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Economic Transition and the Distributions of Income and Wealth

Francisco H. G. Ferreira

Model results suggest the importance, in the transition from central planning to a market system, of the government's continuing to provide basic public goods and services, removing barriers that prevent the participation of the poor in the new private sector, and ensuring that suitable safety nets are in place.

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Summary findings

Using a model of wealth distribution dynamics and occupational choice, Ferreira investigates the distributional consequences of policies and developments associated with the transition from central planning to a market system.

The model suggests that even an efficient privatization designed to be egalitarian may lead to increases in inequality (and possibly poverty), both during the transition and in the new steady state.

Creating new markets in services that are also supplied by the public sector may also contribute to an increase in inequality. So can labor market reforms that lead to a decompression of the earnings structure and to greater flexibility in employment.

The results underline the importance of retaining government provision of basic public goods and services, removing barriers that prevent the participation of the poor in the new private sector, and ensuring that suitable safety nets are in place.

ECONOMIC TRANSITION AND THE DISTRIBUTIONS OF INCOME AND WEALTH

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1.   *Introduction.*

In 1987, two years before the fall of the Berlin Wall, some 2.2 million people lived on less than U$1-a-day (in 1985 prices, using PPP exchange rates for each country) in Eastern Europe and the former Soviet Union. In 1993 - a mere six years later - with economic reform in full swing throughout the region, that number had risen almost sevenfold to 14.5 million.[2] Over this period, and with respect to that poverty line, the region had recorded by far the largest increase in poverty (as measured by the headcount) of any region of the world, even if it still had the lowest average headcount in the developing world.

This unprecedented increase in serious poverty, in a region where it had been almost eradicated, was due fundamentally to two effects of economic transition on its income distributions: a fall in average household incomes, sustained during the period of output collapse; and an increase in income and expenditure inequality, which is almost as pervasive a feature of the transition process as the first. But even if the declines in output - which took place in every country in the region, albeit to different extents (see EBRD, 1995) - may have been the main culprits for the increases in poverty, they may prove less persistent. The output declines have now been completely or partially reversed in a number of transition economies, and the others look set to follow suit. Though they were severe and their impact on living standards was dramatic, they were essentially transitory phenomena; part of the transitional dynamics in moving from one steady-state to another, rather than characteristics of the new steady-state.

The same can not so confidently be said of the substantial increases in inequality. Transition economies, whether in Eastern Europe and the FSU or elsewhere, consistently reported some of the largest increases in Gini coefficients between the early 1980s and the early 1990s among the countries in the Deininger and Squire international inequality

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[2] According to the World Bank (1996).

data-set. Poland's Gini rose by 7.3 percentage points (pp) between 1982 and 1993; Hungary's was up by 6.9pp over the same period; Russia's rose by 5.9pp in 1980-1993. The Chinese Gini rose by 7.3pp between 1981 and 1994. And there has been no indication that this trend is about to be reversed.

Despite data limitations, much has already been written on this distributional effect, and a considerable body of empirical evidence is emerging on the dynamics of income distributions in transition economies, through works such as those by Atkinson and Micklewright (1992), Commander and Coricelli (1995) and Milanovic (1997). The picture of widespread and pronounced increases in income, expenditure or earnings inequality which arises from this evidence is remarkable, particularly when contrasted with the general stability of income distributions in most other countries for which data is available. Based on their recent international compilation of inequality measures from household survey data sets, Deininger and Squire (1996) found that inequality does not tend to vary a great deal over time within given countries - though it varies rather dramatically across countries.[3] The recent experience of economies in transition, with 5-7.5 percentage point rises in Gini coefficients not uncommon, is clearly exceptional.

What lies behind it? What is it about the process of transition from central planning to a market system which appears to involve an inherent increase in inequality? Is this increase likely to be transitory, or could it be permanent? What policy reforms in the menus suggested to governments are likely to cause these increases in income dispersion? How do they do so? This paper seeks to suggest some answers to these questions, by investigating the effects of policies and processes associated with economic transition on the equilibrium distribution generated by a model of wealth distribution dynamics with imperfect capital markets. It relies on a variant of the model discussed in Ferreira (1995),

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[3] "The measures are relatively stable through time, but they differ substantially across regions, a result that emerges for individual countries as well [...]The average standard deviation within countries (in a sample of countries for which at least four observations are available) is 2.79, compared with a standard deviation for the country-specific means of 9.15." (Deininger and Squire, 1996, p.583.)

which draws on insights developed in a growing literature, including works by Aghion and Bolton (1997), Banerjee and Newman (1991 and 1993), Benabou (1996), Galor and Zeira (1993) and Piketty (1997). It is hoped that some of the propositions arising from this conceptual exercise might be of use in suggesting fruitful avenues for future empirical research into the causes of growing inequality in transition economies.

Income distributions are determined by the underlying distributions of assets, and by the rates of returns on those assets. One can think of a household's income as the inner product of the vector of assets it owns (land; shares; bonds; the skills of its members) and the vector of prevailing returns on those assets (rent, actual or imputed; dividends; interest; the wage rates accruing to the different skills). In an uncertain world, some or all of these returns may be stochastic, so that there is a probability distribution associated with each of them, and consequently a random component to the determination of incomes. In principle, therefore, changes in the distribution of income can be due to changes in the distribution of ownership of one or more assets, or to changes in the returns associated with them, or yet to changes in the probability distributions associated with shocks inherent to the income generating process. In the sweeping changes of transition in Eastern Europe and the FSU, it is likely that all three types of changes have played (and continue to play) a role.

This paper focuses on three groups of possible sources of changes in the distribution of income: the privatization of public assets; the development of new markets in privately-provided substitutes to public services (e.g. telephones, schools, health-care); and changes in the returns associated with different skills (i.e. on the earnings-education profile). The first of these leads to a change in the underlying distribution of asset ownership, but we will show that it is also likely to impact on wages in the public sector, thus affecting returns. Privatization can be shown to affect the distribution of income by changing ownership, wages and occupational choices. The creation of new markets in privately-provided substitutes to public services will be shown to affect the returns on assets, and to do so differently for different wealth levels. The new markets are likely to enable richer

agents to top-up public provision, thus increasing the expected returns from their assets as compared to poorer agents. Finally, increases in the returns to education and skills, as well as the greater volatility associated with employment and earnings in a flexible labour market, are likely to lead to increases in earnings inequality.

Although we consider both short-term and long-term impacts of these changes, the analysis ignores a number of transitory effects which may well have contributed substantially to the increases in inequality and poverty early on in the process of transition. Notable amongst these were increases in the rate of inflation, which were known to have hurt those on fixed incomes who did not have the political clout to readjust them often (e.g. pensioners and some public employees), much more than those able to readjust their prices more frequently.[4]
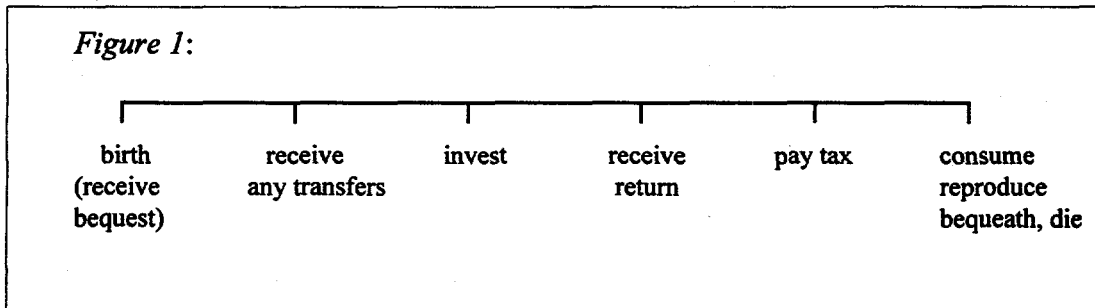
The paper is structured as follows. Section 2 presents the basic model: it describes the supply and demand side characteristics of agents, the government sector and the financial markets; section 2.1 outlines the static equilibrium of the model, by describing the actions and incomes of all agents as functions of their initial wealth and of a random variable; section 2.2 relies on those income processes to characterize the transitional dynamics of this stochastic system and the (steady-state) limiting distribution to which it converges. Section 3 considers the effects of privatizing part (or all) of the state-owned productive assets: it first investigates the short-term effects, through impacts on public-sector wages on the one hand, and higher income from (privatized) capital on the other; then it considers the permanent changes after the one-off windfalls from privatization have been absorbed into the dynamics of the system. Section 4 introduces markets for privately-provided substitutes to public services. This reform is found to add to economic efficiency, as was to be expected from eliminating a missing market problem, but also to add to inequality. Section 5 provides an informal discussion of the factors likely to affect

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[4] See Ferreira and Litchfield (1997) for an empirical analysis of the effects of high inflation on the Brazilian income distribution in the 1980s.

the returns to different skills, and hence the returns to education and the distribution of earnings. Section 6 summarizes the findings of the paper and concludes.

2. *The Model*

Let there be a continuum of agents with wealth distributed in [0, u], with total mass 1. At any time t, their distribution is given by $G_t(w)$, which gives the measure of the population with wealth less than w. $G_t(u) = 1$ for all t. These infinitesimal agents can be thought of as household-firms, identical to one another in every respect other than initial wealth. Their size is normalized to one. Each agent is risk-neutral, lives for one period and has one offspring. The sequential pattern of their lives is as illustrated in Figure 1 below:

Figure 1:

birth	receive	invest	receive	pay tax	consume
(receive	any transfers		return		reproduce
bequest)					bequeath, die

There is a single consumption good in the model, which can be stored costlessly across periods. Agents seek to maximize:

$$U(c_t, b_t) = hc_t^{\alpha} b_t^{1-\alpha} \qquad (0<\alpha<1) \qquad (1)$$

where c_t denotes the agent's total consumption in period t (her life), and b_t denotes the bequest she leaves her only child. The formulation in (1) implies the "warm-glow" bequest motive (see Andreoni, 1989). This is clearly a short-cut approach to full intertemporal optimization, but it is one which has been extensively used in the literature, given the simple dynamic structure it implies for the wealth process. It is not entirely innocuous, and replacement with full intertemporal optimization - where the Keynes-Ramsey rule holds - would change the model and generate additional insights. A discussion of the implications for this model is contained in Ferreira (1996).

On the supply side, agents may choose between two alternative occupations: they may be public sector employees, working for a deterministic wage ω, or they may set up on their own as private sector entrepreneurs, in which case they face a stochastic production function given by:

$$y_t = 0 \qquad\qquad\qquad\qquad \text{if } k < k' \qquad\qquad (2)$$

$$y_t = \theta_t r k_t \qquad\qquad\qquad\qquad \text{if } k \geq k'$$

where k is private capital and θ is a random variable distributed as follows:

$\theta = 1$ with probability q

$\theta = 0$ with probability 1-q   and $q := v^{-1}(g/k)$

g denotes the quantity of public capital used in the production process. The important properties of v are that it is defined on domain [0, 1], and that v' > 0. But it will be convenient to assume the following specific form for v: $g/k = q^{\frac{1}{a}}$, where 0<a<1. This implies that $q = (g/k)^a$, and that

$$E(y_t | k \geq k') = r k^{1-a} g^a . \qquad\qquad (2')$$

Once one of these two occupations is chosen, agents are assumed to allocate their full effort to it, and to it alone, so that effort supply is completely inelastic, and convex combinations of the two activities are ruled out.

Before turning to the capital markets and the role of government, it may be useful to spend a moment discussing the stochastic private sector production function just described. In this private sector, there is a minimum scale of production, given by an amount of private capital k' > 0. This non-convexity in the production set captures the minimum costs of going into business, which can range from the cost of a plot of land, or an industrial plant in which to locate machines, to the cost of a licence to operate a kiosk or of a stall on which to display vegetables in a street market.[5] Once that minimum scale

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[5] Similar minimum scale or more restrictive fixed scale assumptions are common in the literature. See e.g. Aghion and Bolton (1997), Galor and Zeira (1993) and Banerjee and Newman (1993).

has been reached, agents face stochastic returns to private capital, where the probability of success rises with the ratio of public capital to private capital. This is meant to capture both the uncertainties and risks associated with private sector activity, as well as the complementarity between certain types of public and private capital, which has been frequently noted in the growth literature (see e.g. Barro, 1990 and Stern, 1991.)

The nature of 'public capital' g requires elaboration. Just as there is an enormous array of goods and services in the world, all of which are subsumed under the aggregate consumption composite c, there also exists a large and complex range of non-labour inputs into production, which are routinely lumped together in macro models as 'capital'. It has long been recognized both that there are externalities associated with at least some types of capital[6], and that different types of capital can be complements (computers and education of those using them) or substitutes (delivery vans and delivery motorcycles).

Combining these two ideas, let us divide the various forms of capital into two broad groups: forms of capital with limited or no externality generation are aggregated as k and called private capital. It is hard to think of justifications for public provision of this sort of capital in a fully functioning market system in which the usual efficiency advantages of private producers over the public sector are present. Other forms of capital are characterized by high positive externalities associated with their use or production (the best examples may be forms of human capital, such as education and health, or physical infrastructure capital with a strong network dimension, such as streets, rural roads, telecommunications or power). These are aggregated as g, and named 'public capital'. What defines g is the presence of positive externalities in production or use. These inputs are not public goods: they are in fact assumed to be excludable in use.[7] Two things follow: first, there may be justification for public involvement in producing (or financing)

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[6] Famous for having enabled modelers to combine constant returns to an accumulatable factor and competition, helping to endogenize growth in per capita output; see Arrow (1962) and Romer (1986).

[7] Some may be club goods, in that they are excludable but non-rivalrous.

some of this capital directly, because government failures (e.g. red-tape or shirking) may be outweighed by market failures (externalities or high transaction costs). Second, there will nevertheless be scope for private production of some of this capital too. Our aggregate public capital g is likely to be produced both by public and by private sector agents, as is indeed the case with education services, health care or telecommunication services.[8]

Whoever produces it, 'public capital' contributes to private production in this stochastic setting by raising the probability of its success: the better the health care available to your farm labourers, the less likely they are to succumb to a preventable epidemic, leaving crops untended; the more reliable the power supply and the telephone system, the less likely it is that consumers will be disappointed by your own reliability; the better the rural roads (g), the likelier it is that your lorry (k) will deliver produce to market.[9] In this sense, private and public capital are therefore complements in the stochastic production function of the private sector. Given the specific form assumed for the v function, the expected output from private-sector production turns out to be homogeneous of degree one in k and g.

Let us now turn to the role of the government. This role is perhaps the most important thing that changes in the process of transition from central planning and government ownership of the means of production to a market economy. It may therefore be helpful to describe three plausible governments, one for each stage of the transition: before, during and after.

Government B is the stylized picture of the owner of all means of production. It combines labour and capital according to the Leontieff production function:

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[8] We explore the consequences of allowing for this 'topping-up' of public capital from private sources in a later section.

[9] The probability is a function of g/k: if your lorry is a 30-ton articulated container truck, it needs better roads to make it to the market.

$$X_t = \min(\sigma S_t, \lambda L_{st})$$ (3)

where X denotes the output of the state sector, S denotes the stock of capital used by the government, and L_s denotes the size of public sector employment. The practice of labour hoarding, which is widely documented to have been common in centrally planned economies, is incorporated by assuming that $L_{st} > \frac{\sigma}{\lambda} S_t$, so that in effect $X_t = \sigma S_t$. For simplicity, assume that S does not depreciate. Government B has discretion on how to distribute output X_t. One plausible such distribution rule, compatible with the ideal of equality of outcomes, is to set wages equal to the average product of labour:

$$\omega_t = \frac{X_t}{L_{st}} = \frac{\sigma S_t}{L_{st}}$$ (4)

Equation (4) is a distribution rule, a wage setting equation and, since this government administers all production and has no need to tax, it is also Government B's budget constraint. One can think of the wage ω as incorporating any in-kind benefits, such as child or health care, made available to public sector workers in this economy. In this benchmark case, no g is produced, so that there is no private sector. Public employment exhausts the total labour force: $L_s = L$. There is perfect income equality with a Dirac distribution at ω.

Government A is the stylized benevolent government in a mature market economy. In such an economy, there are government failures (particularly pervasive in producing consumption goods or private capital, so that these are produced by private agents) and market failures (which outweigh government failures in the production of some goods, which are here all assumed to be in the public-capital category). This government seeks to maximize a linear social welfare function given by: $W = \int_0^u y(w,\theta) dG(w)$ subject to:

$$g_g \int_0^u dG(w) = \tau \int_0^u y(w,\theta) dG(w)$$ (5)

The budget constraint in equation (5) summarizes four key (assumed) restrictions in the policy choices available to benevolent government A. First, the government can not levy lump-sum taxes. Hence, in this set-up with inelastic labour supply, income taxes are quasi-lump-sum and are preferable to taxing either consumption or bequests only, or both at different rates.[10] Second, the government can only tax incomes proportionately, at a constant rate τ, without exceptions. Third, the government can not make cash transfers. Fourth, the government can not target the in-kind transfers of public capital which it makes (perhaps due to the administrative costs involved). These are hence distributed uniformly to all agents, who receive an amount g_g.[11] The transformation from tax revenues into in-kind transfers of public capital is deliberately not modeled explicitly: it may be more efficient for the government to finance production by private agents, or it may produce them directly, through some implicit production function using the tax revenues.

The third kind of government, D, is a hybrid of the other two. It is a government in transition, and hence combines functions from both B and A. It retains a sector producing the consumption good c, with technology (3), and a modern sector producing public capital goods g, which it distributes uniformly to the population, like A. Its budget constraint is given by:

$$\omega L_s + g_g \int_0^u dG(w) = \tau \int_0^u y(w,\theta)dG(w) + X \tag{6}$$

I continue to assume that the public-sector wage is set in accordance to (4), so that there is no cross-subsidy between the two sectors of this transitional government. I also assume that g_g has been historically determined at some exogenous level (perhaps by some vote

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[10] Given preferences in equation (1), taxing c and b at identical rates is equivalent to taxing incomes. For a discussion of the public economics of this model, see Ferreira (1996).

[11] Since $\int_0^u dG(w) = 1$, the reader can for the moment think of g_g either as an amount of an (excludable) private good uniformly distributed to all agents, or alternatively as the amount of a (non-excludable and non-rivalrous) public good, which any agent can use in his or her production function. This second interpretation must only be abandoned in Section 4.

early in the process of transition) and τ adjusts to satisfy (6).[12] Since we are concerned with the process of economic transition, in the analysis below government will always be this government D.

Finally, I assume that credit markets work imperfectly. The important requirement is that there exist credit ceilings linked to agents' initial wealth levels. This can be obtained through a set-up like that in Banerjee and Newman (1993), based on imperfect enforcement of repayments, but the insights are the same if the credit markets are simply assumed away altogether. For simplicity, this is the route taken below, where we assume agents can not borrow (or lend) at all. Savings are simply stored and, like capital or bequests, do not depreciate.

2.1.   *The Static Equilibrium.*

The objective of this sub-section is to determine how the occupational choice between public and private sectors is made by each agent, and to describe her end-of-period (pre-tax) income as a function of her initial wealth level and of her drawing of the random variable theta. This will allow us to characterize the transition function of wealth, which will provide the basis for investigating the long-run dynamic properties of the system. To focus on an economy in transition, I assume that the government is Government D. The existence of a minimum scale requirement for private sector production ($k \geq k'$) implies that there will be three classes in this simple version of the model, subject to the following restriction:

Assumption 1: Given the private sector rate of return r, the historic level of g_g is sufficiently high in relation to the productivity of labour in the public sector that, at the

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[12] The more satisfactory approaches of modeling the choice of τ explicitly in a voting framework, or alternatively assuming a benevolent dictator which maximizes social welfare by choice of an optimal τ^*, introduce too much complexity for the purposes of this paper. However, see Ch. 4 in Ferreira (1996) for a cut at the latter approach. The alternative route of fixing τ at some exogenous level here is just as unsatisfactory, and would add unnecessary complications.

minimum scale of private production, expected end-of-period income is higher in the private sector than in the public sector. In other words, if we denote (pre-tax) income in the private sector y_P and income in the public sector y_G :

$$E[y_P | w = k'] > E[y_G | w = k']$$

$$rk'^{1-a} g_g^a > \omega + k' = \frac{\sigma S}{L_s} + k' \tag{7}$$

In addition to this assumption, we will also need one more result to fully characterize the three social classes. Let w_u denote the upper bound of the wealth interval supporting the ergodic distribution G^*, the limiting wealth distribution towards which the system converges. w_u is defined below in equation (10).

Lemma 1: The upper bound of the support of the limiting wealth distribution, w_u, is sufficiently high that the marginal product of capital there is below 1:

$$E[MPk(w_u)] < 1 \qquad \Rightarrow \qquad r(1-a)w_u^{-a} g_g^a < 1$$

Proof: See Appendix.

Figure 2 below illustrates the meaning of Assumption 1 and Lemma 1. Assumption 1 requires that the expected income from private sector production at k' be greater than the (riskless) income which can be derived from working as a public sector employee. The latter is equal to the wage ω plus the initial wealth (the return on which is 1, since there are no capital markets and no depreciation). Lemma 1 establishes that the expected marginal product of capital in private production (the convex curve in the bottom panel of Figure 2) is less than 1 at the upper bound of the wealth interval supporting the ergodic distribution (w_u). If we implicitly define w_c as $E[MPk(w_c)] = 1$, then it requires that $w_c < w_u$.

Figure 2
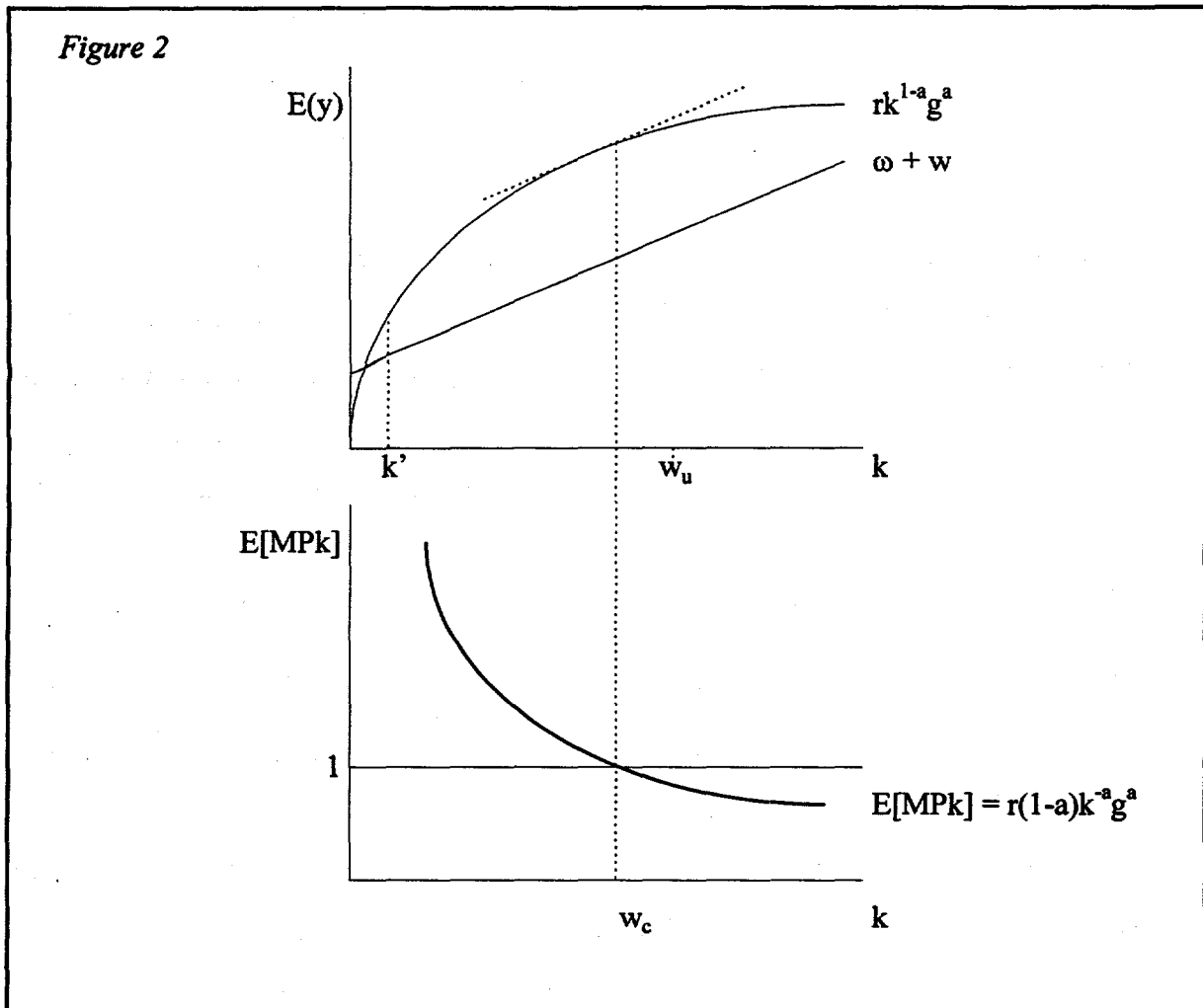
We can now describe end-of-period incomes for all agents, as follows:

Proposition 1: In the economy described so far, there are three classes of agents, defined by their occupation and sector of employment: the poorest agents, with wealth $w < k'$, work in the public sector for a deterministic wage ω. All agents with wealth greater than or equal to k' choose to become entrepreneurs in the risky private sector. But there are two classes of entrepreneurs: those with wealth between k' and w_c invest all their wealth in the production function (2); while those with wealth greater than w_c save some of it. The end-of-period (pre-tax) income function is therefore given by:

$$y_t(w_t, \theta_t) = \quad \omega_t + w_t \qquad\qquad \text{for } w_t \in [0, k')$$

$$\theta_t r w_t \qquad\qquad\quad \text{for } w_t \in [k', w_c) \qquad (8)$$

$$\theta_t r w_c + (w_t - w_c) \qquad \text{for } w_t \in [w_c, u]$$

Proof: 1) Agents with wealth w < k' work in the public sector because:

$E[y_G \mid w < k'] = \omega + w > E[y_P \mid w < k'] = 0$. The first equality arises from earning wage ω from one's labour in the public sector and saving one's initial wealth. The second equality arises from the minimum scale requirement in production function (2).

2) Agents with wealth $k' \le w < w_c$ invest their full wealth in the private sector because:

• Assumption 1 ensures that it is worth investing at least k' in the private sector, and

• Lemma 1 and the fact that $\dfrac{\partial E[MPk]}{\partial k} < 0$, $\forall k$ ensure that it is also preferable to invest

any wealth up to w_c, rather than to save it. Once they invest their full wealth w (> k') in production function (2), their return is $\theta_t r k_t$.

3) Agents with wealth $w \ge w_c$ find it profitable to invest w_c in the private sector because $r w_c^{1-a} g_g^a > \omega + w_c$, which follows from Assumption 1, Lemma 1 and the monotonicity of MPk. Given Lemma 1, however, it is clearly optimal for them to save $(w - w_c)$ rather than invest it.

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2.2. Transitional Dynamics and the Steady-State Distribution.

The utility function in (1), implies that bequests are a fixed proportion of the after-tax end-of-period income for each and every agent: $b_t = (1-\alpha)(1-\tau)y_t$, where y_t is defined in equation (8) above. Since $b_t = w_{t+1}$ for each lineage, the intergenerational law of motion of wealth in this model can be written simply as:

$$w_{t+1} = (1-\alpha)(1-\tau)y_t(w_t, \theta_t) \qquad (9)$$

where $y_t(w_t, \theta_t)$ is defined in equation (8).

θ_t is not i.i.d., because it is not identically distributed over time, since the probability q (= v^{-1}(g/k)) may change from period to period. Nevertheless, since g_t is predetermined and k_t depends only on the current (period t) value of wealth, θ_t *is* independently distributed. α and τ are time invariant exogenous parameters. It follows that there are no indirect links between previous values of w and w_{t+1} or, in other words, that for any set A of values of wealth, Pr ($w_{t+1} \in A \mid w_t, w_{t-1},..., w_{t-j},...$) = Pr ($w_{t+1} \in A \mid w_t$). The transition process of wealth is therefore a unidimensional Markov process, which allows us to be fairly specific about the long-run properties of this dynamic stochastic system, as shown by the following proposition:

Proposition 2: The stochastic process defined by equation (9) is a Markov process, with the property that the cross-section distribution $G_t(w)$ converges to a unique invariant limiting distribution G^*, from any initial distribution $G_0(w)$.

Proof: See the proof of proposition 3 in (the appendix to) Ferreira (1995).

It is intuitive to see that the upper bound of the ergodic wealth set (the support of G^*) must be the highest level of wealth which generates a bequest no smaller than itself. Substituting $y_t(w_t, \theta_t) = \theta_t r w_c + (w_t - w_c)$ - for $w_t \in [w_c, u]$ and $\theta = 1$ - from equation (8) into (9), and requiring that $w_{t+1} = w_t$ solves for w_u:

$$w_u = \frac{(1-\alpha)(1-\tau)(r-1)w_c}{1-(1-\alpha)(1-\tau)} \tag{10}$$

where, of course, Lemma 1 implies that $\dfrac{(1-\alpha)(1-\tau)(r-1)}{1-(1-\alpha)(1-\tau)} > 1$.

Figure 3 below illustrates the wealth transition function given by equation (9). The bequests left by agents in each class are simply a fraction $(1-\alpha)(1-\tau)$ of their end-of-

period incomes, as given by (8). While there is a single bequest function in [0, k'), where incomes are deterministic, there are two in [k', w_u], one for $\theta = 0$ and one for $\theta = 1$. The slope of the bequest function is therefore $(1-\alpha)(1-\tau)$ in [0, k') and for both functions in [w_c,w_u]. For the middle-class in [k', w_c] the function for $\theta = 0$ is a constant at zero, while the upper line (for $\theta = 1$) has a slope of $(1-\alpha)(1-\tau)r$. To avoid poverty traps, I assume that $(1-\alpha)(1-\tau)(\omega + k') > k'$.[13] This and assumption 1 then imply that $(1-\alpha)(1-\tau)r > 1$.

Figure 3
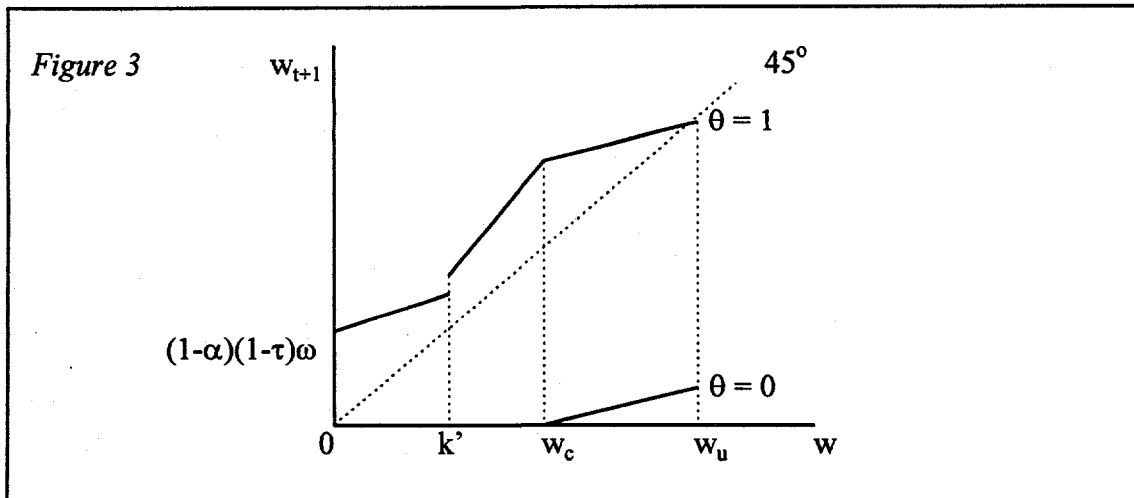
The implication of Proposition 2 and of the specific transition function given by equation (9) is that the long-run equilibrium of this stochastic process is characterized by an invariant non-degenerate wealth distribution, with three 'social classes' defined by the choice of occupation and/or investments undertaken by agents. The poorest agents choose to work in the less productive public sector, because the missing credit markets prevent them from borrowing to invest at the minimum scale required in the private sector. They earn a deterministic wage equal to their average product, which is a linear function of the public sector capital stock. By assumption, this wage is high enough in relation to the minimum scale k' that everyone in the public sector is able to bequeath more than they

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[13] Which merely sets a upper bound on admissible values for the exogenous parameter k'.

themselves started life with, so that the dream of having a descendant among the ranks of the entrepreneurs will eventually always come true.

Between k' and w_c we have middle-class agents, who invest their full wealth in the risky private sector production function. Every period, some of these succeed, earning an income high enough to leave their children a bequest higher than their initial income. Upward mobility in the middle-class is a function of entrepreneurial success. But a fraction of them fail, consigning their children to start afresh as impoverished public-sector workers in the next generation. Those whose ancestors have succeeded repeatedly, eventually are rich enough that the expected marginal product of investing in private capital is not worth the risk. They invest as much as is sensible (w_c) and simply save the rest. Although Proposition 2 and the associated Markov convergence theorems do not specify a functional form for G*, a plausible density function might look like the hypothetical example in Figure 4:

Figure 4
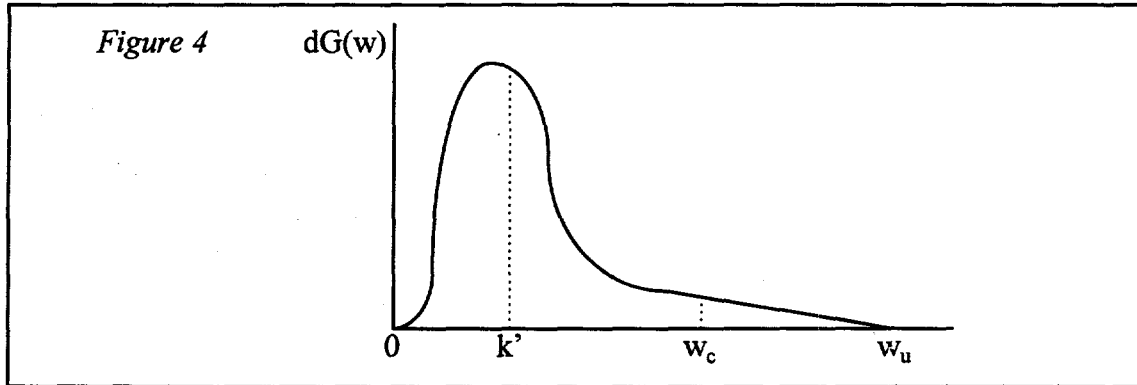
3.   *Privatization, Public Sector Wages and the Distribution of Income*

Let us now begin our investigation into the effects of policies associated with economic transition on the distributions of income and wealth, by considering the privatization of state assets. This will be modeled as the transfer of a fraction π ($0<\pi\leq1$) of the state-owned productive assets S to private hands. The analysis below is primarily concerned

with the short-run effects of privatization on the income distribution. We proceed by comparing the two periods immediately prior to and immediately after the privatization: I denote the pre-privatization equilibrium values of all variables with the subscript zero, and all post-privatization values with the subscript one. At the end of the section, I briefly discuss the implications for the new equilibrium distribution towards which the system eventually converges after the one-off privatization.

For simplicity, I assume that π is sufficiently small in relation to the extent of labour-hoarding going on in the public sector that $X_1 = \sigma S_1$ still holds after the privatization. Furthermore, since the functional form of the limiting steady-state distribution G^* is unknown, the analysis is conducted for representative agents of each class. These are denoted by the subscripts P for the poorest class ($w \in [0, k')$), M for the middle class ($w \in [k', w_c)$), and R for the uppermost class ($w \in [w_c, w_u]$). In particular, since most frequently used inequality measures are scale invariant, we shall be comparing the ratios of expected post-privatization (pre-tax) end-of-period income to the expected pre-privatization (pre-tax) end-of-period income: $E(y_{i1})/E(y_{i0})$, i = P, M, R.

These incomes, and the effect on overall inequality, clearly depend on the specific privatization mechanism adopted. Below I assume the simplest possible mechanism: shares in the privatized assets are simply given away as privatization vouchers, distributed uniformly to all citizens thus:

$$\pi S_0 = v \int_0^{w_u} dG_1(w) \qquad (= v) \qquad (11)$$

Proposition 3: In the short run, a privatization process described by equation (11) will unambiguously increase expected incomes in the upper and middle classes, but it may lead to income reductions amongst the poor.

Proof: From equations (2') and (8), we have that:

- $E(y_{R0}) = rw_c^{1-a}g^a + (w - w_c)$ and $E(y_{R1}) = rw_c^{1-a}g^a + (w + v - w_c)$.

Hence: $E(y_{R1}) - E(y_{R0}) = v$ and $E(y_{R1}) / E(y_{R0}) > 1$.

- $E(y_{M0}) = rw^{1-a}g^a$ and $E(y_{M1}) = r(w+v)^{1-a}g^a$. Hence:

$$\frac{E(y_{M1})}{E(y_{M0})} = \left(\frac{w+v}{w}\right)^{1-a} > 1 .$$

- $E(y_{p0}) = \omega_0 + w_0 = \frac{\sigma S_0}{L_{s0}} + w_0$ and $E(y_{p1}) = \omega_1 + w_1 = \frac{\sigma(1-\pi)S_0}{(1-\beta)L_{s0}} + w_0 + v$

where $\beta = \int_{k'-v}^{k'} dG_0(w) \Big/ \int_0^{k'} dG_0(w)$. β denotes the proportion of public sector employees

who exit the class and join the ranks of middle-class entrepreneurs, as a result of the extra

capital they receive as privatization vouchers. It follows that $L_{s1} = (1-\beta)L_{s0}$. Hence:

$$\frac{E(y_{p1})}{E(y_{p0})} = \frac{\sigma(1-\pi)S_0/(1-\beta)L_{s0} + w_0 + v}{\sigma S_0/L_{s0} + w_0} \tag{12}$$

so that $v < \frac{\sigma S_0}{L_{s0}}\left(\frac{\pi - \beta}{1-\beta}\right) \Rightarrow \frac{E(y_{p1})}{E(y_{p0})} < 1.$ (12') ∎

Corollary: If privatization leads to a (short-run) decline in public sector wages (the
absolute value of) which exceeds the value of the privatization vouchers given to each
agent, then inequality between the poor and the entrepreneurial classes will increase
unambiguously in this transitional period.

Proof: This follows directly from the end of the proof of Proposition 3:

$\omega_0 - \omega_1 = \frac{\sigma S_0}{L_{s0}}\left(\frac{\pi - \beta}{1-\beta}\right)$. If π-β is sufficiently large that this difference is greater than v,

then it was shown that end-of-period incomes for the poor fall (equation 12'), while
expected incomes for the upper and middle classes rise. Inequality between the poorest
class and the other two therefore rises by any measure satisfying the Pigou-Dalton
transfer principle. ∎

Notice that a necessary, but not sufficient, condition for (12') to hold is that $\pi > \beta$, i.e. that privatization leads to a proportional reduction in the amount of capital owned by the state which is greater than the proportional reduction in the amount of labour employed by the state. In other words, the more effective reformers are in enabling employees in an obsolete segment of the public sector to move to alternative occupations in the private sector (as entrepreneurs, in this simple model) relative to the amount of assets privatized, the less likely it is that the privatization will hurt the remaining public sector employees. If the obsolete public sector is, as in this model, effectively a safety-net employer of last resort, staffed by the most vulnerable people in society, this may well be desirable from an equity viewpoint.

Notice also that the corollary to proposition 3 and the condition expressed in equation (12') establish a sufficient, but not necessary, condition for inequality between the poorest class and the private sector entrepreneurs to grow with privatization. They describe an extreme situation, in which incomes in the public sector actually fall in the aftermath of privatization. Whilst the evidence from a number of countries reveals that this can indeed happen, all that is required for inequality to rise is that any increase in incomes there be proportionally less than those for the upper classes. Condition (12') is, on the other hand, both necessary and sufficient for a short-run increase in poverty in this model, since incomes fall unambiguously for all agents with wealth $w \in [0, k')$.

The general results above are easily interpreted. Privatization is modeled here as a uniform transfer of capital from public to private ownership. Government D is assumed to keep its two sectors separate and to maintain the provision of public capital g constant during the privatization. The only government sector to be affected by the privatization policy considered in this section is the productive sector, the output of which is exhausted in the wage bill of the (poor) public sector workers. This explains why entrepreneurial agents (the upper and middle classes) benefit unambiguously from privatization: they

receive no benefits, direct or indirect, from government production of X, so that they do not lose at all from a reduction in its scale. And they receive (an amount v of) free additional private capital, which adds to their total wealth and productivity.[14]

The marginal benefits of privatization are therefore unambiguously positive for them: Recall that $E(y_{R1}) = rw_c^{1-a} g^a + (w + v - w_c)$, so that $\dfrac{\partial E(y_{R1})}{\partial v} = 1$. Similarly, since

$$E(y_{M1}) = r(w + v)^{1-a} g^a \ , \ \frac{\partial E(y_{R1})}{\partial v} = (1 - a)r(w + v)^{-a} g^a > 0.^{[15]}$$

This is not the case for the poorest agents, whose class is defined by their occupation as public sector employees. In their case, privatization of state assets has an ambiguous overall impact, as a result of three separate effects. The first, and simplest, is the voucher effect: receipt of the uniform transfer of size v also raises their initial wealth. Since they simply save it, the marginal effect is exactly like that for the upper class. The other two effects act through changes in the public sector wage rate (ω): the negative 'numerator effect', which follows from the fall in public sector output (X) due to reduced capital in the sector (S), acts to lower the wage. The positive 'denominator effect' follows from the fact that the transfer of v enables a share of the public-sector labour force

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[14] Note that government D keeps the provision of g at its historic exogenous level, which satisfied all the assumptions set out in Section 2, since the taxes collected in the previous period, prior to privatization yield exactly that level of transfers. In subsequent periods during the transition, there may be an additional channel for the impact of privatization on entrepreneurial agents: if economy-wide output rises with privatization, the tax rate τ required to provide g will fall. Naturally, this does not affect the expected incomes used in the above propositions, since they are pre-tax. But it will affect utility, by raising consumption and bequests proportionately by $-\Delta\tau$. This would only affect periods after the immediate short-run impact considered here.

[15] In fact, given the definition of w_c, which implies that MPk is higher for the middle class than for the upper class, $\dfrac{\partial E(y_{M1})}{\partial v} > \dfrac{\partial E(y_{R1})}{\partial v}$. This implies that, in this model, the marginal benefit of privatization is greater for the middle class than for the very rich, given diminishing returns to private capital.

$(\beta L_{s0} = \int\limits_{k'-v}^{k'} dG_0(w)$) to purchase the private-sector's minimum scale of production amount of capital: k'. Assumption 1 then ensures that these agents choose to leave the public sector and join the ranks of the enterprising middle-class. By reducing the number of those who must share the (lower) new public-sector output as wages, this effect acts to increase the post-privatization wage rate.

These three effects can be seen clearly in the expression for the marginal benefit of privatization for the public-sector employees. Rewrite $E(y_{P1})$ as:

$$E(y_{p1}) = \frac{\sigma(S_0 - v)}{\int\limits_0^{k'-v} dG_0(w)} + w_0 + v \text{ , and it follows that:}$$

$$\frac{\partial E(y_{p1})}{\partial v} = 1 - \frac{\sigma}{(1-\beta)L_{S0}} + \frac{\omega_1 dG_0(k'-v)}{(1-\beta)L_{S0}} \tag{13}$$

The three terms on the right-hand side of (13) are, respectively, the unit-valued voucher effect, the negative wage numerator effect and the positive wage denominator effect. The expressions are quite intuitive: the marginal impact of an extra unit of public capital being privatized is one through the receipt of a voucher; minus the public-sector productivity of that capital divided by the new number of wage recipients; plus the wages given up by those moving out of the public sector, divided amongst those who stay. (13) may, of course, be positive or negative depending on the relative strengths of these effects.

In sum, proposition 3, its corollary and equation (13) suggest that privatizations (of a given size) are less likely to hurt the poor in the short run: (a) the lower the productivity of capital in the public sector (σ); and (b) the larger their effect on the mobility of labour away from the inefficient public sector and into profitable private activities (β). Naturally, overall economic benefits also depend on the productivity of capital in the private sector

(r). In practical terms, it is likely that the privatization of state owned assets will impose a much less severe burden on the poor if conditions exist for people to move to the private sector, either by starting their own small businesses (a low k'), or by being employed in someone else's.[16] Cumbersome licensing procedures, inefficient or missing credit markets, labour market restrictions and distortions, inexistent or thin land and property markets are all factors which are both common to many transition economies and likely to lower labour mobility into the more productive private sector.

Turning now to the new steady-state equilibrium towards which the system converges after the original equilibrium is disturbed by privatization, we must first note that the transfer of the v vouchers to all agents is clearly a one-off event. It raises individual wealth levels at that time, but the law of motion of wealth in equation (9) and the stochastic nature of returns ensure that the extra pool of private wealth in the economy is redistributed across lineages in the course of future generations. Proposition 2 will still hold, but the exact wealth distribution G** towards which the system converges is in general different from the pre-privatization distribution G*, since at least one parameter in the transition function has changed: the public sector wage rate ω. Whereas $\omega_0 = \dfrac{\sigma S_0}{L_{s0}}$,

$\omega_2 = \dfrac{\sigma(1-\pi)S_0}{L_{s2}}$, where the subscript 2 denote values in the post-privatization ergodic distribution. A first concern is that $(1-\alpha)(1-\tau)(\omega + k') > k'$ should still hold for ω_2, so as to avoid poverty traps.

Naturally, if $L_{s2} = L_{s0}$, then $\omega_2 < \omega_0$ (since $\pi > 0$), and we have a situation where income inequality between the poorest class and the entrepreneurial classes rises unambiguously in the long-run after privatization, whatever the (ambiguous) short run effect. In this case, since incomes fall for all agents with $w \in [0, k')$, it will also be possible to say that poverty increases, whatever the poverty line. However, it is impossible to know whether

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[16] A private sector labour market is not modeled in this paper, to keep the structure as simple as possible.

$L_{s2} = L_{s0}$, since the G** is a different distribution from G*, and hence density $L_{s2} =$ G**(k') ≠ G*(k') = L_{s0}, in general.

An issue which also deserves mention in this section is the applicability of this model to total privatizations (π=1). In that case, government D transforms itself directly into government A, which concentrates only on the production of public capital, and does not produce consumer goods with the obsolete technology (3). Consequently, the poorest class as defined here disappears. Whether this is the best possible policy for the poor in the short run depends ultimately on whether $S_0 > k'$. If so, the privatization mechanism given by (11) will ensure that all public sector employees can start their own private businesses, and the whole society will - in a first instance - consist of middle- or upper-class entrepreneurs. There are two problems, however. First, if $S_0 < k'$, the poorest public sector workers will not receive enough in privatization vouchers to purchase the minimum scale of production amount of capital k'. Deprived of a public sector in which to work, these people would be forced to subsist on their own inadequate initial resources. They would constitute a new underclass of idle people living at the margins of society.[17]

Second, even if $S_0 > k'$ and everyone is able to move up to the entrepreneurial class in the first instance, these vouchers are a one-off transfer. As stated above, the post-privatization equilibrium distribution G** will include agents with wealth less than k', as a result of entrepreneurial failures. In the absence of public sector employment, they would need some alternative safety-net mechanism. The model reminds us that, since market systems involve substantial risks to individual incomes, governments must accompany reductions in the ability of the public-sector to act as an employer of last resort with measures to create alternative safety nets, in the interests of both equity and long-term efficiency.

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[17] In fact, given the dynamics of this particular model, this development would eventually destroy the entire economy. The underclass would be locked in a poverty trap which would eventually - given the positive probability of failure faced by everyone in the private sector - attract the whole mass of the distribution. To preserve a non-degenerate ergodic wealth set, some alternative source of income would have to be found for those with wealth less than k': unemployment insurance; private sector jobs, whatever.

4. *Allowing for the Private Provision of Public Capital*

But privatization is only one component of a much broader set of reforms which support the process of economic transition from central planning to a functioning market economy. A transformation at least as important as any other is the creation and development of a number of markets which may have previously been missing. Some such markets may be for public capital inputs into private production, as defined in Section 2. While services like health care, education, telecommunications, postal delivery and security (policing) may indeed be characterized by large market failures, justifying government intervention, nothing prevents private sector entrepreneurs from competing with the government in their provision. In fact, because none of these services is a pure public good, all of them having different degrees of excludability and rivalrousness in consumption, a coexistence of private and public provision is in fact observed in most countries. In many cases, private sector suppliers specialize in providing "upmarket" services, leaving poorer agents to consume the public alternatives. This section suggests how this may quite naturally develop, and investigates the consequences of the development of these markets during economic transition for the distribution of income.

Let us consider the implications of allowing agents in the private sector to purchase additional quantities of public capital g from private suppliers. We continue to denote by g_g the amount of g uniformly distributed by the government, as in equations (5) and (6). Let the amount of g privately purchased by any agent with wealth w be given by $g_p(w)$, which will be written g_p in short. g_p is produced by private sector agents through the same production function used to produce the consumer good, and units are chosen so that the price is one.

The basic implication of allowing for a private market in public capital in this model is that this enables sufficiently wealthy agents to combine k and g in the optimal proportions for production, rather than exhausting their wealth in private capital k alone.

Recall that all our agents are risk neutral, and that the expected returns of private sector production are given by (2'): $E\left(y_t|k \geq k'\right) = rk^{1-a}g^a$. To the extent possible, agents therefore seek to combine inputs k and g in their production process so as to maintain the optimal input ratio: $\dfrac{k}{g} = \dfrac{1-a}{a}$. When inputs are combined in this ratio, (expected) marginal products are identical:

$$MPk* = MPg* = ra^a(1-a)^{1-a} \tag{14}$$

But because there is a minimum scale of production given by k', and a free transfer of g = g_g, not all agents are able to produce with the optimal input ratio. In fact, subject to the two additional assumptions below, it is possible to show that with private top-ups of public capital, the model yields an end-of-period income function different from (8), and hence a transition function of wealth different from (9). Whilst the limiting distribution is still characterized by three occupational classes, they are no longer the same as in the equilibrium described in Section 2. Below, we describe the new long-run equilibrium and compare its distribution with that in Section 2. This comparison can be interpreted as a comparative statics exercise between the pre-market-opening-reform equilibrium and the post-market-opening-reform equilibrium.

Assumption 2: Let r be sufficiently high that the marginal products of public and private capital at the optimal input ratio are greater than one: $MPk* = MPg* = ra^a(1-a)^{1-a} > 1$.

Assumption 3: Let the level of government-provided public capital g_g be sufficiently high that at the minimum amount of private capital k', the marginal product of k exceeds that of g: $MPk(k') = r(1-a)k'^{-a}g_g^a > rak'^{1-a}g_g^{a-1} = MPg(k')$.

Definition: Let w* be a wealth level such that, for the historic level of government-provided public capital g_g, $MPk(w*) = r(1-a)w*^{-a}g_g^a = raw*^{1-a}g_g^{a-1} = MPg(w*)$

Proposition 4: In this economy, there are still three classes of agents, defined by their occupation and sector of employment: the poorest agents, with wealth w < k', work in the public sector for a deterministic wage ω. All agents with wealth greater than or equal to k' choose to become entrepreneurs in the risky private sector and invest all their wealth in the production function (2). But there are two classes of entrepreneurs: those with wealth between k' and w* buy only private capital k', and have a k/g ratio less than the optimal. Those with wealth greater than w* divide their initial wealth between k and g_p, so as to operate always at the optimal input ratio $\frac{k}{g} = \frac{1-a}{a}$. The end-of-period (pre-tax) income function is therefore given by:

$$
y_t(w_t, \theta_t) = \begin{cases} \omega_t + w_t & \text{for } w_t \in [0, k') \\ \theta_t r w_t & \text{for } w_t \in [k', w*] \\ \theta_t r \gamma(w) w_t & \text{for } w_t \in (w*, u] \end{cases} \tag{15}
$$

where $\gamma(w) := \dfrac{k}{k + g_p(w)}$ is the fraction of the agent's wealth spent on private capital.

Proof: 1) For agents with wealth w < k', see Part (1) of the proof of Proposition 1.

2) Agents with wealth k' ≤ w < w* invest their full wealth in k because Assumption 1 ensures that it is worth investing at least k' in the private sector; and Assumption 3 and the definition of w* ensure that it is preferable to buy k than g over that wealth range. Assumption 2 implies that it is preferable to invest their full wealth in the production function (2) than to save. Once they do so, their return is $\theta_t r k_t$.

3) Agents with wealth w > w* allocate a positive share 1-γ(w) of their wealth to purchases of g_p, so as to keep the input ratio at its optimal. The definition of w* ensures that this is only sensible at wealth levels greater than it. Assumption 2 ensures that it is always preferable to buy \$a of g_p and \$(1-a) of k than to save \$1. ∎

The law of motion of wealth is still given by equation (9): $w_{t+1} = (1-\alpha)(1-\tau)y_t(w_t, \theta_t)$, but now $y_t(w_t, \theta_t)$ is given by equation (15), rather than (8). Proposition 2 still holds, but

since the transition function is a different one, so is the invariant limiting distribution. To distinguish it from both the pre-transition long run equilibrium distribution G*, and from the post-privatization equilibrium distribution G**, let us now call the limiting distribution towards which the dynamic system described by (9) with $y_t(w_t, \theta_t)$ given by equation (15) converges, G***.[18]

Assuming that the basic exogenous parameters of the model (r, a, α, σ, k', S) and that the level of g_g are unchanged, two outcomes are possible in terms of the distribution of expected pre-tax incomes, depending on how G***(k') compares with G*(k'). It turns out that in one case, there is an unambiguous welfare result, and in the other an unambiguous inequality result.

Proposition 5: If G***(k') < G*(k'), then the distribution of expected pre-tax incomes associated with G*** displays first-order stochastic dominance over the distribution of expected pre-tax incomes associated with G*. Expected welfare is therefore unambiguously higher in the post-market-opening equilibrium than in the pre-market-opening equilibrium.

Proof: First-order dominance can be defined both in terms of distribution functions, or their inverses, the Pen Parades. Here, dominance is established through the latter method, by showing that E[y(w) | G***] ≥ E[y(w) | G*], ∀w:

- For w ∈ [0, k'),

$$E[y(w)|G***] = \frac{\sigma S}{G***(k')} + w > \frac{\sigma S}{G*(k')} + w = E[y(w)|G*].$$

- For w ∈ [k', w*], $E[y(w)|G***] = rw^{1-a}g_g^a = E[y(w)|G*]$.

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[18] For this limiting distribution G*** to exist, the following parametric restriction must hold:
$r(1-\alpha)(1-\tau)(1-a) \leq 1$. This can be seen as an upper bound on r. It follows from the fact that the upper-bound of the new ergodic set, w_{uu} is defined by setting $w_{t+1} = w_t$ in
$w_{t+1} = (1-\alpha)(1-\tau)\gamma(w)rw_t$. The non-zero solution is given by: $(1-\alpha)(1-\tau)r\gamma(w) = 1$, where $\gamma(w)$ declines motonically from 1, with $\lim_{w\to\infty}\gamma(w) = 1-a$.

- For $w \in (w^*, w_c]$, $E[y(w) \mid G^{***}] = r(\gamma w)^{1-a}\left[g_g + (1-\gamma)w\right]^a > rw^{1-a}g_g^a = E[y(w) \mid G^*]$. The inequality follows from the fact that $\gamma(w)$ is a control variable chosen by each agent so as to keep $\dfrac{k}{g} = \dfrac{1-a}{a}$ above w^*. The marginal revenue on any dollar above w^* is lower if spent on k alone (as in G^*), than if shared between k and g_p (as in G^{***}).

- For $w \in (w_c, w_{uu}]$,

$$E[y(w) \mid G^{***}] = r(\gamma w)^{1-a}\left[g_g + (1-\gamma)w\right]^a > rw_c^{1-a}g^a + (w - w_c) = E[y(w) \mid G^*].$$

The inequality follows from Assumption 2: For every dollar above w^*, the expected return $\left(ra^a(1-a)^{1-a}\right)$ is higher in G^{***} than in G^*. Since the returns on every dollar until w^* are identical for agents richer than k', the total income for this class must be higher than in G^*. ■

In this case, therefore, social welfare is unambiguously higher in the long-run equilibrium after the market-opening reform than prior to it. All expected incomes are at least the same as before (and in many cases strictly greater), for any given wealth level, regardless of one's social class. This outcome is due to two effects. The first is an increase in the higher incomes in the distribution, brought about by the ability to allocate one's wealth more efficiently through topping up the amounts of public capital provided by the government, thus increasing one's probability of entrepreneurial success. The second effect is an increase in incomes in the bottom of the distribution, due to an increase in the public sector wage rate. With unchanged public sector output σS, this is due entirely to a fall in public sector employment: $L_s = G^{***}(k')$. Note that whereas the first effect is an inherent consequence of the market-opening reform, the latter is only a possibility. The functional form of G^{***} is unknown, and the mass below k' might therefore be either greater or lower than for G^*.

In this first case, with $G^{***}(k') < G^*(k')$, public sector employment falls, causing the wage to rise. As a result, although changes in welfare (in terms of the distribution of

expected incomes) are unambiguous, the same can not be said of changes in inequality. These will largely depend on the proportional rise in public sector wages, versus the proportional rises in upper-class expected entrepreneurial incomes.

As noted above, however, the population mass below k' may also be greater in the post-reform equilibrium than in the pre-reform equilibrium:

Proposition 6: If $G^{***}(k') > G^*(k')$, then (expected) income inequality between representative agents of the three classes rises unambiguously between the pre-reform equilibrium associated with G^* and the post-reform equilibrium associated with G^{***}.

Proof: Let the pre-reform equilibrium variables be denoted by the subscript 0, and the post-reform equilibrium variables by the subscript 1. Let the representative agent of each of the three classes be subscripted P, M and R, as in Section 3. The unambiguous rise in inequality follows from a fall in the expected income of P, no change in the expected income of M, and a rise in the expected income of R, as follows:

- $$E(y_{P1}) = \omega_1 + w = \frac{\sigma S}{G^{***}(k')} + w < \frac{\sigma S}{G^*(k')} + w = \omega_0 + w = E(y_{P0})$$

- $$E(y_{M1}) = rw^{1-a} g_g^a = E(y_{M0})$$

- $$E(y_{R1}) = r(\gamma w)^{1-a} \left[g_g + (1-\gamma)w \right]^a > rw_c^{1-a} g^a + (w - w_c) = E(y_{R0}).$$ (See the proof of Proposition 5.) $\blacksquare$

In this second case, merely because public sector employment increased, causing the wage rate to fall, the beneficial impact of the market-opening reform appears substantially less general. Only the (expanded) upper class sees rises in their expected incomes. Inequality rises unambiguously between the three classes, and for any poverty line below $y(w^*)$, poverty also rises. This can be interpreted as suggesting that the creation of private suppliers of services previously provided only by the public sector, such as health care and education, benefits only those who are rich enough to consider topping up the public

provision. Even though there is no requirement that a minimum amount of g_p be purchased, poorer agents do not benefit from the new markets, because they are either precluded from employing its benefits in any production function at all, or because they still choose to use all of their wealth to buy private capital. The only way in which these new markets can help the poor is if they somehow reduce the mass of people constrained to the public sector $(G^{***}(k'))$, perhaps through increased efficiency and reduced failure rates in the private sector.

Figure 5 below illustrates the results from the last three propositions. The expected end-of-period incomes are plotted on the upper panel, while expected marginal products are plotted in the bottom panel. For agents with wealth between 0 and k', incomes are given by the line segment AB, along the ω + w line. When wealth reaches k', agents become able to invest in the risky (but more profitable) private sector production function. There is a discontinuity in the income function, and agents with wealth between k' and w* earn incomes along the curve CD. At D, the marginal product of private capital (k) equals $ra^a(1-a)^{1-a}$, and hence the marginal product of public capital (g). With private markets for g_p available, as in G^{***}, agents with wealth greater than w* share their wealth between k and g_p, so as to keep producing at the optimal input ratio k/g = (1-a)/a, and hence their incomes are plotted along DE, until w_{uu}, the upper bound of their ergodic set.[19]

In the pre-market-opening-reform equilibrium distribution G*, agents could not top up the government transfers of g privately, so that they kept purchasing k until its expected marginal product fell below 1, the return to simply storing wealth. This happened at w_c, so that middle-class expected incomes were then plotted along the arc CF. At F, agents became saver/storers, in addition to the amount w_c they invested in the private sector. Their incomes were then plotted along FG. To understand propositions 5 and 6, note that

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[19] Note that k, rather than w, is on the x-axis. Beyond, w*, the amount of k purchased by agents (γw), which yields E(y) along DE, is strictly less than w. This is why, although DE is a line with slope greater than one, there nevertheless exists an upper bound to the ergodic distribution. At w_{uu} so much of w is spent on g_p that the bequest left of the successful person's income is only the same as w_{uu}.

the curve CD is common to both income functions (whether under G* or G***). This is the part of the middle class which remains middle class after the reforms, by virtue of not being sufficiently rich to purchase privately supplied public capital. Above point D, expected incomes are unambiguously greater in the post-reform equilibrium (DE lies everywhere above DFG).

Figure 5
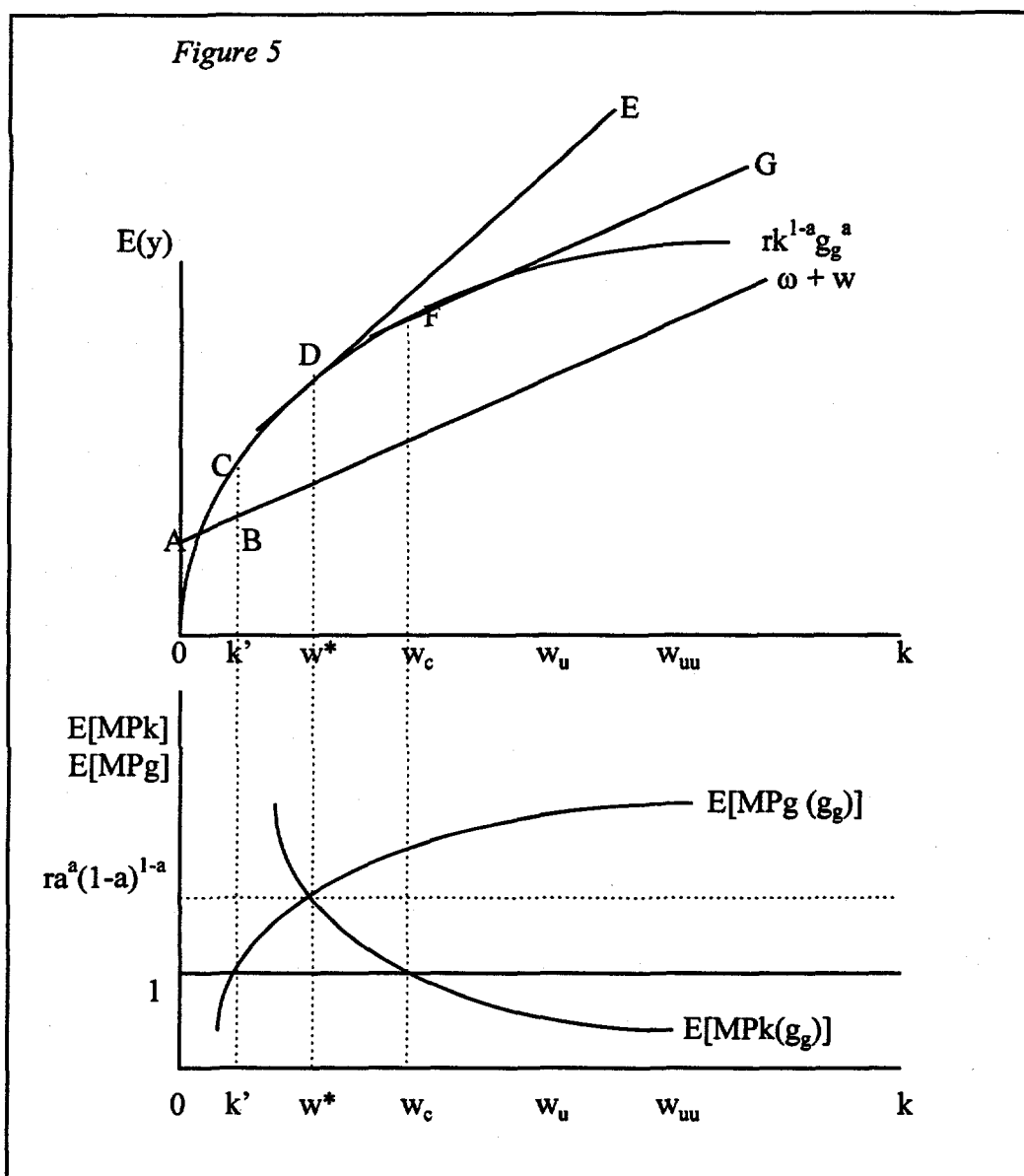
Proposition 5 refers to the case when the mass of people with wealth below k' in the limiting distribution is lower in G*** than in the pre-reform equilibrium G*. Then, the public sector wage rate ω rises, shifting the AB segment up. In that case, it is easy to see that no expected incomes in the post reform situation are lower than in the pre-reform situation, for the same initial wealth level. This is what generates the unambiguous increase in (expected) welfare described in Proposition 5. Inequality may or may not have risen, depending on how much ω rose by, compared to gains above w*.

Proposition 6, on the other hand, refers to the case when the mass of people with wealth below k' in the limiting distribution is greater in G*** than in the pre-reform equilibrium G*. Then, the public sector wage rate ω falls, shifting the AB segment down. In that case, incomes for the poorest class are lower in the post-reform equilibrium than before; expected incomes for the (remaining) middle class are unchanged; and expected incomes for the (enlarged) upper class are greater. Inequality between the classes rises unambiguously.

The overall message from this section is that the creation of private markets for public capital (e.g. education, health care, some infrastructure, telecommunications), which enables investors to top up public provision by allocating resources to private purchases of these services, contributes to economic efficiency but has ambiguous effects on welfare. Efficiency gains are clear: even if public sector wages fall, public sector output is unchanged, and there are always gains in the private sector. As for the distribution of these gains, propositions 5 and 6 reveal that, while richer agents always gain, poorer workers may either gain or lose, depending on what happens to public sector employment. If their incomes decline, inequality in expected incomes will be unambiguously higher in the post-reform long-run equilibrium. Even if their incomes rise, but by proportionately less than those of the rich, some measures of inequality will indicate an increase. This is an example of the sort of policy reform likely to lead to more efficient, but also more unequal, societies in the long run.

5. *Returns to Skills and Volatility in the Labour Market.*

We have so far focused on the differential impacts of reforms - such as privatization or market openings - on social classes characterized by their different occupational choices. The model shed light on the mechanisms through which these transformations affected people differently, depending on whether they worked for a safe but inefficient public sector, or risked it out on their own as entrepreneurs in the new private sector. Within that sector it was argued that, under plausible assumptions about the interaction between public and private capital in the production function, expected returns differed depending on whether one's wealth level allowed for purchases of privately provided education and health care, say. The analysis of the model suggested circumstances under which efficiency-augmenting policies, such as privatization or creating new markets, might lead to increased inequality (and in some cases poverty), through lowering the incomes of those unable to enter the private sector, or through increasing the incomes of the wealthiest segment of the population disproportionately.

One important omission from this stylized model has been any treatment of the emerging private sector labour market. Naturally, our treatment of the private sector as consisting of atomistic household-firms should not be taken too literally; k can be interpreted as private human capital and returns θrk could be seen as a wage rate which is linear in human capital and subject to random employment shocks. Nevertheless, the focus of the foregoing analysis was indeed on private physical wealth and its effect on broad occupational choices and incomes, rather than on human capital and skills. This has meant that we have largely ignored a third and important potential source of increased inequality in economies in transition, namely an increase in the dispersion of labour earnings due to changes in the pattern of returns to skills.

In particular, two changes are likely to have taken place in the earnings structure in these economies: an increase in the returns to education at all levels of schooling, as the artificially compressed wage structure under central planning is replaced by market pricing for different types of labour; and an increase in the volatility of (real) pay, reflecting reduced security in employment, greater risks of business failure, unpredictable rates of inflation, etc. Both of these changes, which are essentially inherent in the greater flexibility required of a functioning labour market, can lead to increased earnings inequality even if there is no change at all in the underlying distribution of skills. Consider the standard earnings functions often estimated in empirical studies of the labour market:

$$\log y_{it} = \underline{\beta_t} \cdot \underline{\log x_{it}} + \varepsilon_{it} \tag{16}$$

where y_{it} denotes the earnings of individual i in period t; x is a vector of individual characteristics, such as years of schooling, years of experience, gender, race, etc; ε is a stochastic term; and the parameter β_i in vector β can be interpreted as the "earnings elasticity" of characteristic x_i, providing some indication of its labour market return.

In order to focus more narrowly on returns to skills, suppose the true earnings determination model in our transition economy is given simply by:

$$\log y_{it} = \beta_t \log s_{it} + \log \theta_{it} \tag{17}$$

where s_{it} denotes some measure of the level of skills[20] embodied in individual i at time t, and $\varepsilon_i = \log \theta_i \sim$ i.d. $N\left(0, \sigma_{\theta t}^2\right)$. Let us also assume that this transitional society is characterized by a lognormal distribution of skills, so that $\log s_i \sim N\left(\mu_s, \sigma_s^2\right)$. Let $\log \theta$ and $\log s$ be distributed independently of any current or lagged value of each other. $\log \theta$ is also distributed independently of its own lagged values, but need not be identically distributed over time. β is a constant across individuals i, and is determined exogenously at each time t.

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[20] This could be a standard proxy such as years of formal schooling, or a more complex indicator, incorporating years of experience and/or quality adjustments.

Equation (17) can then be rewritten as $y_{it} = \theta_{it} s_{it}^{\beta}$, with $s \sim LN(\mu_s, \sigma_s^2)$ and $\theta \sim LN(0, \sigma_{\theta t}^2)$. Being the product of two lognormals, it follows that earnings are also distributed lognormally, as follows:

$$y_{it} \sim LN\left(\beta_t \mu_s, \beta_t^2 \sigma_s^2 + \sigma_{\theta t}^2\right) \tag{18}$$

It is then immediate to see how the two transformations discussed above impact the distribution. First, an increase in the education elasticity of earnings β (the 'returns to education') will raise both the mean and the dispersion of the earnings distribution. Mean earnings rise, since the return on the mean level of education has risen. But a rise in β will also increase the variance of the lognormal distribution of earnings, even if there has been no change in the variance of the underlying distribution of skills (σ_s^2). As one would expect, the move from a compressed earnings-education profile under central planning to a steeper one in a freer labour market contributes to a further skewing of the earnings distribution.

A second mechanism through which transition to a freer labour market may lead to increases in the dispersion of the earnings distribution is a decline in the 'security' of an individual's earnings, arising from an increase in volatility. There is some riskiness associated with one's earnings under any situation, which is embodied in the stochastic term ε_{it} in equation (16) (or θ_{it} in equation 17). This term captures shocks such as illnesses, unemployment, bankruptcy of one's employers, bad weather, poor harvests, recessions, etc. It is reasonable to suppose that the variance of these shocks, $\sigma_{\theta t}^2$, is higher in a market economy than under central planning. In the former, unemployment is more widespread; earnings are more responsive to macroeconomic shocks; firms go bankrupt (and start up) more often; business deals fail astoundingly (or succeed explosively) more often than in the latter. Greater efficiency comes at the cost of greater volatility, higher risk. Ceteris paribus, a higher variance for the stochastic term $\sigma_{\theta t}^2$ means a greater variance for the earnings distribution. Combined with an increase in the returns to

education (β), this suggests that the transformations in the structure of earnings likely to be associated with the labour market transition from central planning will lead to an increase in the dispersion of the distribution of earnings. This adds another mechanism to those considered in Sections 3 and 4, through which economic reforms associated with the process of economic transition can increase income inequality, despite their beneficial (long-term) effects on efficiency.

6. Conclusions.

This paper investigates ways in which some of the economic transformations associated with transition from central planning to a market system affect the distribution of income. Most of the analysis relies on a dynamic model of wealth distribution and occupational choice, in which agents choose between working for a deterministic wage in a (relatively inefficient) public sector and being entrepreneurs in a risky private sector, where the probability of success increases with the availability of public capital. Credit markets are assumed to be (extremely) imperfect, and there is a minimum scale of production required for participation in the private sector. The model yields a steady-state wealth distribution in which the poorest agents are unable to invest in the private sector, and are constrained to safe but low-paying public sector employment. Richer agents invest in the new, risky private sector and can be further divided between a middle-class, where people exhaust their initial wealth in production, and an upper class, where some wealth is (risklessly) stored, in addition to the private sector investments.

The effects of a privatization of some of the government's productive assets on the expected incomes of households differ along this wealth distribution. As a result, even if privatization is designed to be equitable, with assets uniformly distributed through vouchers amongst the population, it turns out that inequality may rise both in the short and in the long run. In the short run, the middle and upper classes stand to gain unambiguously, since they are able to channel the extra capital they receive from the

government into their own private production functions, increasing their expected returns. The impact on the welfare of the poor is more complex, since the privatization is likely to affect the public sector wage rate, from which they derive most of their incomes. If wages are set to equal the public sector average product of labour, a reduction in its capital stock which exceeds any reduction in public employment will lower the wage, and this effect may be sufficient to outweigh short-term gains from the receipt of a privatization voucher. If barriers to entry into the new private sector are large, and privatization fails to move a substantial number of public employees to alternative, more productive occupations, then the decline in the public sector wage rate will lead to greater inequality and deeper poverty in the transition economy. If the transfer of labour to alternative occupations outside the public sector continues to be insufficient in the long run, so that the new equilibrium is characterized by a government which has lost more capital than it has shed workers, it is likely that the new steady-state will also be characterized by greater inequality and poverty (for at least some poverty lines).

Another transformation which is likely to increase economic efficiency but also lead to greater inequality is the creation of markets where private sector entrepreneurs can buy and sell substitutes to 'public capital' goods, such as education and health services, toll roads, etc. Whilst this transformation will not hurt the poor - unless it somehow leads to an increase in public sector employment - it is very likely to benefit the rich much more than the poor. This is because only richer agents will find it worthwhile to channel their private resources to pay for extra (or better) schools, health insurance and cellular telecommunications, rather than investing it in straight-forward private capital. As a result, though, the expected returns from their investments rise, and the distance between their incomes and those of the remaining middle class and the poor increases. Once again, the increase in inequality will be the smaller, the greater the impact of the reform in terms of enabling people to escape public employment into a more productive private sector occupation.

Finally, substantial changes taking place in the labour market are certain to affect the distribution of final incomes in transition economies. While we did not model the private sector labour market explicitly, a simple earnings equation was used to suggest that an increase in the slope of the earnings-education profile - due presumably to a "decompression" of the wage structure prevalent under central planning - will increase the dispersion of the earnings distribution, even if the underlying distribution of skills has not changed. This effect may be compounded by an increase in the volatility of earnings, due perhaps to greater risks of unemployment or business failures in a market economy. A greater variance in the probability distribution of any such random shock will also increase the variance in the cross-section distribution of earnings.

Overall, the analysis illustrated a number of specific mechanisms through which policies and developments which increase economic efficiency (measured by equilibrium economy-wide output) are likely to lead to greater inequality and, in some cases, higher poverty. These results may attain even in the long run, with new limiting (steady-state) distributions characterized by greater inequality than prior to the transition. Whenever the incomes accruing to the poor actually decline, while average incomes rise, there is a classic equity-efficiency trade-off. In those cases, greater efficiency does not automatically imply higher social welfare, and policy implications depend on a normative judgement.

Given how inefficient systems based on state ownership and central planning turned out to be, the question will almost certainly not be whether these efficiency-augmenting reforms should take place, but how. The general lesson that can be derived from this paper is that - since economic reform takes place in the context of an existing non-degenerate wealth distribution, and with incomplete and imperfect markets - explicit attention should be paid to equity objectives. Greater efficiency is not sufficient to imply higher social welfare. In particular, reformers should seek to ensure three things: that the state continues to produce goods and services in which market failures outweigh government failures - such as law and order, primary education, basic health care, rural

infrastructure - and which are in many cases indispensable to a successful private sector; that new profitable opportunities in the private sector are available to poor people too, enabling them to leave the inefficient segments of the old public sector and to benefit from the greater prosperity to be achieved elsewhere; and that provisions exist to protect minimum standards of welfare for the poorest people. The ergodic nature of this model's limiting distribution is a reminder that, over the long-run, all lineages face a positive probability of finding themselves among the poor, and thus benefit from whatever safety nets have been put in place to provide them with a minimum income and a chance for subsequent upward mobility. The market economy is an inherently risky system; by replacing the public sector employer of last resort with suitable alternative safety nets, today's reformers may be looking after the welfare of their grandchildren's children.

Appendix.

Proof of Lemma 1: By contradiction. Suppose $E[MPk(w_u)] \geq 1$. Then the third class defined in proposition 1 would not exist, since all agents in the ergodic distribution would invest all their initial wealth in production function (2). Then, rather than setting $w_{t+1} = w_t$ in $w_{t+1} = (1-\alpha)(1-\tau)[rw_c + (w_t - w_c)]$, which yields (10), we would search for an upper bound by setting $w_{t+1} = w_t$ in $w_{t+1} = (1-\alpha)(1-\tau)[rw_t]$, the only solution to which is $w = 0$, implying the inexistence of an ergodic set. If an ergodic set exists, its upper bound exceeds any wealth level such that $E[MPk(w)] \geq 1$. Since $\dfrac{\partial E[MPk]}{\partial k} < 0$, $\forall k$, it follows that $E[MPk(w_u)] < 1$. ∎

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