of natural resources becomes negligible and the resistance to modernization disappears. The actual dynamic path of the economy turns out to depend on the (dynamic) distribution of factors of production (economic inequality) and on the distribution of political power.

Both economic and political inequality appears to be crucial. In first place, the resistance to reform is harder to eradicate the larger is the inequality in the distribution of natural resources. Indeed, the larger is $\eta_t$ the larger is the level of $\delta_t$ needed to make the support the reforms $M$ individually profitable. This means that, ceteris paribus, the change of attitude of those individuals is delayed in time. In second place, the frictions imposed on development of the modern sector are larger the larger is the political power in the hands of the (i.e., the bigger the political inequality). Unfortunately, in most underdeveloped countries today, the political power is in the hands of an elite which is typically formed by those who control natural resources. The observation of resistance to profitable reforms is more likely the more unequal is the distribution of resources and the more politically entrenched this conservative elite is.

As a consequence the development path followed by a country depends on economic and political inequality. In general the resistance to reforms will be larger, and the change in attitude will happen (if it happens at all) later in time the higher is the inequality. In the next section a simple version of the model is simulated to illustrate these theoretical findings.

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17This case is historically and empirically relevant since typically political power (or even voting rights) are associated to either income or land ownership. In the next section we simulate the model for the simple case of two groups only and we make the extreme assumption that only the richest one have decision power.
6 Multiplicity of development experiences.

In this section we consider the simple case in which the population is split into two groups: a dynasty of natural resources owners $l$ and a dynasty of without natural resources $p$ collecting fractions of population $\psi < 0.5$ and $1 - \psi$ respectively. Each owner of natural resources owns a fraction $1/\psi$ of the normalized total stock $N/L$ and he his initially endowed with $k_l^0$ units of capital. Each member of the $p$ dynasty does not possess natural resources and he is initially endowed with $k_p^0$ units of capital. Therefore the value of $\psi$ represents a rough measure of inequality. Also given $\psi$ inequality increases with natural resource abundance. In particular, to study the evolution of the economy we simulate this simplified version.

Different political regimes can be studied. The most interesting case is the one with political inequality. If political power is exclusively in the hands of the $l$ dynasty, the oligarchy coincides with a dictatorship of the elite. Alternatively the majority voting turns out to be equivalent to the dictatorship of the $p$ group which are the biggest class (since we assume $\varphi < \frac{1}{2}$), while in the consensus democracy case the decisive voter is always the most conservative agent which can oppose her veto to the proposed reforms. To model inequality in the distribution of political power we assume that the decision over reform implementation is in the hand of owners of natural resources (oligarchic society).

Consider first the benchmark. A perfectly equal community will always implement the Pareto efficient innovations (i.e. the ones which move the production possibilities frontier more outwards). The model works as a standard (two sectors) growth setting in which the economy accumulates capital overtime as well as total factor productivity due to the implementation of the reform opportunities. These implementations increase the productivity of the modern sector or the one of the primitive one depending on the and choices of the society.

The benchmark rule used to select what reform to implement changes overtime. In particular, in the first stages of development the society tends to implement reforms in the primitive sector while in the long run, due to the continuous process of capital accumulation, the preference goes towards innovations which affect the modern one.

Figure 4 about here

Figure 4 presents the evolutions of the total factor productivity in the two sectors across generations. A reform $v_i^M$ is implemented in the modern sector whenever $\frac{v_i^M}{\gamma} > \frac{1}{\delta_t} \left( \frac{B_i}{A_i} \right)^{1-\alpha}. \therefore$ Therefore when $\delta_t$ is very little the primitive

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18The parameters that we use to study the change of attitude and the transition towards modern growth are the followings: $\alpha = 0.5, \beta = 0.6, \gamma = 1.9$. The initial conditions taken into account are: $N = A_0 = M_0 = K_0^l = 1$. Finally, to study the overtake which takes place between a poor and more equal society and an initially richer one (in terms of natural resources), we consider: $N_1 = 1.7 > N_2 = 1$, and $\eta_1 = 1.1 < \eta_2 = 3$. 

16
sector productivity is the one which grows faster but, as time goes and as $\delta_t$ increases, it decelerates and eventually it is overtaken by the TFP of the $M$.

This change of preferences of the society from one sector to the other triggers the take off of the process of economic growth. In fact, when the implementation of reforms become more frequent in the $M$ sector, the process of reinforcement between TFP growth and capital accumulation leads the society to a much faster economic growth in terms of income per capita. This take off is illustrated in Figure 5.

Figure 5 about here

Another interesting feature is that structural change is associated with both capital accumulation and the tendency to implement more in the $M$ sector. At the beginning both the technological possibilities and the availability of resources for investment are scarce and, as a consequence, a large fraction of labor is devoted to the primitive sector. Gradually, the total factor productivity of the manufacturing sector increases (because of the reform implementation), and therefore the productivity of physical capital and labor in this sector increase. The labor shifts to the $M$ sector.

Consider now the existence of inequality in the distribution of factors of production. The presence of such an inequality, and the fact that the political decisions are taken exclusively by the natural resources owners, slow down the change of attitude of the society with respect to the benchmark case. A resistance to Pareto efficient reforms emerges and this in turn leads to the implementation of much more reforms which privilege the primitive sector with respect to the benchmark (and efficient) case.

This resistance to innovation is illustrated in Figure 6. The productivity growth of the modern sector is much faster in the benchmark case (panel above) while the opposite is true for the primitive sector (panel below).

Figure 6 about here

The unequal economy is characterized by a change in attitude towards modernization which takes place only later on. The unequal economy eventually adopts the benchmark rule but it is characterized by intermediate periods of large instability. The large availability of natural resource opens the room to profitable modernization, but also to conservative reforms. Therefore the road to modernization is full of potential reversal of attitude and the history of such a society is characterized by a phase in which movements towards modernization can be followed by very little reformism.

As a result the modernization of an unequal society is characterized by large instability and repeated changes of attitude, as documented in the figure below.

Figure 7 about here
Engerman and Sokoloff (1994) provide an extensive evidence on the role played by natural resource abundance and opposition to productive improvements in the process of economic development. They focus in particular on the development of north and south America. The theoretical findings of this paper are largely consistent with this reading of the development path of north and south America.

Figure 8 displays the dynamic evolution of two economies which differ in terms of distribution of factor endowments. Also one economy is richer in natural resources than the other one. The dynamic evolution is characterized by overtaking.

Both economies are ruled by the landlords elite, but the largely endowed with N is more biased towards the primitive sector with respect to the implementation of reforms.19 Figure 9 displays the dynamic evolution for a longer time spell. The bottom panel shows the evolution of the productivity of the two sectors in the richer but more unequal economy. This economy tends to privilege the primitive sector whose TFP remains above the level of the manufacturing even in the very long run. On the contrary as shown in panel two, the more equal (and initially poorer) economy changes attitude pretty soon and, as a result, tends to implement those reforms which are more productive for the M sector, experiments faster physical capital accumulation, and, in a word, is the first that modernizes. As a result, the initially poorer society ends up overtaking the initially richer one.

7 Concluding Remarks

Although the comprehension of the driving forces underpinning the process of economic development is far from being a settled issue, there is an increasing sense among economists and social scientists that technological innovation and their institutions, are first-order determinants of their economic performances. We addressed the question of whether there might be systematic reasons why some societies are more likely than others to adopt innovations that are conducive to economic development.

The central concern of this paper is to explain the differentiated performances of economies over time. We focused our attention on the relation between the process of innovation (both technological and institutional) and the one of economic development. We consider reforms as opportunities which need an active process of adoption and which are undertaken to exploit productive improvements. Economic and political inequality creates vested interests and

19 Clearly north america was also a more democratic society. The consideration of this element would just reinforce the findings by speeding up the transition even more.
opposition to profitable reforms. In a politico-economic framework in which the preferences are not aggregated by some sort of benevolent social planner, inequality in the distribution of factors of production, and in particular natural resources and physical capital, influences the dynamics and therefore affects development. The vested interests affects the productivity improvements but also the reverse is true and the causation run both ways. The increase in available effective capital in the economy makes modernization reforms more profitable and more attractive for all individuals; in turn, the increases in TFP which follow the reforms implementation increase the returns on capital and incentive further accumulation.

We studied how this process of modernization (i.e, the enlargement of the production possibilities of the economy due to both larger productivity and larger availability of resources for investment) changes individual attitude towards reforms overtime. In early phases of development it is optimal to adopt reforms which are biased towards the primitive sector. Eventually investing in the modern sector insures larger productivity improvements but the owners of natural resources tend still to oppose reforms which enhance the productivity of modern sectors and community as a whole. Hence, in an oligarchic society (with political power in the hands of those controlling the rents from natural resources) we observe vested interests and resistance to reforms. Inequality tends to slow down development as the economy implement reforms which enhance the productivity of the primitive sector even when it would be more profitable to invest in the modern one. Eventually productivity of the modern sector reaches a critical level and the importance of natural resources shrink sufficiently, then the opposition to modernization naturally disappears. Nevertheless, this late change in attitude may imply large costs. By simulating the model for illustrative purposes we showed that late change in attitude due to unequal distribution of natural resources may lead to divergence in development and episodes of overtaking.

8 Appendix

Proof of Lemma 1

By constant return to scale, total production in each moment in time equal total income,

\[ Y_t = w_t + K_t R_t + N z_t \] (23)

Express the rents on capital and natural resources in terms of the wage as,
\[
R_t = \frac{\alpha w_t M_t^{1-\alpha}}{\tilde{N}_t + \tilde{K}_t} \frac{1}{1 - \alpha} \\
z_t = \frac{\alpha w_t}{\tilde{N}_t + \tilde{K}_t} \frac{1}{1 - \alpha}
\]

By (23) and (24) we have

\[
Y_t(v^*_t) = w_t + \tilde{K}_t \frac{\alpha w_t M_t^{1-\alpha}}{\tilde{N}_t + \tilde{K}_t} \frac{1}{1 - \alpha} + \tilde{N}_t \frac{\alpha w_t A_t^{1-\alpha}}{\tilde{N}_t + \tilde{K}_t} \frac{1}{1 - \alpha} = w_t \frac{1}{1 - \alpha}
\]

(25)

hence, when choosing which reform to implement agents compare,

\[
Y_t(v^*_A) \geq Y_t(v^*_M) \iff w_t(v^*_A) \geq w_t(v^*_M)
\]

(26)

\[
\left[ M_t^{1-\alpha} (1 + v^*_M) K_t + A_t^{1-\alpha} N \right]^\alpha \geq \left[ M_t^{1-\alpha} K_t + A_t^{1-\alpha} (1 + v^*_A) N \right]^\alpha
\]

(27)

equating the RHS and the LHS and developing we obtain (14).

**Proof of Proposition 1**

We now study the conditions under which an individual \( i \) prefers the implementation of a reform in the modern sector vis-a-vis the primary one. Let us consider,

\[
y^*_i(v^*_M) > y^*_i(v^*_A)
\]

(A)

Thus,

\[
(1 - \alpha) \left[ \tilde{K}_t (1 + v^*_M) + \tilde{N}_t \right] \left[ \tilde{K}_t + \tilde{N}_t (1 + v^*_A) \right]
\]

\[
\left\{ \left[ \tilde{K}_t + \tilde{N}_t (1 + v^*_A) \right]^{-\alpha} - \left[ \tilde{K}_t (1 + v^*_M) + \tilde{N}_t \right]^{-\alpha} \right\} +
\]

\[
+ \gamma^*_i \alpha \left\{ \left[ \tilde{K}_t + \tilde{N}_t (1 + v^*_M) \right]^{1-\alpha} \tilde{K}_t (1 + v^*_M) - \left[ \tilde{K}_t (1 + v^*_M) + \tilde{N}_t \right]^{1-\alpha} \tilde{K}_t \right\} >
\]

\[
\eta^*_i \alpha \left\{ \left[ \tilde{K}_t + \tilde{N}_t (1 + v^*_A) \right]^{1-\alpha} \tilde{N}_t (1 + v^*_A) - \left[ \tilde{K}_t + \tilde{N}_t (1 + v^*_A) \right]^{1-\alpha} \tilde{N}_t \right\}
\]

Rearranging and isolating \( \gamma^*_i \) get,

\[
\gamma^*_i > C_t + S_t \eta^*_i
\]
where,

\[
C_t = \frac{(1-\alpha)[\tilde{K}_t(1+v_t^M) + \tilde{N}_t][\tilde{K}_t + \tilde{N}_t(1 + v_t^a)]}{\alpha \left\{ [\tilde{K}_t + \tilde{N}_t(1 + v_t^a)]^{1-\alpha} - \left[ \tilde{K}_t(1+v_t^M) + \tilde{N}_t \right]^{1-\alpha} \right\}}
\] (28)

and

\[
S_t = \frac{[\tilde{K}_t(1+v_t^M) + \tilde{N}_t]^{1-\alpha} \tilde{N}_t(1 + v_t^a)}{[\tilde{K}_t + \tilde{N}_t(1 + v_t^a)]^{1-\alpha} - \left[ \tilde{K}_t(1+v_t^M) + \tilde{N}_t \right]^{1-\alpha} \tilde{K}_t}
\] (29)

The slope is always positive. In fact,

\[
\left[ \tilde{K}_t + \tilde{N}_t(1 + v_t^a) \right]^{1-\alpha} \tilde{K}_t(1 + v_t^M) > \left[ \tilde{K}_t(1+v_t^M) + \tilde{N}_t \right]^{1-\alpha} \tilde{K}_t
\]

Thus

\[
\left[ \tilde{K}_t(1+v_t^M) + \tilde{N}_t \right]^{1-\alpha} > \left[ \tilde{K}_t(1 + v_t^M) + \tilde{N}_t \right]^{1-\alpha} \tilde{K}_t
\]

\[
\Rightarrow \tilde{K}_t \left[ \tilde{K}_t + \tilde{N}_t(1 + v_t^a) \right]^{1-\alpha} \tilde{K}_t(1 + v_t^M) > \left[ \tilde{K}_t(1+v_t^M) + \tilde{N}_t \right]^{1-\alpha} \tilde{K}_t
\]

But

\[
\left[ \tilde{K}_t(1 + v_t^M) + \tilde{N}_t \right]^{1-\alpha} > \left[ \tilde{K}_t(1 + v_t^M) + \tilde{N}_t \right]^{1-\alpha} \tilde{K}_t
\] (30)

\[
\Rightarrow \frac{\tilde{K}_t(1 + v_t^M)}{\tilde{K}_t} > \left( \frac{\tilde{K}_t(1 + v_t^M) + \tilde{N}_t}{\tilde{K}_t + \tilde{N}_t} \right)^{1-\alpha}
\] (31)

\[
\Leftrightarrow \frac{\tilde{K}_t(1 + v_t^M)}{\tilde{K}_t} > \frac{\tilde{K}_t(1 + v_t^M) + \tilde{N}_t}{\tilde{K}_t + \tilde{N}_t}
\] (32)

and since \( \partial \left( \frac{\tilde{K}_t(1 + v_t^M) + \tilde{N}_t}{\tilde{K}_t + \tilde{N}_t} \right) )/\tilde{N}_t < 0 \) then \( \frac{\tilde{K}_t(1 + v_t^M)}{\tilde{K}_t} > \frac{\tilde{K}_t(1 + v_t^M) + \tilde{N}_t}{\tilde{K}_t + \tilde{N}_t} \) and analogously one can show that,

\[
\left[ \tilde{K}_t(1 + v_t^M) + \tilde{N}_t \right]^{1-\alpha} \tilde{N}_t(1 + v_t^a) > \left[ \tilde{K}_t + \tilde{N}_t(1 + v_t^a) \right]^{1-\alpha} \tilde{N}_t
\] (33)

Hence \( \gamma_t^i = C + S\eta_t^i \) with \( S > 0 \). Moreover note that when the extracted shocks are such that \( v_t^a/v_t^M = \mu_t \), condition A becomes,

\[
\gamma_t^i \left[ \tilde{K}_t(1 + v_t^M) - \tilde{K}_t \right] > \eta_t^i \left[ \tilde{N}_t(1 + v_t^a) - \tilde{N}_t \right]
\]

so that if \( \gamma_t^i > \eta_t^i \) then \( v_t^M \) is implemented while if \( \gamma_t^i < \eta_t^i \) then \( v_t^A \) is implemented.
Proof of Remark 2
By definition of $\gamma_i^t$, we have

$$\gamma_i^t = \frac{y_i^t}{y_t} = (1 - \alpha) + \alpha \frac{\gamma_i^t K_t + \eta_i^t \tilde{N}_t}{K_t + \tilde{N}_t}$$

If $K_t$ goes to infinity faster than $\tilde{N}_t$, then in the limit for $t \to \infty$ we have that

$$\gamma_i^\infty = 1 - \alpha + \alpha \gamma_i^t \Rightarrow \lim_{t \to \infty} \gamma_i^t = 1$$

Proof of Lemma 3
Using, $\delta_t \equiv \frac{K_t}{\tilde{N}_t}$, rearrange the expression for the slope as,

$$S = \frac{1}{\delta} \frac{\delta(1 + v^M_t) + 1}{[\delta + (1 + v^A_t)]^{1-\alpha}(1 + v^M_t) - [\delta(1 + v^M_t) + 1]^{1-\alpha}}$$

So

$$\lim_{\delta \to \infty} S \overset{Hopital}{=} \frac{1}{\infty} = 0$$

$$\lim_{\delta \to \infty} S \overset{Hopital}{=} \frac{1}{0} = \infty$$

Let us now consider the intercept,

$$C = \frac{(1-\alpha)[\tilde{K}_t (1+v^A_t)+\tilde{N}_t] [\tilde{K}_t+N_t(1+v^A_t)] [\tilde{K}_t+N_t(1+v^A_t)]^{-\alpha} - [\tilde{K}_t (1+v^M_t)+\tilde{N}_t]^{-\alpha}}{\alpha [\tilde{K}_t+N_t(1+v^A_t)]^{-\alpha} [\tilde{K}_t(1+v^M_t) - [\tilde{K}_t(1+v^M_t)+\tilde{N}_t]^{1-\alpha} \tilde{K}_t]}$$

(34)

We have already shown that

$$\alpha \left\{ [\tilde{K}_t + \tilde{N}_t (1 + v^A_t)]^{1-\alpha} \tilde{K}_t (1 + v^M_t) - [\tilde{K}_t (1 + v^M_t) + \tilde{N}_t]^{1-\alpha} \tilde{K}_t \right\} > 0$$

(35)

Moreover we know also that

$$(1 - \alpha) \left[ \tilde{K}_t (1+v^M_t) + \tilde{N}_t \right] \left[ \tilde{K}_t + \tilde{N}_t (1 + v^A_t) \right] > 0$$

(36)

therefore the sign of $C$ turns out to depend on

$$\left[ \tilde{K}_t + \tilde{N}_t (1 + v^A_t) \right]^{-\alpha} - [\tilde{K}_t (1+v^M_t) + \tilde{N}_t]^{-\alpha}$$
and

\[
\lim_{\delta t \to \infty} \left\{ \frac{1}{[\delta_t + (1 + v_t^A)]^\alpha} - \frac{1}{[\delta_t(1 + v_t^M) + 1]^\alpha} \right\} < 0
\]

\[
\lim_{\delta t \to \infty} \left\{ \frac{1}{[\delta_t + (1 + v_t^A)]^\alpha} - \frac{1}{[\delta_t(1 + v_t^M) + 1]^\alpha} \right\} > 0
\]

Hence,

\[
\lim_{\delta t \to \infty} C > 0 \text{ and } \lim_{\delta t \to 0} C < 0
\]

Also consider,

\[
\frac{\partial y_i}{\partial v_i^M} = \frac{1 - \alpha}{\delta + 1} \left\{ (1 - \alpha) (\delta + 1) + \alpha (\gamma_i^t \delta + \eta_i^t) \right\} + (1 - \alpha + \alpha \gamma_i^t)
\]

\[
= -(1 - \alpha) \left\{ (1 - \alpha) + \alpha \frac{\gamma_i^t \delta + \eta_i^t}{\delta + 1} \right\}
\]

Thus

\[
\frac{\partial y_i}{\partial v_i^M \partial \delta} = \gamma_i^t [\delta + 1] - \gamma_i^t \delta + \eta_i^t = \gamma_i^t - \eta_i^t
\]

So as the effective capital increases in the economy the effect of an M-reform opportunity on the individual income increases if the individual is relatively a capitalist and decreases if it is relatively landlord.

**Market for Land**

Consider the following set up and timing. Any agent receive the bequest of land and money. He can buy land and capital on the market and use them for production and, in the case of land, for bequest (in fact, he can leave money and land and, since there is a one to one relationship between money and capital, he values the overall amount of bequest at their unit of money values). Denote by

\[
\begin{align*}
&n_i^t \quad \text{the inherited land} \\
&n_i^{t+1} \quad \text{the amount land of land left as bequest} \\
&\overline{m}_i^t \quad \text{the land bought on the Land market} \\
&\overline{p}_i^t \quad \text{the amount of inherited land sold on the Land market}
\end{align*}
\]

Therefore, the maximization problem faced by an individual \( i \) of generation \( t \) is the following
\[
\max_{\{b_{i+1}, n_i, \bar{n}_i\}} (c^i_t)^{1-\rho} (b_{i+1}^i + q_t n_{i+1}^i)^{\rho}
\] 
(37)

under the constraints,

\[
c^i_t \leq \bar{\pi}_t^i - b_{i+1}^i
\] 
(38)

\[
n_{i+1}^i \leq n_i^i + \bar{n}_i^i - \bar{\pi}_i^i
\] 
(39)

which will always hold as equality by non satiation and various non negative constraints. Utility is maximized from consumption and the value of bequest passed to the following generation.

Let us now assume that the returns on the land bought in the market are slightly lower than the ones on the inherited land. In particular, we assume the existence of a fix cost \(\varepsilon\) ("learning" cost) that the individuals have to pay for each unit of land bought in the market to enjoy the rents. Total income available for consumption is given by ,

\[
\overline{y}_t^i = \left(n_i^i - \bar{n}_i^i\right) z_t + \overline{\pi}_t^i \left(z_t - \varepsilon\right) + \left[b_{i+1}^i - \left(\overline{\pi}_i^i - \bar{\pi}_i^i\right) q_t\right] R_t + w_t
\] 
(40)

We also denote by \(y^i_t\) the income earned in the absence of any exchange on the factor markets,

\[
y^i_t = n_i^i z_t + b_{i+1}^i R_t + w_t
\]

Note that,

\[
\overline{\pi}_t = \bar{\pi}_t^i = 0 \Rightarrow \overline{y}_t^i = y^i_t
\] 
(41)

The problem (40) is concave so we have the three first order conditions (leave aside the non negativity constraints and restrict to interior optimum and set first order conditions as equality).

\[
b_{i+1}^i : \quad - \frac{1}{\overline{y}_t^i - b_{i+1}^i} + \frac{1}{b_{i+1}^i + q_t \left(n_i^i + \overline{\pi}_i^i - \bar{\pi}_i^i\right)} = 0
\] 
(42)

\[
\pi_t : \quad \frac{1}{\overline{y}_t^i - b_{i+1}^i} \left[(z_t - \varepsilon) - q_t R_t\right] + \frac{1}{b_{i+1}^i + q_t \left(n_i^i + \overline{\pi}_i^i - \bar{\pi}_i^i\right)} q_t = 0
\] 
(43)

\[
\bar{\pi}_{i+1}^i : \quad \frac{1}{\overline{y}_t^i - b_{i+1}^i} \left[q_t R_t - z_t\right] - \frac{1}{b_{i+1}^i + q_t \left(n_i^i + \overline{\pi}_i^i - \bar{\pi}_i^i\right)} q_t = 0
\] 
(44)
Now note that from (42) we have,

\[ \frac{b_{t+1}^i + q_t \left( n_t^i + \bar{m}_t - \bar{n}_t \right)}{y_t - b_{t+1}^i} = 1 \]  
(45)

Therefore from (44) and (45) we get,

\[ q_t^S = \frac{z_t}{R_t - 1} \]  
(46)

I call this value \( q_t^S \) since it can be interpreted as the value of the land (or the reservation price) for the potential seller. That is, no one in the economy is willing to send land for a price lower than \( q_t^S \).

Also, form (43) and (45) we get,

\[ q_t^B = \frac{z_t - \varepsilon}{R_t - 1} \]  
(47)

which can be interpreted as the value of land (or reservation price) for a potential buyer. Namely, no one in the economy is willing to buy land for a price higher than \( q_t^B \).

Therefore if it exists a learning cost \( \varepsilon > 0 \) then \( q_t^S > q_t^B \) and this implies that no land will be exchanged in our economy.

Consider now, in the light of this result, the bequests story. From (45)

\[ b_{t+1}^i = \frac{1}{2} \left( y_t - q_t \left( n_t^i + \bar{m}_t - \bar{n}_t \right) \right) \]  
(48)

and since we already proved that no land is exchanged we get from 48 and 41

\[ b_{t+1}^i = \frac{1}{2} \left( y_t^i - q_t^S n_t^i \right) = \frac{1}{2} \left( y_t^i - \frac{z_t}{R_t - 1} n_t^i \right) \]  
(49)

In fact, the value of the land from the point of view of an individual \( i \) which received \( n_t^i \) as a bequest (and so is a potential seller of this amount) is given by \( q_t^S \).

As a result in equilibrium each dynasty will always leave as bequests the amount of land it inherited (landlords will remain landlords for ever). Moreover, we know that \( z_t \) is monotonically decreasing with time while \( R_t \) is monotonically increasing therefore as time goes by the monetary part of the bequest is monotonically increasing. In the limit:

\[ \lim_{t \to \infty} q_t^S = 0 \Rightarrow \lim_{t \to \infty} b_{t+1}^i = \frac{1}{2} y_t^i \]  
(50)

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References


Hall, R.E., and C.I. Jones (1999), *Why Do some Countries produce so much more Output per Worker than Others?*, Quarterly Journal of Economics, 114(1).


Figure 4