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Politico-economic transition

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Abstract. Political and economic transitions of non-market economies often go hand in hand. We propose an economic theory of this transition process, which highlights how the success of such a transition depends upon the policies chosen in the new democratic environment. In this paper, *economic success* is characterized by the continual adoption of new technology (and economic growth), which requires costly human capital investment. The political choice is whether to allow the adoption of new technology. As a non-market economy begins its transition, agents with human capital specific to a particular technology find it in their interest to vote against continued innovation. As such, the transition to a market economy can be choked off. Our theory has the following features: (i) an economic transition is associated with a substantial drop in output; (ii) it is in the interest of large groups in the population to resist laissez–faire, as factor payments equal marginal products in the post–reform economy; (iii) although the joint move to democracy and a market economy does make people better off, it is insufficient for the transition to be successful, as the number of agents with a vested interest against continued innovation grows; and (iv) a *temporary* restriction on voting rights which ensures a laissez-faire regime is sufficient to produce *long-run* prosperity. This restriction may not be only one capable of overcoming the anti–innovation interests. Other mechanisms such as supermajority rules on policy changes may also guarantee laissez–faire.

1 Introduction

The recent experience of former eastern-block countries, as they move towards free market economies,[1] suggest that political and economic transition of go hand in hand. In light of this, both the economic and political transitions should be analyzed

[1] See for example the nice summary in Wyplosz (2000).

jointly to understand the transition process fully. In this paper, we formalize what we believe are generally important properties of economic and political transition in the context of a simple dynamic model. We then use the model to analyze the impact of allowing democracy in a situation where the economy is in a standstill.

In the context of our abstract model, our main conclusion is that political transition itself– interpreted as a move from dictatorial rule to democracy – may not be sufficient for a successful economic transition. Indeed, it is quite possible that a simple move to democracy will, in addition to creating an initial recession, lead to relatively poor long-run performance due to the dynamics of policy determination. The argument is that vested interests against rapid economic transition will build with economic development, and that these vested interests may persist over time and across generations. Our dynamic model, emphasizes that policy may be changed through time, and as voters cannot commit to how they will vote in the future, desirable outcomes, including a successful transition to a market economy, cannot be guaranteed. The focus of this paper is on the formation and evolution of vested interests against continued economic transition through time, and their impact of the success of this transition.

We also reach some conclusions regarding the welfare consequences of moving to democracy. First, the joint political and economic transition will improve the welfare of all agents, as productive efficiency improves.[2] We also show that, in our model, a temporary restriction on voting rights (or some other mechanism) may actually improve the welfare of all agents. A commitment mechanism introduced at the start of the economic transition could either make it harder for any vested interests that emerge against continued innovation to vote against it, or change their incentives to suspend further innovation at all. As such, the dynamic structure of vested interests in the population changes fundamentally so as to put the economy on a path of continual innovation and the fastest feasible growth. The fact that all agents are made better off is of course special to our particular assumptions, but the overall point is clear: the democratic policy process does not always lead to good outcomes, especially in a dynamic context when agents cannot commit their future votes.

As the focus of our paper is on the transition from a non-market to a market economy it is necessary for us to describe our view of the development process. We consider the adoption of new technology, and the costly investment in human capital that it necessitates, to be the crucial aspect of economic development. It is a natural consequence of this view, then, that a transition from a socialist to a laissez-faire economic regime will be associated with a period over which substantial (unmeasured) learning is taking place. This initial redirection of resources from production in old inefficient plants to learning activities is what allows us to identify a drop in measured output and productivity during transition as well as a decrease in employment.[3] Our assumptions regarding the transition process are clearly simplifying. While we could have formalized the development process

[2] The result that everyone is made better off is not general; it applies only because of the specific demographic assumptions we use in our main example.

[3] As such, it is reminiscent of the abstraction chosen by Atkeson and Kehoe (1992). See also Wyplosz (2000) for a discussion of the main features of the transition process.

in other ways, we have chosen the simple environment to highlight the way the evolution of vested interests impacts on the policy determination process.[4]

We use a simple 3 period lived agents OLG model of technology adoption. Agents choose whether to innovate or not by attaching themselves to different technologies, and choosing whether to support continued innovation or not. We model policy voting as the choice each period of whether to allow further innovation or not via a majority rule system. The model is completely dynamic not only in its economic environment (agents forecast the prices that they will face and choose their actions accordingly), but also in its political environment as agents understand the full effects of their political choices (which include elements of assessing off-equilibrium path prices and political outcomes).

After a sustained period with neither innovation nor democracy (which we call socialism), agents choose to allow innovation when democracy is introduced. This defines the beginning of the (potentially lengthy) transition process. The beginning of the transition goes hand in hand with a measured drop in output as technological developments do not show up in standard measures of output. A feature of the model is that, at the beginning all agents support the legalization of innovation, while the dynamics of skill accumulation are such that some time later a majority of agents support the return to a policy that outlaws further innovation. Further we show how a temporary deviation from majority rule or other commitment mechanism soon after transition starts is capable of placing the economy in a virtuous path of perpetual innovation.

Our approach to understanding some elements of political and economic transition is admittedly highly abstract. This of course precludes us from drawing close parallels with specific transition experiences in Eastern Europe. The recent academic literature on transition includes many empirical as well as theoretical analyses, and most of these seem to be of more immediate relevance for actual transition economies.[5] As for theoretical studies of political-economy aspects of transition, Dewatripont and Roland (1991) consider a private information framework in which it is possible for a government to use various policy instruments to achieve efficient restructuring of an obsolete industry. In their framework, the government's role is that of an agenda-setter, who can propose a "reform"–by changing wage rates and including exit bonuses for any worker who elects to leave the obsolete sector – which is subject to popular vote (the authors label this a "political constraint" on policy). Dewatripont and Roland compare the benefits of the government choosing either "cold-turkey" reform or gradual reform which requires several subsequent votes. Although the framework and issues in our paper are different in many respects, there is a similarity in that Dewatripont and Roland also find that the dynamics of voting, especially given that government (and voters) cannot commit to future

[4] The main elements of development are the assumption that the move to new technology requires technology specific human capital investment, which leads to vested interests against continued innovation which can persist through time.

[5] See, e.g., Murrell (1996) or Fischer et al. (1996) for empirical country comparisons and Blanchard and Kremer (1997) for an alternative theoretical analysis of why output is depressed during transition. Moreover, a number of both empirical and theoretical studies can be found in the Blanchard et al. (1994) volumes.

behavior, can lead to new insights. Their insights, however, are quite different: they find that the possibility of holding several votes can effectively weaken the political constraints on a benevolent government and allow for better outcomes, whereas we find in our positive model that sequential voting without benevolent actors can lead to surprisingly poor outcomes.

The outline of the paper is as follows. We describe the model – the economic environment and the definition of equilibrium – in Sect. 2. We then characterize politico-economic equilibria in Sect. 3. In Sect. 4 the transition experiment is studied, and we draw conclusions in Sect. 5.

2 The model

We begin by describing the economic environment in Sect. 2.1, after which we describe how agents interact in price and policy determination. Although the basics of the model are very simple, the dynamic nature of the policy choice makes it difficult to solve a more general version of the model analytically.[6] For this reason, we will restrict attention to a finite-agent version of the setup. However, we first describe the general setup with a large number of agents, since the notation is simpler in this case. The restriction to a finite number of agents is then adopted in Sect. 3.

2.1 Economic environment

We start by reviewing the demographics, preferences and technologies in Sect. 2.1.1. We then proceed to describe what constitutes a market economy and socialism in our environment in Sect. 2.1.2, and finally we provide some simple examples in Sect. 2.1.3.

2.1.1 Agents and technologies

There are overlapping generations of a large number of 3-period-lived agents. Each agent's utility function is linear in consumption:

$$c_1 + \beta c_2 + \beta^2 c_3,$$

where c_i is the consumption of an agent at age i. Agents, are all born alike, and have one unit of time in each period.

[6] The reason for this is the size of the state space: with a heterogeneous population (in particular, agents differ in age and acquired skills), the aggregate state space is large, and the politico-economic analysis necessarily involves studying the dynamics of the aggregate state. In other words, to support a given policy sequence as a political equilibrium, we always need to track the evolution of the aggregate state vector in response to alternative current policies (so that the voters can compare them at each point in time). For a general discussion of these issues, see Krusell et al. (1997).

The single consumption good each period is produced with a technology of the type

$$f_\kappa(x_s, x_u) = \gamma^\kappa x_s^\alpha x_u^{1-\alpha}, \qquad 0 < \alpha < 1, \gamma > 1,$$

where x_s is the input of skilled and x_u is the input of unskilled labor.[7] The variable κ denotes the vintage of the production technology. The adoption of new technologies and the acquisition of skill are central in this theory. We now turn to describing these in more detail.

A. Technological change. Each new technology improves by a factor γ on the best existing technology. Technologies have to be adopted in order: if in a given period the best technology in use is of type κ, then the next technology adopted is by necessity $\kappa + 1$, irrespective of when type κ was adopted.

B. Skill acquisition. Each period, a given agent can only be active (work) in one technology. If the agent works as (un)skilled, we refer to him as a manager (worker). Any agent may work as an unskilled worker, but skill is a function of experience. In particular, no agent can become skilled until their third period of life. In addition, skill is technology-specific and may only be acquired in one of two ways.

1. An agent can remain active in a given technology for two consecutive periods – this allows the agent to be skilled in that technology in the third period.
2. An agent can "retrain". Retraining is defined as working in some technology as young, then switching to another technology in the next period in which there is currently production. We sometimes refer to it as "watching". After retraining in a given technology, the agent has skill to manage the unskilled workers employed in this technology in the next period.

We refer to those who choose the first way of acquiring skills as "developers" when there are no agents that already have skills in that technology. In this case, there is no output of goods until in the third period in that technology (there is, of course, unmeasured value added in terms of skill accumulation). Acquisition of skill by an unskilled agent is only productive in terms of current output if there is an active manager employed in this technology and the agent who is acquiring the skill is not in the process of retraining. In contrast, a retraining agent has zero marginal productivity in that period, even though there are managers (and workers) currently present in that technology.[8] These assumptions imply that skill accumulation carries a direct cost in terms of lost production opportunities: (i) if the agent is a developer, two periods of productivity are lost, or (ii) if the agent is retraining, one such period is lost. In the latter case, the skill is specific to an older and less productive technology.

To summarize, we can separate the work and the consumption decisions of agents. Linearity of preferences makes the consumption decision irrelevant. With respect to the work decisions, an agent chooses a career path that can be described

[7] The functional forms we have chosen simplify the analysis but are not necessary for the main result. What is important is that there be a sufficient amount of complementarity between the two types of labor.

[8] The retraining option is not necessary for our main results to go through. Its role is to make sure that the technology currently in operation is no worse than the best technologies used previously in production.

as a choice of which technology to work for and in what capacity. The relevant[9] career paths are unskilled-unskilled-unskilled always in the most recent technology in production (if there is innovation in the economy), unskilled-unskilled-skilled (if there is no innovation), developer-developer-skilled (if a developer), or unskilled-retrainee-skilled. If there is more than one choice in equilibrium, it has to be the case that they yield equal utility because all agents are born alike and they are free to choose what to do.

C. Adding up. The economy's current and future production possibilities at the beginning of any period can be completely described by a listing of the skill characteristics of the middle-aged and old agents. We refer to the *distribution of skills* as the economy's state variable, and for future reference we refer to this distribution with the vector μ listing each agent's skill. A middle-aged agent's skill can thus be summarized by the technology where he was active the previous period, and the old agent's skill typically requires knowledge of what this agent did in both of his first two periods of life.

The feasibility constraints involve accounting for the agents' actions. This just means a specification of which technology each existing type of agent chooses to be active in subject to the restrictions discussed above on skill choice.

Once agents' current actions are specified, a given current skill distribution can be mapped into a skill distribution for the next period, which then fully describes future production possibilities, and so on.

D. Policy. There is one form of collective action in our economy: that there is a possibility, at each point in time, of prohibiting investment in new technologies.[10] For simplicity, we do not consider the possibility of taxing innovators once they were allowed to start developing a new technology. We denote the policy by π; if $\pi = 0$, innovation is allowed, and if $\pi = 1$, it is not allowed.

2.1.2 Economic allocation mechanisms

We will consider two mechanisms, both of which are decentralized in the sense that agents choose their career paths themselves: a market-economy, competitive-equilibrium mechanism, and a "socialist" mechanism.

I. The market economy. The relevant prices in our simple economy are the spot wages for the skilled and unskilled inputs (in terms of the numéraire consumption good in that period), w_s and w_u, respectively.[11] Moreover, we assume that firms profit maximize and are free to enter the market. This implies that spot wages must be given by the marginal product of each type of worker.

[9] At this point we are making a guess that there is only one technology in place in each period. Later we verify this guess.

[10] Alternatively, this policy can be stated as the decision whether to tax skilled agents' income two periods hence.

[11] Wages should also be indexed by type of technology. In the equilibria below, however, there is only one technology in operation at each point in time, which is why we saved on notation. Furthermore, because of the linearity of preferences, gross interest rates trivially must equal $1/\beta$.

The economic choices of consumers can be summarized by stating that they choose career paths optimally. This just means that agents maximize the present value of wage incomes subject to the restrictions on skill accumulation. Therefore, if we observe young agents making different choices in any period, it must be that these different career paths generate the same payoff, in *equilibrium*. For example, if at some period some agents develop new technologies and some choose to be workers throughout their careers, it has to be true that

$$\beta^2 w_s'' = w_u + \beta w_u' + \beta^2 w_u'',$$

where primes are used for future values. We will restrict attention to equilibria which are first-order Markov, so that we can summarize the description of an equilibrium by a time-invariant law of motion for the distribution of skills,

$$\mu' = H(\mu),$$

and a specification of the within period individual occupational and voting choices as a function of μ. We refer to the latter function as the aggregate activity function. Also, we will assume that the collective policy choice π, may be written as a function Ψ of the current state μ. Later we will justify this assumption by deriving it as an outcome of explicit voting over π in each period.

Formally, a *recursive competitive equilibrium* consists of a law of motion for the skill distribution[12], a list of choices made by each agent for each current skill distribution, and wages for every current skill distribution, satisfying the following conditions:

1. Wages equal marginal products given the allocation of labor inputs implied by the actions taken at each skill distribution.
2. Activities are consistent with individual agents maximizing their utility subject to (i) the technology for skill accumulation; (ii) the law of motion for the skill distribution; (iii) the dependence of wages on the current skill distribution; and (iv) the policy outcome function.
3. Activities and the law of motion for the skill distribution are consistent, i.e., they satisfy the adding-up constraints.

The equilibrium definition only applies to the set of equilibria which we will study below. In particular, it relies on there being only one technology producing output at each point in time.[13]

II. Socialism. For the purpose of studying transition from socialism to a market economy it is necessary to say something about what socialism means in the context of our model. Many assumptions could be adopted at this point. We chose the simplest one that captures a lack of a sufficient incentive structure to generate "good" outcomes. We assume that all agents who work in a technology with positive output are paid the same wage, independent of their skill type and production technology, and that any agent who does not currently produce output receives a

[12] Mapping a current distribution into a distribution for the following period.

[13] This model setup can give rise to more complicated equilibrium behavior for some parameter values, and such equilibria would require more detailed notation.

zero wage. This can be interpreted either as conforming with the old socialist motto of giving according to ability and receiving according to need, or simply as a way of representing the fact that rewards are made on grounds other than productivity in socialist economies.

With initial skill of only one type, and with unregulated career choices, these assumptions trivially imply that the socialist economy will remain at a standstill never experiencing technological change. This characterization of the initial state of an economy which has been subject to socialism is all that we will use in the analysis below.

2.1.3 An illustration

We now illustrate our model assumptions by imposing career behavior and working out the implied stationary distribution of skills. There are two kinds of distributions which are easy to look at: one with and one without continual innovation.

Fast growth. Suppose that every period a fraction x of the young agents choose developer-developer-skilled while the rest choose unskilled-unskilled-unskilled. The unskilled workers, switch technologies every period, and in their third period of life they do not qualify as skilled for any technology. Assuming that all skilled agents are employed as skilled, the corresponding stationary distribution is one where the number of unskilled workers is $3(1-x)$ in every period. Output grows at a constant rate, γ, in every period.

Can this allocation be supported as a decentralized equilibrium if innovation is always allowed? Well, this depends on the value of the parameters of the economy – the fraction x will be determined as a function of the parameters, and it has to be verified that it does not pay to operate more than one technology at a time. Indeed the set of parameter values for which this occurs is nonempty.

No growth. Suppose that no agent ever develops a new technology, and that there is only one technology in operation. Suppose furthermore that agents when they become old always work as skilled. In terms of career choices, this means that all the population chooses unskilled-unskilled-skilled, and it leaves, at any given date, a third of the population working as skilled and another two thirds working as unskilled.

Is it ever possible for this type of allocation to appear as a market-economy outcome? We will argue that this is precisely the stationary distribution that would result with competitive wage setting if the economic policy does not allow innovation.[14]

2.2 Political environment

We now turn to the discussion of how the policy π is chosen. First, we adopt the assumption that only market economies feature voting, with the policy outlined

[14] This is true as long as $\alpha \geq 1/3$; for $\alpha < 1/3$ not all agents of a given age become managers.

above being set by decree in the socialist economy.[15] The key components of this discussion are how agents' political preferences are formed and how the agents' preferences are aggregated into a chosen policy. The second part is straightforward: we assume that each agent gets one vote, and votes in favor of and against innovation are simply counted up with the policy with the largest number of votes being the winner.

Before discussing our equilibrium concept, let us make a preliminary remarks to clarify why disagreements over policy choices arise, and why the political choice facing many agents is non-trivial.

2.2.1 Tensions in the population

The simplest way to describe the political disagreements in this model is to study the effects of the economic policy on the labor market.[16] Managers and workers are complements in production. *Ceteris paribus*, then, managers are happy to have many workers present, and workers are happy to have many managers around, and in addition, both workers and managers of course like to be active in high-tech production. All of these phenomena are reflected in the wages of managers and workers. At the same time, a given worker would like to minimize the number of other workers, since workers are substitutes for each other: an increase in the number of workers will affect the unskilled wage negatively.

What are the effects of having innovation in a given period? Having innovation raises the unskilled wage and lowers the skilled wage for this period and the next, since it implies withdrawing potential workers from the workforce. For this reason, currently old managers will be against innovation. Similarly, old workers will favor innovation.

Middle-aged agents who are and will remain workers are in favor of the *ceteris paribus* experiment of allowing innovation, since they will enjoy two periods of higher wages because of it. Of course, the *ceteris paribus* concept is a fiction, and a full analysis requires working out the effects of current innovation on next generation's career choices, which in part requires working out whether allowing innovation today may tilt the political majority next period against innovation. We will see in the end that indeed middle-aged agents on a working career will favor innovation.

The situation for middle-aged developers is simpler; they simply wish to maximize the number of workers available tomorrow. Disallowing innovation today raises the number of middle-aged workers tomorrow. Whether or not it will affect the number of young workers tomorrow again is a more complicated matter: it requires thinking about the future effects of current innovation. The situation for middle-aged agents who are currently working but who are on a managerial career path is a bit more complicated. For them, innovation raises their current wage, but

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[15] As such, there would never be any innovation in the socialist economy, even if agents could vote.

[16] In Krusell and Ríos-Rull (1996), we use an alternative description based on the price effects in the markets for goods at different points in time.

it lowers their wage as managers next period (*ceteris paribus*). As we will see, all agents on a managerial career path will prefer not to see current innovation.

Finally, young agents of course have even more outcomes to predict. However, since the vote is taken before the young commit to a career choice, young agents will prefer innovation – innovation effectively increases their choice set, allowing more efficient production of goods to take place.

2.2.2 Policy preference formation

As indicated in the above discussion, when an agent forms preferences over policies, he thinks about what each policy would imply for equilibrium prices today and in the future. This thought experiment is nontrivial: he needs to figure out not only what happens to all the agents' behavior today for each policy, but also how the state variable evolves in response to the two policies. The latter has important implications for how future policies will change in response to policy changes today; the agent finds out what agents choose in response to a policy change, then uses the resulting state variable in the following periods together with the policy outcome function Ψ to predict what will happen to the future policies. The policy which results in the highest utility for the agent is the (induced) policy preference of the agent.

Before we go into some more detail about how policy preferences are formed, let us summarize the "big picture": a politico-economic equilibrium is a policy outcome function Ψ, with its associated economic equilibrium behavior, such that for each state μ the winning vote is $\Psi(\mu)$.

Turning back to the derivation of policy preferences, in order for the agent to evaluate his utility given by $\pi = 0$ and $\pi = 1$, respectively, two values are needed. First, the agent needs the utility under the policy which will result as an outcome at the current skill distribution μ: $\pi = \Psi(\mu)$. This value corresponds to the utility attained in the competitive equilibrium for the the policy function Ψ.

Before we can calculate' Ψ it is necessary to specify how the skill distribution, prices (wages) and policy would evolve under each policy alternative. We therefore define $\tilde{H}(\mu, \pi)$: this function gives us next period's skill distribution μ' if the current distribution is μ and the policy today is π, given that the evolution of the skill distribution and political choices are given by H and Ψ. In other words, $\tilde{H}$ describes the outcome of a "one-period deviation" where policies today are given by an arbitrary π, and policies in the future by the function Ψ. That is, when the voter thinks about what will happen in response to a current change in policy away from $\Psi(\mu)$, he uses Ψ as the reaction function of future majorities to changes in the skill distribution in response to the policy change. The Markovian equilibrium concept we use here is discussed in detail in Krusell et al. (1997), where it is shown that it corresponds to imposing what is equivalent in a politico-economic context to a time-consistency requirement.

3 Politico-economic equilibrium in a simple example economy

After describing the framework in general terms, we now restrict attention to an economy with a finite number of agents. More precisely, to simplify our analysis, we restrict the population size to be the smallest so that we obtain non-trivial outcomes. This means a population with three agents in each generation.[17]

In the following we will first characterize equilibria for our politico-economic market-economy model. We will then turn to the issue of politico-economic transition. We do this by first identifying the initial value of μ consistent with a socialist economy. We then use our equilibrium characterization to analyze what would occur if democratic rule and a market economy were adopted. In particular, we study what would happen over time to the policy π which regulates adoption of new technologies, and to economic growth.

3.1 Characterization of politico-economic equilibria

Our focus will be on finding equilibria in which (i) there is only one technology used in production at any point in time, and (ii) the number of realized skill distributions is not too large. Fortunately, it is possible to specify values of the primitives of the model – the parameters α, β, and γ – to obtain these equilibrium characteristics. Although we will present results only for one specific parameters vector – we will use $(\alpha, \beta, \gamma) = (0.8, 1.2, 2.2)$, the obtained equilibrium remains an equilibrium for a large range of parameter values around the given ones.[18]

Our analysis of equilibria follows a guess-and-verify procedure. It consists of the following steps:

1. Specify an ergodic set of skill distributions, i.e., a set such that once in this set, the equilibrium skill distribution never leaves this set.
2. Specify the feasible activities given these skill distributions and make a guess regarding the behavior of agents in a competitive equilibrium. In particular, we guess the choices of career paths for different agents for each skill distribution in the ergodic set.
3. Fill in the mechanics of how the skill distribution evolves given the career choices and each possible value for the policy and verify that the implied set of skill distributions coincides with the ergodic set.
4. Guess on the voting behavior for each group and each skill distribution.
5. Verify that the career choices are utility-maximizing and that the voting behavior is maximizing.

We now proceed by following these steps.

[17] The equilibrium definitions above need to be adjusted appropriately to take the implied discreteness into account. In particular, we regard the decision of the young as a joint utility-maximizing decision implemented with lotteries. Since this part is straightforward and adds no new insight, we omit it here.

[18] This is because no equilibrium decisions are interior solutions due to the discreteness of the economy which means that small changes of the parameters yield decisions that also satisfy all the equilibrium conditions.

Equilibrium skill distributions			
		Skill distribution	
		Number of agents with	
State	Age	high-skill training	low-skill/no training
		(relative age of technology)	
D	m-a	$2^{(0)}$	$1^{(2)}$
(Dynamic)	old	$2^{(1)}$	$1^{(-)}$
B	m-a	$3^{(0)}$	0
(Backward)	old	$3^{(0)}$	0
A	m-a	$2^{(0)}$	$1^{(1)}$
(Awakening)	old	$3^{(1)}$	0
C	m-a	0	$3^{(1)}$
(Choking)	old	$2^{(0)}$	$1^{(-)}$

Fig. 1. The ergodic set of skill distributions

3.1.1. The set of skill distributions

Given our specific assumptions, the state space can be greatly simplifies. There is an ergodic set of four possible states/skill distributions, which we label A, B, C, and D. These four states are described in Fig. 1.

In each of these states, there are either 2 middle-aged agents who innovated in the previous period or none (i.e., either 1 or 3 agents worked as low-skill when young). The number of old agents able to manage the more productive technology is either 2 or 3. The technology-specific skills of the agents are indicated in the figure as superindices. The number within parenthesis equals the relative age of the technology where the skill was accumulated: a $^{(0)}$ indicates training in the most recent technology, $^{(1)}$ in the next most recent technology, and so on, and $^{(-)}$ indicates a lack of relevant skill.[19]

To understand our choice of labels for these states consider the following. In state D, the last two periods had innovation, and therefore new technologies will appear in the current and in next periods. Therefore, Dynamic seems an appropriate label. In contrast, state B is Backward: there, no innovation has occurred in the previous two periods (in particular, the middle-aged agents have skills in the same technology as the old agents). State A, for Awakening, appears after a history of first no innovation, but most recently one period of innovation. Finally, state C represents a negative trend where technological change is being Choked: it comes

[19] In fact, this categorization into four states is not quite correct; there are really six states. In particular, states C and D each occur in two slightly different forms, say, C1 and C2 and D1 and D2, respectively. The difference between C1 and C2 (and, similarly, between D1 and D2) is that in C1 the old agents have no ability at all to manage, whereas in C2 they have the ability to manage an old ($^{(2)}$) technology. We collapse each of these pairs of states into one for expositional simplicity, since it turns out that they give rise to the same equilibrium activities (in particular, the old agents with ability to manage the old technology do not exercise this possibility). See Krusell and Ríos-Rull (1996) for details.

after a history where two periods ago there was innovation, but where most recently no innovation occurred.

3.1.2. Competitive equilibrium behavior

It turns out in our equilibrium that the behavior of agents, i.e., their career choice, is the same for all four values of the aggregate state. This result depends on the specific parameter values, but it holds for a while range of those values. The reason is that alternative configurations of young agents' choices have a larger quantitative impact in the income associated to those choices than the configurations of the skills of old agents. This happens because the income of the young when skilled does not depend on the current old but on the actions of agents of future generations. In particular the properties of this career choice are that

1. The young generation always has 2 agents developing and 1 agent working if innovation is allowed. If innovation is not allowed, all these agents work in the available production technology.
2. Those old agents with the most high-tech skill all become managers; the remaining old agents work as unskilled.
3. Middle-aged developers continue developing. Middle-aged non-developers work in case there are developers present (states D and A). If there are no developers present, the middle-aged agents work (state B) if that allows them to become managers next period (that is, if they worked in the same technology as young), and they retrain (state C) if this is the only way of becoming managers next period (that is, if they worked in a different technology as young). In other words, middle-aged agents who can become the most high-tech skilled agents next period make sure they do, since then they will become managers.

None of these choices are surprising, and they are straightforward to verify once the law of motion of μ is laid out.

3.1.3. The mechanics of the evolution of skills

Given our characterization of equilibrium behavior, it is straightforward to figure out the possible laws of motion for the skill distribution. There are two possibilities in each case: either innovation is allowed, or it is not, and these cases obviously imply different future skill distributions. The next figure, Fig. 2, lists the possibilities.

This demonstrates, among other things, how the two steady states discussed above can potentially be achieved. First, a no-growth steady state can occur as B followed by B. Note, however, that this requires a no-vote to innovation in state B. Second, the fast-growth steady state results if in state D innovation is allowed; then people's career choices lead the economy to D again.

3.1.4. The voting behavior

To implement our definition of politico-economic equilibrium consider the following experiment. Suppose, for example, that we are in state D. Then we know the

μ	μ' if $\pi = 0$	μ' if $\pi = 1$
A	D	C
B	A	B
C	A	B
D	D	C

Fig. 2. Possible laws of motion for the skill distribution μ

Equilibrium voting patterns					
State	Individual votes			Totals	
	age	developers or managers	retrainees or workers	yes	no
	young	3 yes			
D (Dynamic)	m-a	$2^{(0)}$ no	$1^{(2)}$ yes	5	4
	old	$2^{(1)}$ no	1 yes		
	young	3 yes			
B (Backward)	m-a	$3^{(0)}$ yes		6	3
	old	$3^{(0)}$ no			
	young	3 yes			
A (Awakening)	m-a	$2^{(0)}$ no	$1^{(1)}$ yes	4	5
	old	$3^{(1)}$ no			
	young	3 yes			
C (Choking)	m-a		$3^{(1)}$ no	4	5
	old	$2^{(0)}$ no	1 yes		

Fig. 3. Equilibrium voting patterns

two possible states tomorrow, and the policy decision will imply which of these two states the economy will reach tomorrow. However, this is not enough information for deciding which current policy is preferred, at least not for the middle-aged agents; for their preferred policy choice will also depend on whether innovation will be allowed in the next period or not. The equilibrium concept dictates that the voting agent then takes the policy outcome function Ψ as determining next period's vote. In this particular case, the question is what $\Psi(\mathrm{D})$ is and what $\Psi(\mathrm{C})$ is.

Given this, we now guess how different agent will vote; this guess implies Ψ. Our guess is (1) young agents vote yes to innovation; (2) middle-aged agents who will become managers next period vote so as to ensure that there will be a no when they are managers; (3) middle-aged agents who will not become managers tomorrow vote yes; (4) old managers vote no; and (5) old workers vote yes. Under this conjecture, the following voting patterns emerge:

The table implies that $\Psi(\mathrm{D}) = \Psi(\mathrm{B}) = 0$, and $\Psi(\mathrm{A}) = \Psi(\mathrm{C}) = 1$, i.e., innovation is allowed in the dynamic and the backward states D and B, and not in the awakening or choking states A and C.

In terms of our formal notation, the economic and political behavior imply that

$$\tilde{H}(\mathrm{A}, 1) = H(\mathrm{A}) = \mathrm{C} \text{ and } \tilde{H}(\mathrm{A}, 0) = \mathrm{D}$$

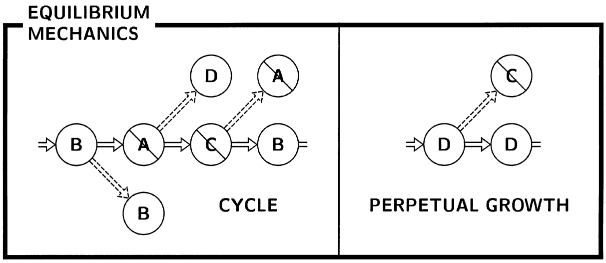

Fig. 4. Equilibrium mechanics

$$\tilde{H}(\mathrm{B},0) = H(\mathrm{B}) = \mathrm{A} \text{ and } \tilde{H}(\mathrm{B},1) = \mathrm{B}$$
$$\tilde{H}(\mathrm{C},1) = H(\mathrm{C}) = \mathrm{B} \text{ and } \tilde{H}(\mathrm{C},0) = \mathrm{A}$$
$$\tilde{H}(\mathrm{D},0) = H(\mathrm{D}) = \mathrm{D} \text{ and } \tilde{H}(\mathrm{D},1) = \mathrm{C}.$$

Taken together, these patterns imply the politico-economic equilibrium mechanics depicted in Fig. 4. States that are "not allowed" signs if innovation is prohibited. Solid arrows indicate the equilibrium path, and dotted arrows indicate where the economy would go given a deviation from the current equilibrium policy outcome (i.e., they indicate behavior "off the equilibrium path").

The figure shows that there are two possible outcomes: either there is fast growth, or there is a cycle. Over the cycle, there is only innovation in one out of three periods. The economy will end up in one of the two very different long-run outcomes depending on the initial skill distribution. We will come back to this important point later when we discuss politico-economic transition.

The fast-growth outcome is straightforward to understand. In it, there are always 3 young agents and two workers (one middle-aged and one old) who favor innovation, and this is enough for a majority. None of these groups face any nontrivial tradeoffs in voting.

The cycle is less obvious. In the backward state B, the economy innovates, since the middle-aged agents prefer this over the alternative. The reason is not that they like growth *per se*, but that this gives them less competition in the current labor market. For the next two periods, the innovators make up a 5-4 majority against further innovation, first with the aid of the old managers, and then with the aid of the three middle-aged agents on a managerial, but non-innovating career path (the latter take advantage of the lack of innovation, retrain and become managers in the backward state). Since two periods of no innovation are sufficient for a return to the backward state, the cycle is completed.

Note that there is no outcome in which innovation never occurs: this is because in the most backward state, innovation is allowed. There, the middle-aged agents do prefer innovation, although there are two opposing effects of the *ceteris paribus* experiment of letting there be innovation (higher wage today due to a smaller number of other current workers; lower wage next period due to a smaller number of workers then). However, the difference between the equilibrium and the *ceteris paribus* experiments is important here. This is because, at all points in the state space, a policy change today actually forces a policy change tomorrow. Hence, only the age composition of the workers tomorrow will depend on the current vote, but not the number of workers (there will be 1 young and 3 middle-aged workers if there is innovation today and 3 young and 1 middle-aged workers if there is no innovation today).[20]

3.1.5. Verification that behavior is optimal

We omit this verification here for brevity; it is straightforward but tedious to verify that agents maximize their discounted lifetime income by making the joint career and voting decision indicated above. As discussed above, non-trivial decisions only occur for some middle-aged agents.

4 Politico-economic transition

We now discuss the implications of our model for the politico-economic transition from a socialist to a market economy. Since the Socialist economy corresponds to a stagnant economy without recent innovation, the backward state (state B) would seem the most appropriate initial state before democracy is introduced. The political transition corresponds to the introduction of democracy, or allowing agents to vote over whether future innovation will be allowed. Therefore, to analyze the politico-economic transition, we need only study the politico-economic equilibrium of an economy starting in state B, the backward state.

We now analyze the political and economic outcomes along the transition path (i.e., the collective political choices regarding regulatory policy, and the pace of technological adoption). Our discussion can be brief as we will only focus on some aspects of the transition.

4.1 Properties of transition

As can be seen from the "equilibrium mechanics" discussed in the previous section (see Fig. 4), the initial condition on the skill distribution is both good and bad news for future technology adoption and economic growth. There will be an initial period of economic development. development. However, technological innovation, and therefore economic growth, will only take place in every third period, meaning that the long-run growth rate will only be one third of its potential. In particular, the economy will *never* reach the equilibrium path where new technology is adopted in

[20] It is straightforward to check that there is a steady-state equilibrium with no growth if the value of the discount factor is sufficiently low (a lot lower than in our example). It is characterized by $\Psi(\mathrm{B}) = 1$ since all other aspects of the equilibrium are the same as above. In this steady state, a change in policy in state B does not tilt the vote the period after, and there is a trade-off between high wages today and low tomorrow (if innovation is allowed) and low wages today and high tomorrow (if innovation is not allowed). Innovation is the winning policy if the discount factor is low enough. This steady state does not preclude the cycle from being an equilibrium, i.e., there is multiplicity of equilibria in this part of the parameter space.

every period. In other words, the transition to a high growth economy will never be complete, because in this economic environment there is a fundamental dependence of the equilibrium path on the initial conditions.

Now let us consider the political and economic outcomes along the transition path. Once democracy is introduced, there is majority support for innovation, as we start in state B. This leads to an initial drop in *measured* output because a subset of young agents start developing new technology, removing themselves from the productive labor force. This explanation for the initial drop in output is similar to the explanation proposed by Atkeson and Kehoe (1992), where the reshuffling of workers between jobs causes the initial fall in output. Notice that in both of these cases the cause of initial fall in output – innovation in our case and worker reallocation in theirs – is ultimately productive."

This initial fall in output is accompanied by the fall in the wages of the currently old managers, and a rise in the wages of the young and middle-aged workers. In the second period of transition, total output remains at the same level as last period, and wages do not change. It is only in the third period that output and wages actually rise. The innovation occurs again, so there is a simultaneous rise of output and innovation along the cycle, but only because innovation gives a boost to output with a two-period lag.

After this initial burst of innovation, however, sufficient vested interests have built up against further innovation, which means that innovation will be choked off in the next period (i.e., state C). Significant interests against continued innovation also build along the continual growth (innovation) politico-economic equilibrium path (where the economy is always in state D), except that in that case, the interest group is never a majority. It is the existence of a large group of managers with old skills (and the dynamics implied by their choice) which leads to the building up of new vested interests that prevents the economy from eventually reaching state D. Note that these findings do not exactly say that people are against change in the sense that they would prefer to go back to socialism.[21] The regulation option is a milder policy instrument which produces a similar outcome as the type of Socialism we have assumed in this paper.

The success of the agents with vested interests against the adoption of new technology – typically old managers and agents with skills specific to old technologies – critically depends on the size of this group.[22] In a dynamic economy, where technology adoption occurs every period (state D in the model), the group of managers/innovators is not large enough to make up a majority (2 middle-aged and 2 old agents out of a population of 9 agents in our model). In contrast, when the economy has been in a standstill, or, in a less extreme case, when the economy has recently lacked innovation, the groups with a vested interest in the old technologies are relatively large. In our model, they consist of a whole generation typically.

[21] Since we do not allow a complete return to socialism, this stops us from making a prediction about what people would actually do if given such an option.

[22] This is because we have assumed that democracy takes the form of costless voting with simple majority rule, and where each agent has one vote. Given the simple policy space, there is no role for strategic considerations, such as lobbying.

More generally, our model predicts that skilled workers (or managers) make up a smaller share of the population in a dynamic economy, than in economies that have not recently experienced innovation. Moreover, these properties of the distribution are quite persistent: since lack of innovation tilts the distribution of skills to generate large groups against new innovation, the economy can get stuck with a growth rate below its potential, depending upon its initial conditions.

4.2 Who gains from democracy?

In terms of economic welfare, who gains and who loses from opening to democracy and competition? Certainly, the free-market system implies substantially greater dispersion in incomes than does a socialist economy, however this dispersion is measured in a cross-section or for the time-series, since agents are now paid according to their level of skill, and (ex post) skills are different in this economy.[23]

In this overlapping-generations economy, we distinguish the current old, the current middle-aged, the current young, and the future (yet unborn) generations, and at any moment in time there is typically also skill heterogeneity within generations. In general, there may be both winners and losers among these groups, and the equilibrium we discuss above has sharp implications in this regard.

First, the currently old agents (who all have skills to manage in the initial, B, state) face pros and cons with opening up. With free markets, they get to collect their full marginal product as managers. However, they will also have a smaller labor force to work with, since the opening up implies that some young agents invest in new technologies rather than work for a current wage. On net, the old agents gain from opening up in our economy. We report the utility numbers for these and other agents with and without democracy in the Appendix.

Second, middle-aged agents may in general also be winners or losers; they will receive substantially lower wages as workers, both because total product goes down at the beginning and because they are now paid their marginal product – before they also received some of the marginal product of the managers. Next period, however, they do receive higher pay as managers, since although the work force is smaller, they are now collecting their full marginal product. In the economy we study, the net effect is that the middle-aged agents are also better off with democracy.

Third, young agents are winners, since they will get to benefit from technological change, which indeed occurs when agents are free to vote.

Finally, future generations are clear winners just like the current young, since they also get to benefit from new technologies; after all, there will be recurrent growth in this economy.

Thus we find that for reasonable parameter values all agents do benefit from the introduction of democracy and the de–regulation of markets, even though these free markets may suffer from a suboptimal pattern of technology adoption, depending upon the initial state of the economy.

[23] Note, however, that there cannot be any dispersion in discounted lifetime consumption within a generation.

4.3 Temporarily restricted voting rights

Given the inherent problems we find transition leads to, is there any policy advice which could help the economy find its way onto a good track with uninterrupted growth? In terms of the model, policy is not chosen by economists, but by a political majority, and it would be against the spirit of our theorizing to suddenly intervene in the policy making process. Any normative issues in political-economy contexts have to be raised explicitly in terms of constitutional change or other discussions of the rules of the game. Let us therefore only point at the following. In this economy one is, as a modeler, free to challenge the democracy aspects of the constitution. We wish to end with a few brief comments along such lines.

First, letting only young people vote would take care of all the problems of vested interests. We know they all prefer innovation in our model, and independently of the initial skill distribution, the economy will transit to state D within a finite number of periods. In fact, it would only be necessary to temporarily restrict voting rights, since the model predicts that once in state D, it will remain there even under universal franchise.

Second, and more pointedly, let us pursue the idea of restricting voting rights further by exploiting the politico-economic equilibrium mechanics a bit more. Again referring to Fig. 4, note that the period after transition, i.e., in state A, there is a no-vote to technology adoption, which causes a further no-vote in the next period (state C). Suppose now that in state A innovation were imposed exogenously and *for only one period*. This political outcome can be interpreted as a result of various forms of restrictions on democracy; for example, it could be arrived at with an electorate which temporarily only consists of young voters, or by a reform-oriented ruler with temporarily far reaching powers, or even as the outcome of the requirement of a supermajority for switching policies. Then, as described in the “mechanics” diagram, we see that the economy would go to state D immediately, and thereafter stay there under democratic vote. In other words, a brief dictatorial period characterized by an imposition of laissez-faire will in fact be a recipe for future economic success.

5 Conclusions

Let us sum up. We have described a formal framework which allows us to study a simultaneous change from an absence of democracy and an absence of free markets to a situation with democracy and free markets. The model allows us to analyze whether the transition will be successful or not, and has also yielded some predictions regarding the transitional movement of output and welfare of different groups. It finally allowed us to speculate about how temporary restrictions on voting rights and other commitment mechanisms would in fact allow the economy to enter a more prosperous track. Our main conclusions are:

- The transition will be successful in that it gives an overall better outcome than what was achieved with the old system. Although it was not an obvious outcome, it is true in our economy that all agents will be left better off with the changes than without them.

- The transition will not be successful in the sense that it will lead to a permanently lower growth rate than what is feasible.
- The transition has some features which remind of real-world experiences: there will be an initial recession, and there will be significant resistance against the laissez-faire policy.
- Finally, the model shows (i) that opening up to markets under democratic policy determination can make everybody better off; but (ii) that a short period of voting restrictions in order to impose laissez faire could make the population even better off by altering the skill distribution so that the power of vested interests is never strong enough to prevent technology adoption and economic growth.

Appendix

Here we report the utility levels of the agents, measured in current consumption units.

1. In state B, there are 3 managers and 4 workers. The old agents achieve utility 0.8474 (which equals the managerial wage). The middle-aged agents achieve a present value of 1.1757 (from a current worker's wage and a managerial salary next period). The young agents achieve an expected present value of 2.1788 (they become developers with probability 2/3 and workers with probability 1/3).
2. In state A, there are 3 managers and 4 workers as well. The old agents obtain 0.8474, the middle-aged developers 2.4262, the middle-aged workers 0.4622, and the young agents 2.8435.
3. In state C, there are 2 managers and 4 workers. The old managers obtain 0.9190, the old workers 0.1149, the middle-aged agents all 1.0169, and the young agents 1.5257.
4. In state D, there are 2 managers and 3 workers. The old managers obtain 0.8676, the old workers 0.1446, the middle-aged developers 2.2905, the middle-aged workers 0.5263, and the young agents 4.2067.
5. In the socialist economy, there are 3 managers and 6 workers, and total product is shared equally. This means that the old agents receive 0.3829, the middle-aged agents 0.8424, and the young agents 1.3938 in total utility.

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