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Abhijit V. Banerjee and Andrew F. Newman

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A Dual-Economy Model of Modernization and Development*

Abhijit V. Banerjee† and Andrew F. Newman‡

Abstract

The purpose of this paper is to formally model the interaction between economic growth and the process of institutional modernization which frequently goes with it. We model an economy with a modern sector, where productivity is high but agents have little information about each other, and a traditional sector where productivity is low but agents know a lot about each other. Consequently, agency costs in the modern sector make insurance against idiosyncratic shocks difficult, while such insurance is readily obtainable in the traditional sector. Because of the resulting tradeoff between insurance and productivity, not everyone will move to the modern sector: the richest and most productive, as well perhaps as the poorest and least productive agents are more likely to move to the modern sector than are the intermediate ones. We also show that the laissez-faire level of modernization may be too low in the sense of not maximizing net social surplus; whether this occurs depends in part on the distribution of wealth. In a dynamic version of the model, the rate of modernization of the economy may be too slow, and it is possible that the economy gets stuck in

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a trap and never fully modernizes. The dynamics of movement between the sectors also leads to well-defined dynamic relations between average income and inequality. We find that although the Kuznets inverted-U curve may arise, it is equally likely that the relationship between inequality and income follows other patterns, including an upright U.

1. Introduction

The process by which an underdeveloped economy transforms itself into a developed one involves more than just a rise in living standards. It usually brings about substantial changes in the way people conduct their entire lives — their social relations, their levels of urbanization and commercialization, even their political roles. In this paper we look at the relation between this process of institutional change — often called modernization — and the process of economic change that seems to go with it.

We take the view that these processes are not independent; nor is modernization merely a product of economic growth. Rather they are autonomous processes which interact with each other and can, under different circumstances, either promote or retard each other. While this position is not entirely uncontroversial, there is now a sufficiently impressive body of evidence in support of this point of view to warrant its exploration in a formal model.[1]

We study an economy consisting of two sectors which are distinguished in two ways: technological and institutional . One sector has a more modern technology, and is therefore more productive, but people live and work in different places and are essentially anonymous — the information they have about each other is poor. By contrast, the other sector is more traditional: the technology is less productive, but because people live and work together, they know a lot about what is going on in the lives of their neighbors.

This difference in the degree of information asymmetry is important because people in the economy are subject to idiosyncratic risk and need insurance in the form of emergency consumption loans. Loan transactions are subject to default by the borrower and as a result, lenders are reluctant to lend to those who cannot provide a significant amount of collateral. The superior information in the traditional sector allows lenders to monitor borrowers better; as a result, each

[1] Among economic historians this line of argument has been developed by North and Thomas [16], Mokyr [15] and Rosenberg and Birdzell [18], among others. See also Baumol [5]. Among political historians see, for example, the work of Putnam[17].

individual borrower gets as good or better insurance than he would be able to get in the modern sector. This sets up a trade-off between the superior insurance in the traditional sector and the higher productivity in the modern sector. It follows that some of the population will fail to migrate to the more productive sector, even long after the opportunity to move becomes available.

The first result in the paper identifies those who have the most incentive to leave the traditional sector and work in the modern sector. They are the wealthiest, the most productive and possibly, the poorest and least productive. This should accord with intuition: the wealthy leave because they can self-insure and do not value insurance, the most productive leave because they have much to gain and the poorest and least productive leave because they have nothing to lose — they cannot get insurance in either location.

A second result, which is implicit in the first, is that more people will move to the modern sector when the interest rate is either very low (at low interest rates the temptation to default is weak and therefore the advantage from being able to monitor better is more limited) or very high (no one can afford to take out a consumption loan).

Our third result says that the equilibrium rate of movement out of the traditional sector may be lower than the socially optimal rate (where social welfare is measured by net social surplus).[2] This is because as long as there are a lot of people in the traditional sector, the market for consumption loans works relatively well (because the quality of information is high). This allows the lenders to charge a higher rate of interest on these loans than they would be able to charge if the market worked less well. But given that the market rate of interest is high,[3] a lot of people may be reluctant to leave the traditional sector. Therefore this kind of a situation can be an equilibrium. Now suppose that everyone in the traditional sector was forced to move to the modern sector. Because of the lower quality of information, there will be fewer people who are good credit risks from the point of view of the lenders. Competition for these people will drive the interest down to the point where more and more people will be able to get consumption loans even in the modern sector. Therefore the number of people who, in equilibrium, get consumption loans may not shrink (or shrink very much) while the number of people who are working in the more productive sector goes up by a lot. Therefore the social surplus must be larger in the new situation.

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[2]Williamson [25] surveys the evidence on whether the rate of migration to the modern sector is optimal and argues that there is at the very least no clear evidence of over-migration.

[3]But not too high (see the discussion in the previous paragraph).

This 'inefficiency' result provides a formal statement of what it can mean for modernization to be too slow. It reflects the general principle that in information constrained economies, the market equilibrium may not be surplus maximizing. [4] Moreover, in order to keep the model simple we have left out the important but well-understood effects of congestion in the modern sector; these effects typically result in the equilibrium rate of modernization being too high rather than too low. Thus, the inefficiency result should be viewed less as a guide to policy and more as a illustration of the general point that an institution that appears to work well (in this instance, the system of lending in the traditional sector) may actually end up hurting the people it appears to be helping (the people who stay in the traditional sector in order to get the consumption loans) once one takes into account general equilibrium effects.

We go on to try to characterize the set of economies where this kind of inefficiently slow modernization is likely to emerge. We show is that it is less likely both in very poor and very inegalitarian economies and in very rich economies than in the intermediate range of economies.

Turning next to dynamics, we observe that our model builds in a two-way interaction between the process of growth and the process of institutional change. On one side, the rate of growth in this economy depends on how many people take advantage of the new technology and is therefore constrained by the institutional difference between the traditional sector and the modern sector. Conversely, the long run survival of the traditional institutions depends on the rate of growth. This is because the price of insurance loans (i.e. the rate of interest) depends on the supply of capital: as the economy grows, capital becomes abundant and the price of loans in both sectors falls. Since falling interest rates reduce agency costs in the modern sector, the comparative advantage of the traditional sector in the provision of insurance is diminished, and people are further encouraged to emigrate to the modern sector.

The dynamics of our model are in principle quite complex, and we provide only a partial characterization. Nonetheless, we are able to provide conditions under which the economy fully modernizes in the sense that the traditional sector vanishes. We can also show that full modernization is not inevitable — an economy can partially modernize and then stop.

We also look at the income distribution implications of the process of modernization. Forty years ago, Kuznets [13] concluded on the basis of a study of the

[4] On the other hand, we have not established that the equilibrium is inefficient in the Pareto sense — indeed, our conjecture is that it is constrained Pareto efficient.

process of modernization in a number of then-developed countries that the initial impact of modernization was to increase inequality but that over time, inequality would decrease as the economy approached full modernization. This prediction for the pattern of evolution of inequality is what is known as the Kuznets inverted U-hypothesis and has been the subject of many empirical studies and much controversy in the development literature (e.g. [1], [9], [10], [25]). The favorite explanation for why such a pattern should emerge seems to be based on the shifting of the population from a low wage sector to a high wage one; thus a model such as ours is a natural place to ask whether there are indeed robust theoretical underpinnings for the inverted-U hypothesis.

We show that in one case the predictions of our model correspond exactly to the Kuznets hypothesis. But this result is very sensitive to assumptions about self-selection in the decision to move to the modern sector. By altering these assumptions in seemingly inconsequential ways, we are able to generate a range of patterns for the evolution of the income distribution, including one in which inequality decreases, then increases during the course of modernization, in effect turning Kuznets on his head. This might explain why some countries seem to follow the Kuznets pattern, while others do not.

Our results are clearly driven by the specific assumptions we make. The basic premise that the traditional sector provides surprisingly good insurance is supported by studies of consumption smoothing ([22], [23]). A number of recent papers have also argued that the remarkable success of certain traditional sector institutions (such as Grammeen banks in Bangladesh and the 19th century German credit cooperatives) derive from the high quality of information that people in the traditional sector have about each other ([21], [24], [3]). There is also a lot of evidence that idiosyncratic risks are very important, at least in traditional agriculture.[5] The relative anonymity of life in the modern sector is all too familiar to require proof. Finally the one survey of people's motives for remaining in traditional sector that we are aware of ([7]), finds that access to informal security mechanisms is the main reason why people do not move.

Of course all of this cannot really *prove* that the story we tell is right. Certainly the assumption that we have been implicitly making, that once one starts working in the modern sector one is completely cut off from the traditional sector, is an exaggeration of how things really work. A number of studies have stressed the fact that one remains closely connected to the family or even the extended family, long

[5]See Townsend [22] to get some sense of the size of the risks faced by villagers in semi-arid parts of India.

after one has physically moved to the modern sector. At the same time, however, there is also evidence of conflict and moral hazard between those who have moved and those who remain.[6] A variant of our assumption that would therefore be closer to the truth is that one retains imperfect access to the security mechanisms of the traditional sector for some time after one has moved. We believe that our qualitative results are robust to this kind of change in assumptions.[7]

Our work follows on a tradition in development economics of studying modernization which goes back to the work Arthur Lewis [14]. Our two-sector economy is a dual economy in the sense of Lewis and the question we ask about the determinants of the rate of modernization and whether the rate of modernization is optimal, are very much the questions Lewis asked in his classic paper more than 40 years ago. Our work departs from the work of Lewis and others in this tradition[8], in not assuming a difference in the nature of economic rationality between the two sectors.[9] Our agents are equally rational wherever they are - the differences between the two sectors are technological and informational.

Finally, a remark about interpretation — we model the actual act of moving to the modern sector as an act of migration from the rural sector to the urban sector. The words, rural and traditional, urban and modern and migration and modernization will be used interchangeably in the paper. This is done partly to give a specific content to the idea of modernization and partly because migration is one very important channel through which modernization takes place. Nevertheless

[6] Stark [20] using data from Botswana has argued that the fact that remittances from urban immigrants to their families based in rural areas rises with the migrant's income is evidence for a coopertaive outcome within the family. However, the same result would also obtain if there was moral hazard within the family which was *partly mitigated* by the repeated-game considerations that Stark has empahasized. Williamson [25] surveying the evidence on remittances from migrants to their families suggests that there is some evidence which supports high default rates among migrants and concludes that the amount of control the family has over those who migrated is an open empirical question.

[7] As they are to the observation that migration can provide a degree of insurance against village-level *aggregate* risk by diversifying the family's income. This benefit of migration works in essentially the same way as the productivity boost, and in any case des not gainsay the fact that migration has costs in the form of lost idiosyncratic insurance.

[8] See for example Fei and Ranis [8], Harris and Todaro [11] and Sen[19].

[9] Lewis, for example, assumed that members of a family farm are always paid their average product as long as they remain on the farm but are not paid once they leave. This is obviously not the optimal contract for the family farm since it discourages people from leaving even though they would be more productive elsewhere. There is now substantial evidence that the family farm does act as an economically rational unit when it takes migration decisions, which puts into question this assumption.[6]

we want to emphasize that this is only one interpretation of the model; nothing in the model requires that the move from the traditional sector to the modern sector should involve physical displacement. Indeed, as has often been noted, in some developing countries, migrants to cities often reproduce the social networks formerly located in their villages. But membership in a network is costly, and full engagement in the modern sector typically requires participation in different networks or in a high degree of mobility (the latter is often cited as a source of the modern sector's higher productivity) which makes the maintenance of close social ties impossible. The point is that the patterns of income and inequality generated by our model may be valid even if they do not manifest themselves in the patterns of migration: everyone might move from village to city, but the economy will still be slow to modernize.

2. The Model

To make these ideas precise we consider a simple model with just two possible locations — a single village representing the traditional sector and a single city representing the modern one. The economy has a single storable consumption good which may also be as capital. The biography of a typical individual goes as follows. At the beginning of his life, an individual receives an inheritance from his parent, who bequeaths a portion β of his income. With this initial wealth a in hand, the child makes his location choice, which has no direct cost — labor is freely mobile. In his youth, before entering his productive phase, the individual has a chance q of suffering a utility loss s which may be offset by consuming $m < s$ units of the good (think of illness and cure); without the loss, extra consumption at this phase of life yields no utility. Finally, in adulthood, the individual earns his income from labor, which he supplies inelastically. The von Neumann-Morgenstern preferences have the form $y - ql$, (so the agent is risk-neutral in income y), and l denotes the utility loss from illness, which is either s if m is not consumed, or 0 if it is.

The first crucial assumption is that productivity is higher in the city than in the village. We model this by assuming that an individual who can earn w in his village could earn λw in the city, where $\lambda > 1$. In a first-best world, where information was not at issue, everyone could borrow and lend at the market gross interest rate r (the only reason to borrow would be to finance the medicine). Thus every individual would move to the city, purchase the medicine at a price r, enjoy a utility of $\lambda w + (a - qm)r$,[10] and the economy would operate efficiently.

But this is not a first-best world, and this fact affects the workings of the market for consumption loans. We assume that capital is freely mobile between the two locations. What is not mobile is information and enforcement powers. The consumption loan/insurance market is distinguished by the possibility that a borrower might renege on a debt.[11] To abstract from bankruptcy issues, assume for the moment that labor income is high enough to ensure that borrowers can afford repayment. Suppose an agent puts up all of his wealth a (the maximum he can provide) as collateral and borrows an amount L. When it comes time to repay the loan, he may attempt to avoid his obligations by fleeing from the purview of the lender and disappearing into the urban crowds, albeit at the cost of lost collateral ar. The borrower succeeds in escaping attempts at recovering the loan with probability π, in which case he enjoys a net income of y, having avoided paying Lr; with probability $1-\pi$ he is caught before he has a chance to dispose of his income and a maximal punishment is imposed which holds his lifetime income to zero. Reneging therefore yields a payoff of πy, while repaying yields $y - Lr + ar$; the borrower will renege whenever $(1-\pi)y + ar < Lr$. Knowing this, lenders will only make loans that satisfy $(1-\pi)y + ar \geq Lr$. All loans made in equilibrium will satisfy this constraint, and the borrower will never renege.

Since the agent needs exactly m to recover from illness and qm to cover an insurance premium that will cover this need, his initial wealth must satisfy $a \geq qm - (1-\pi)y/r$ if he is to borrow at all; if his wealth is below this threshold value, he will be unable to pay for the medication. Observe that this threshold value of wealth is increasing in the interest rate, decreasing in income, and increasing in the escape probability π; this simple, if perhaps extreme, model of an imperfect loan market accords in its conclusions with those of other agency models.

We now use this model to distinguish the informational advantage of the village over the city. Specifically, we make the extreme assumption that escape is impossible *if one is born and remains* in the village; any attempt to escape would immediately be detected by the local network or village moneylender. Hence, $\pi = 0$ there, and the threshold wealth is $qm - w/r \equiv a_V(w,r)$: as long as the individual's wage in the village exceeds qmr, she can borrow and insure against

[10]Since illness only occurs with probability q, this expression can be interpreted as saying either that with probability q, the agent buys m, or that he pays qm before he knows his health, receiving m only if he is sick. Below, these interpretations will not be equivalent, and we shall prefer the latter.

[11]This model of an imperfect loan market is very similar to that studied by Kehoe-Levine [12] and Banerjee-Newman [4].

illness. If however, one locates in the city (either by choice or by birth), π is large in the sense that $\lambda(1-\pi) < 1$; thus, $a_C(w,r) \equiv qm - (1-\pi)\lambda w/r > a_V(w,r)$ for all w and r.[12]

This market imperfection is the source of the possibility of undermigration: an individual whose wealth lies between the threshold values $a_C(w,r)$ and $a_V(w,r)$ would indeed gain a higher wage by migrating, but would be giving up the possibility of insuring himself. (Note that it is never socially or individually optimal for someone born in the city to move to the country, because he faces the same value of π but earns a lower income.) It remains to see whether this possibility is compatible with competitive equilibrium.

3. Static Equilibrium

Normalize the population of adults in the world in any period to be of Lebesgue measure 1. Denote by $R(a)$ the measure of people born in the village with wealth less than a at the beginning of the period. Denote by $U(a)$ the corresponding measure in the city.

Let us now consider the choice problem faced by the those who grew up in the rural sector. Given an interest rate r, an agent with $a \geq a_C(w,r)$ has a payoff of $w - qmr + ar$ if he stays in the village and $\lambda w - qmr + ar$ if he moves to the city, so he clearly will migrate. If his wealth is less than $a_V(w,r)$, he will also migrate because he doesn't get insurance in either location and so takes the higher urban wage. An agent with wealth between $a_C(w,r)$ and $a_V(w,r)$ however, will migrate only if $w - qmr + ar \leq \lambda w - qs + ar$, i.e. if $r \geq \frac{s}{m} - \frac{(\lambda-1)w}{qm} \equiv \hat{r}(w)$. What this tells us is that migration will tend to be carried out by the relatively wealthy and by those for whom the market interest rate exceeds $\hat{r}(w)$; since this is a decreasing function of w, it is those with the highest incomes (e.g. the most skilled) who will migrate. Finally, very poor low-skilled people may also migrate — this requires that their skill levels are low enough to make $a_V(w,r)$ positive; if not, even agents with zero wealth will be able to borrow for insurance and will remain in the village.

[12]Notice that we could as well assume that reneging occurs *before* income is earned. Thus, anyone who reneged would presumably escape to the city and obtain the urban wage. With $\pi = 0$ in the village, this does not change the expression for $a_V(w,r)$; more generally, it would slightly diminish the advantage of remaining in the village (by raising $a_V(w,r)$), but would not change the qualitative nature of the analysis.

To summarize, we have

Proposition 3.1. *An agent born in the village with wealth a and who earns w there migrates to the city when the interest rate is r only if (a) $a \geq a_C(w,r)$ or (b) $r \geq \hat{r}(w)$ or (c) $a < a_V(w,r)$.*

As we have already noted, those who grew up in the urban sector never have reason to migrate to the village. See Figure 1 ($\hat{w}(r)$ is the inverse of $\hat{r}(w)$, i.e. the income level at which an agent is indifferent between staying in the village with insurance and moving to the city without it).

Given this proposition, the supply and demand for loans can be characterized very simply. For the remainder of this section we assume that everyone earns the same income (equivalently, we may assume that no one learns his income, which is independent of initial wealth, until after he has made his location decision, while the opportunity to renege occurs after locating but before income is earned — this will be the preferred interpretation in the first two parts of the next section), so that agents only differ in initial wealth; thus we might as well write $a_C(r)$ and $a_V(r)$ for $a_C(w,r)$ and $a_V(w,r)$ evaluated at this common value of w, and $\hat{r}$ for $\hat{r}(w)$. All of those with wealth above $a_C(r)$ demand loans, as do those with wealth less than $a_C(r)$ who remain in the village. If the interest rate is greater than $\hat{r}$, everyone migrates, so the demand for loans is $qm[1-R(a_C(r))-U(a_C(r))]$, which is decreasing (at $r = \frac{s}{m}$, the demand is the interval $[0, qm[1-R(a_C(\frac{s}{m}))-U(a_C(\frac{s}{m}))]]$). At $\hat{r}$, those villagers with wealth below $a_C(\hat{r})$ but above $a_V(\hat{r})$ are indifferent between the two locations, so the demand becomes an interval $[qm[1-R(a_C(\hat{r}))-U(a_C(\hat{r}))], qm[1-R(a_V(\hat{r}))-U(a_C(\hat{r}))]]$; as r declines further demand becomes $qm[1-R(a_V(r))-U(a_C(r))]$, eventually reaching its maximum value of qm. Supply is simply the aggregate wealth $\bar{a}$. Thus equilibrium, if it exists, is generically unique.[13] It is straightforward to check that the maximum equilibrium gross interest rate is s/m, while because the good is storable, the minimum is 1.

Figure 2 illustrates the situation. Also shown are the demand functions which would result in the first-best case without information problems (this is also the demand function for a pure village economy in which there was no urban sector

[13]Existence is guaranteed if $R(\cdot)$ and $U(\cdot)$ are continuous. With such distribution functions, the only case of nonuniqueness occurs when $\bar{a} = qm$, in which case we focus on the equilibrium in which $r = 1$, which is the one that maximizes the level of migration and social surplus.

to migrate to), and the demand from a pure urban economy (say one in which everyone was forced to move to the city).

We can now check whether the equilibrium level of migration is efficient in the sense of making full use of the existing supply of resources. In particular we shall ask whether social surplus could be increased relative to its equilibrium level by forcing agents to choose locations in some way other than the one which occurs in equilibrium.[14] Thus we shall not be concerned here with the possibility of increases in social surplus which might be obtained from interventions in the loan market or from tax and transfer schemes more generally. We should also note at this point that, as is often the case in economies in which incentives and wealth effects play a role, the potential surplus increases under discussion cannot typically be transformed into Pareto improvements.

On the face of it, we should expect that any situation where some agents remain in the rural sector is a candidate for inefficiency. To see this, note that labor in the rural sector is being used inefficiently. If a small number of people were moved to the urban sector, more income would be generated. This reduces the demand for loans however, but if the interest rate is able to fall, the capital that is no longer being used in the rural sector can flow to the city, clearing the market at a lower interest rate, as shown in Figure 2.[15]

The next step is to determine whether and under what conditions an inefficient equilibrium actually exists. Figure 3 illustrates the level of migration as a function of the equilibrium interest rate. Clearly a necessary condition for inefficiency is that the equilibrium r be no higher than $\hat{r}$. Since 1 is the lowest equilibrium value of r, a necessary condition for the existence of inefficient undermigration is

$$q(s-m) \geq (\lambda - 1)w. \tag{3.1}$$

This condition is quite plausible. If the productivity differential between village and city is large (λ is large), then the attraction of the city is enough to swamp the possible lack of insurance, and everyone migrates. By the same token, if the value of insurance is small (s is close to m), undermigration is unlikely, since poor people have little to lose by leaving their village.

[14]Surplus here is defined here as total output plus the net value of all insurance — thus the maximum surplus an economy with mean wage $\bar{w}$ and mean wealth $\bar{a}$ can generate is $\lambda\bar{w} + \bar{a}(s/m - 1)$.

[15]This does not say that the optimal allocation has everyone moving to the urban sector, since if the interest rate cannot fall enough, some of the wealth would be consumed rather than being used for insurance. This will be clarified below.

As is evident from Figure 2, the existence of inefficient undermigration depends in part on the mean level of wealth. But it also it depends on the higher moments of the wealth distribution. A complete characterization for continuous distributions of wealth is offered in the following

Proposition 3.2. *Suppose condition (3.1) holds and $R(\cdot)$ and $U(\cdot)$ are continuous. Then the level of migration is inefficient if and only if (a)* $1 - R(a_V(1)) - U(a_C(1)) > \dfrac{\bar{a}}{qm}$ *and (b)* $\dfrac{\bar{a}}{qm} > [1 - R(a_C(\hat{r})) - U(a_C(\hat{r}))]$.

Proof. First, suppose that conditions (a) and (b) hold. Condition (a) ensures that the equilibrium interest rate r^* is greater than one, while Condition (b) implies that at least some agents remain in the rural sector. There are now two cases. If $\dfrac{\bar{a}}{qm} \leq 1 - R(a_C(1)) - U(a_C(1))$, then moving all people to the urban sector raises output (because they are more productive) without changing the surplus from insurance, because the loan market will now clear at a new interest rate lower than r^*. Thus, surplus increases, and the original level of migration was inefficient. If instead $\dfrac{\bar{a}}{qm} > 1 - R(a_C(1)) - U(a_C(1))$, one can increase surplus by requiring $\dfrac{\bar{a}}{qm} - [1 - R(a_C(1)) - U(a_C(1))]$ agents with wealth less than $a_C(1)$ (this quantity is less than $R(a_C(1)) - R(a_V(1))$ by Condition (a)) to stay in the village and sending everyone else to the city; this clears the insurance market at $r = 1$ and increases output by increasing the number of people in the city.

Conversely, suppose that (a) fails to hold, i.e. that $r^* = 1$. Then moving anyone from the village to the city increases output, but they will now be unable to get a loan since the interest rate cannot fall (their wealth must be less than $a_C(1)$ or they already would have moved); by (3.1) this entails a net loss of surplus. If (b) fails, then as we have seen, everyone migrates, so equilibrium is efficient. ■

This proposition is the central result of this section. It helps to shed light on exactly what the rural institution is doing. Clearly, since in the initial equilibrium there are people who choose to remain in the traditional sector, they are paying less in interest in the traditional sector than they would in the modern sector (more precisely, they are getting loans there that they would not get in the modern sector). In other words, the rural credit institution does facilitate borrowing. On the other hand if they were moved to the modern sector the wealth they were using would not lay fallow. Somebody will end up using it and now it will be used in the more productive modern sector. The interest rate will fall to make this possible; in other words the rural credit institution creates inefficiency by allowing the interest rate to be set too high relative to its second-best level (it will typically be too *low* relative to its first-best level).

One special case deserves to be underscored. If the economy is wealthy in the sense that $\bar{a} \geq qm$, migration is always efficient (condition (a) is violated in this case). Since, as we have said, poor economies will tend to have efficient migration as well (although this is not necessary), it is the middling economies, where the villagers have something to lose but wealth is not yet so plentiful as to render the urban agency problems nugatory, that are the best candidates for inefficient undermigration.

Observe that the falling interest rate which results from a policy of forced migration will hurt net lenders (which may include very poor agents as well as the very wealthy); the beneficiaries would tend to be those at the middling wealth levels. But as we suggested before, it appears unlikely that there are taxes and transfers can turn the surplus increase into a Pareto improvement.

One possibility which we have not so far discussed is that of *overmigration,* according to many a major problem in many countries today. In the present model, overmigration exists when the aggregate wealth $\bar{a}$ is less than qm, but the loan market fails to clear, i.e. even at an interest rate of unity there is more wealth than is demanded for use as insurance. Now, while this won't be possible under laissez-faire (if $r = 1$, anyone who moved to the city who doesn't have a loan there would be better off staying in his village; the capital would flow to him there, and condition (3.1) implies he would be better off), it is possible that catastrophes such as the Bengal famine in the 1940's would have the effect of forcing sudden movement to the city with concomitant dissolution of the rural information networks. Suppose that the condition $\frac{\bar{a}}{qm} > 1 - R(a_C(1)) - U(a_C(1))$ mentioned in the proof of Proposition 3.2 holds. Then we would have a situation in which everyone (say) was in the city, but a fair amount of them (more than is necessary given the amount of wealth in the economy) were uninsured so that much of the economy's wealth would be "idle," i.e., consumed rather than used for insurance. Thus, while forced migration might have desirable consequences if there are not too many villagers who are poor (have wealth less than $a_C(1)$), the opposite may be true if there are too many of them; an optimum would then involve keeping some of those people in the rural sector.[16]

[16]The optimal allocations of people across sectors are the those used in the proof of Propo-

A different sort of possibility arises when we drop the assumption that wealth is free to flow between the village and the city. It has frequently been a concern in development contexts that capital formation is inhibited by its inability to flow across sectors. Policies have often been designed with a view toward encouraging intersectoral mobility of resources. Without going into details on the effects of closing the "national" capital market on the level of migration (it could be higher or lower, depending on parameters, but as in the case we have been considering, will generally not result in instantaneous full modernization), we will focus on what it says about the nature of the inefficiency in our model.

Supposing then that wealth cannot freely flow between sectors, the principal effect is that the argument for static inefficiency no longer applies: while forcing everyone into the modern sector would continue to result in increased output, the capital would no longer follow them to the city. Indeed, the forced migration would leave the city loan market unaffected; since those who were forced to migrate were better off in the village before, they will be worse off now (because interest rates don't adjust), so total surplus must decline.

This situation parallels the one in which life in the village has some consumption value that is unavailable in the city (scenery, for instance). In this standard hedonic pricing setting, agents locate in one sector or the other depending on their tastes for scenery; the resulting allocation is efficient. Thus, it is the ability of wealth to flow between the sectors that generates the static inefficiency in our model.[17]

But there is a difference between the case of wealth and that of scenery: next period's capital can effectively be brought to the city, while next period's scenery cannot. Once everyone is forced into the urban sector, they will generate more wealth for the ensuing period than they would have under laissez faire. Since capital market clearing within the urban sector entails that all of this wealth be used for insurance, surplus will be higher in the second period than it would be without forced migration. Therefore, when wealth cannot flow across the two sectors, the static economy is efficient, but the dynamic economy may remain inefficient.

Returning now to the case in which wealth does flow freely between village

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sition 2. Of course, this discussion presupposes that interventions in the loan market or direct redistributions of wealth are not possible.

[17]This is not to say that the laissez-faire surplus generated when capital can flow is smaller than it is when capital cannot (again, it can go either way). But in the former case, it is not as large as it could be, given the constraints on information and resource flow, while in the second case, it is.

and city, we summarize this section by noting that if the urban sector is suddenly opened to a very poor economy, there should be full migration (the interest rate is likely to be higher than $\hat{r}$). Only if the rural economy has a sufficiently high aggregate wealth is undermigration likely to be a problem. The degree of undermigration will depend not only on the aggregate level of wealth but also on its distribution. For instance, if the distribution is fairly inegalitarian while the mean is reasonably high, $R(a_C(\hat{r}))$ is likely to be large, so that it is quite easy for undermigration to occur. The general point to note is that distribution of wealth in the two sectors is the state variable which tells us, among other things, how many people migrate. Thus if we can generate an account of the dynamics of the wealth distribution, we will also have generated the rate of migration and modernization endogenously.

4. Some Rudimentary Dynamics

Our main interest is in the transitional dynamics of the economy. Specifically, starting with a purely rural economy, we wish to examine the level of migration and the distribution of labor earnings over time after the urban sector is opened. A full analysis of the global dynamics of the model is beyond the scope of this paper (this is partly for technical reasons — see [4]), so we limit ourselves to a few special cases which nevertheless illustrate how the migration dynamics can lead to a variety of patterns of the evolution of inequality.

In order to study the dynamics in the simplest possible way, we need to elaborate a bit on the timing and preferences used in the previous sections. Suppose that during an agent's life (that is in the course of one period) there are five dates. At date 0, the agent inherits his wealth; at date 1 he chooses his location and engages in the insurance contract (uncertainty about the utility loss is resolved at date 2) agents earn twice in their lifetimes, at dates 3 and 4, and also consume at those dates.

The agent consumes for the first time after earning a wage and repaying any loans (below we shall make assumptions to guarantee that repayments can be made out of a single date's earnings). He then earns the (same level) wage again and splits this income between consumption and a bequest to his child. Utility is

$$c_3 - ql + \alpha c_4^{1-\beta} b^{\beta},$$

where c_3 and c_4 are the consumption levels at dates 3 and 4; b is the bequest; $l = 0$ if the insurance is purchased, and s if it is not; and $\alpha < 1$. If the agent earns y at each date, then this yields the indirect utility $(1+\delta)y+ar-qmr$ (or $(1+\delta)y+ar-qs$ if he doesn't obtain the insurance loan) where $\delta \equiv \alpha\beta^{\beta}(1-\beta)^{1-\beta} < 1$.

Notice that with these preferences, income at date 3 yields greater utility than income at date 4. This introduces the possible need for a second consumption-loan market, distinct from the insurance-loan market: agents have an incentive to borrow against fourth-date earnings in order to consume at the third date. Equilibrium in this consumption-loan market would entail that the gross interest rate there be equal to $1/\delta$. One equilibrium allocation — the one we shall focus on exclusively — has each agent consuming date-3 earnings net of insurance repayments at date 3, and splitting date-4 earnings between date-4 consumption and the bequest; in particular, there is no borrowing and lending between dates. This is the unique symmetric allocation and the only one that would be compatible with even a slight imperfection in the consumption loan market.

Under these assumptions, the bequest, which is identical to the offspring's initial wealth, is equal to βy, provided that y is large enough to cover any loan repayments. This specification of preferences, earnings levels and the consumption loan market yields exactly the same one-period behavior that we saw in the previous sections, assuming that agents who are caught after reneging on loans are subject only to having their date-3 income confiscated, while their date-4 income is inappropriable.[18] Moreover, it greatly simplifies the analysis of the dynamics; in particular, the information contained in the distribution of wealth in each location is summarized by the single number R denoting the fraction of the population in the rural sector. Since our purpose is to illustrate the variety of possible dynamic behavior generated by migration (as distinct from wealth accumulation, which has been studied by many authors), rather than to make strong predictions, we feel justified in imposing this structure.

Finally, for what follows we need to distinguish between two alternative assumptions about when an agent's skill becomes known (to himself and the public alike). In one case, this information is not learned until date 3; in the second it is learned at date 0.

[18]If one assumes instead that *lifetime* income can be held to zero, the expressions for $a_C(r)$ and $a_V(r)$ become $qm-(1+\delta)(1-\pi)\lambda w/r$ and $qm-(1+\delta)w/r$; this is nearly inconsequential for the analysis but requires some cumbersome modification of notation.

4.1. Full Modernization and the Kuznets curve

Suppose first that agents learn their skill level *after* choosing a location (to be precise, at date 3), so that their decisions correspond to the one-wage case alluded to in Section 3. Let the distribution of skills (corresponding to village labor earnings) be $F(w)$, which is supported on a nondegenerate interval $[\underline{w}, \overline{w}]$ with density $f(w)$, mean $\bar{w}$, and variance σ^2. The distribution of earnings among those in the city is then $F(\frac{w}{\lambda})$.

In order to guarantee that agents repay loans out of date-3 earnings alone, we need to assume that $\underline{w} \geq qs$ (qs is the largest possible value of qmr, since $r \leq s/m$.) Notice that this implies that the fraction of villagers born with wealth less than $a_V(r)$ is always zero (the largest value of $a_V(\cdot)$ is $qm - \frac{\bar{w}}{s/m} \leq qm - \frac{\underline{w}}{s/m} \leq qm - \frac{qs}{s/m} = 0$): villagers can always insure. We are only interested in the case in which average wealth $\bar{a}$ is less than qm, since in the other case modernization is instantaneous. Thus we assume that β is small enough that $\beta\bar{w} < qm$.

For ease of computation, we use the coefficient of variation as an inequality measure. Suppose that in period t the population of the rural sector at the beginning of the period (i.e. *before* the location decisions) is R_t; then the urban population is $1 - R_t$. This will serve as the state variable; we don't need to consider any higher dimensional objects such as the wealth distribution: since an agent whose income realization is w and who remains in the village in period $t-1$ bequeaths βw to his child, the fraction of the rural population at the beginning of period t with wealth less than x is given by $R_t F(\frac{x}{\beta})$; the urban wealth distribution is just $(1 - R_t)F(\frac{x}{\lambda\beta})$.

The distribution of wages in the economy in period t is then given by $R_{t+1}F(w) + (1 - R_{t+1})F(\frac{w}{\lambda})$ (by our notational convention, R_{t+1} is the rural population after people choose their locations and so represents the relevant population for computing the distribution of incomes). One can readily check that inequality is equal to $\frac{\sigma}{\bar{w}}$ when $R = 0$ or 1, is increasing at 0, decreasing at 1, and has a (unique) maximum at $R = \frac{\lambda}{\lambda+1}$.[19] Since mean income $R\bar{w} + (1 - R)\lambda\bar{w}$ is decreasing in R, if we can show that (a) R_t decreases monotonically; (b) the economy fully modernizes (that is, R_t converges to 0); and (c) it does so in more that one period (otherwise

[19]These properties can be established using the expression for the coefficient of variation, which is

$$\sqrt{\frac{[R + (1 - R)\lambda^2](\sigma^2 + \bar{w}^2)}{[R + (1 - R)\lambda]^2\bar{w}^2} - 1},$$

where $R \in [0, 1]$.

inequality remains at $\frac{\sigma}{\bar{w}}$ for all time); we will have shown that the economy follows the inverted-U curve as it develops.[20]

We note first that the level of migration (i.e. $R_t - R_{t+1}$), as shown in Figure 3, is nonnegative — no one ever migrates from the city to the village. Thus R_t does indeed follow a monotonic path.

¿From Figure 3, a lower bound for the level of migration is given by $R(\infty) - R(a_C(\hat{r})) = R_t(1-F(\frac{a_C(\hat{r})}{\beta}))$. Thus, if $\overline{\overline{w}} > \frac{a_C(\hat{r})}{\beta}$, there is a uniform positive lower bound on the fraction of the rural population that will migrate each period, and it follows that R_t converges to zero.

Finally, we need to ensure that the economy does not modernize instantly. Note (again refer to Figure 3) that if the interest rate is $\hat{r}$ upon opening the urban sector, then not everyone migrates in the first period, except in the singular case in which $qm[1 - R(a_C(\hat{r}))] = \beta\bar{w}$. This is equivalent to the condition that $\frac{\beta\bar{w}}{qm} > 1 - F(\frac{a_C(\hat{r})}{\beta})$.[21] Thus we have

Proposition 4.1. *If* $\overline{\overline{w}} > \frac{a_C(\hat{r})}{\beta}$, $\underline{\underline{w}} > qs$, *and* $\frac{\beta\bar{w}}{qm} > 1 - F(\frac{a_C(\hat{r})}{\beta})$, *then as* $t \to \infty$, $R_t \to 0$ *(the economy fully modernizes) and the path of inequality and income follows an inverted-U curve.*

Notice that although the economy fully modernizes, it does so too slowly — even if full modernization takes only finite time,[22] any discounted sum of single-period social surpluses would be increased if modernization were to occur immediately as the modern sector opens.

The modernization process in this example operates at two levels. When full modernization occurs, it is because some fraction of rural agents are always successful enough to pass on a large bequest to their children, who can then afford

[20] Apparently, the idea that a monotonic increase in the urban population leads to this inverted-U relation between income and the coefficient of variation is known (see [9]), although there the rate of migration is left unexplained.

[21] It is not hard to find distributions which satisfy this condition. Start with a mean wage $\bar{w}$ $> qs$ and the unit mass there. Choose β small enough to render $\frac{a_C(\hat{r})}{\beta} > \bar{w}$. Now replace the unit mass with a uniform with mean $\bar{w}$ and support in $[qs, \frac{a_C(\hat{r})}{\beta}]$. Through mean-preserving spreads, generate a continuous distribution $G(w)$ with support equal to $[qs, \frac{a_C(\hat{r})}{\beta}]$. Since $G(\frac{a_C(\hat{r})}{\beta}) = 1$, $\frac{\beta\bar{w}}{qm} > 1-G(\frac{a_C(\hat{r})}{\beta})$. Finally, let F be a mean-preserving spread of G which puts (a small) positive weight above $\frac{a_C(\hat{r})}{\beta}$, preserving the condition.

[22] For some parameter values, mean wealth might exceed qm in finite time, which as we have seen, then leads immediately to full modernization.

to insure themselves in the modern sector. This is an individual level effect which depends on primitive assumptions about the distribution of earnings. But there is also a "trickle-down" effect which operates at a more aggregate level: as people move to the city, they earn more so that aggregate wealth increases; meanwhile, demand for insurance typically does not increase. This leads to a decrease in the interest rate, thereby lowering everyone's cost of insurance. In particular, the agency costs of borrowing in the city are reduced at the lowered interest rate (i.e., $a_C(r)$ falls), which in turn make the modern sector attractive to more people. A related trickle-down mechanism is discussed in [2]

In a parallel way, increasing wealth in the modern sector reduces the effects of poor information there. For an individual, having a lot of wealth improves his borrowing prospects. And as the whole economy becomes wealthy, falling interest rates lower the agency costs of borrowing for everybody. Thus, there is a dual sense in which a wealthy economy can afford to do without good information.

4.2. Undermigration in the Long Run

What if the conditions of Proposition 4.1 are not satisfied? Is it possible that a long-run version of undermigration can occur, i.e. that the economy could settle into a steady state in which some people inefficiently remain in the rural sector?

If the economy were to get stuck in an undermigration trap, both the individual and trickle-down effects would have to be mitigated. We first begin by dispensing with the assumption that $\overline{\overline{w}} > \frac{a_C(\hat{r})}{\beta}$, which weakens the first effect, and is necessary if there is not to be full modernization; thus $\overline{\overline{w}} \leq \frac{a_C(\hat{r})}{\beta}$ and $F(\frac{a_C(\hat{r})}{\beta}) = 1$. We continue to assume that $\beta\bar{w} < qm$, as this is also a necessary condition for undermigration, as discussed above.

We shall be interested in deriving the recursion function for the state variable R_t, the rural population at the beginning of the period t. Denoting the current interest rate by r_t, the rural population evolves according to:

$$R_{t+1} = G(R_t) = \begin{cases} R_t F(\frac{a_C(r_t)}{\beta}), & r_t < \hat{r} \\ \frac{\beta\bar{w}}{qm}[R_t + (1-R_t)\lambda] - (1-R_t)(1-F(\frac{a_C(r_t)}{\lambda\beta})), & r_t = \hat{r} \\ 0, & r_t > \hat{r}. \end{cases} \tag{4.1}$$

Of course, this is not yet a proper characterization of dynamics, because r_t itself depends on R_t through the insurance market equilibrium. The insurance loan market equilibrium can be characterized very simply, however. The supply of loans each period is $\beta\bar{w}[R_t + (1-R_t)\lambda]$. Demand is

$$\begin{array}{ll} qm[1-(1-R_t)F(\frac{a_C(r_t)}{\lambda\beta})], & r_t < \hat{r} \\ [qm(1-R_t)\{1-F(\frac{a_C(r_t)}{\lambda\beta})\}, qm\{1-(1-R_t)F(\frac{a_C(r_t)}{\lambda\beta})\}] & r_t = \hat{r} \\ qm(1-R_t)[1-F(\frac{a_C(r_t)}{\lambda\beta})], & r_t > \hat{r} \end{array}$$

¿From these expressions, one can verify that r is increasing in R when $r_t < \hat{r}$.

Now observe that for all $R \in [0,1]$, $G(R) \leq R$, since migration never goes from city to village. Since $G(R) \geq 0$ by definition, we conclude that $G(0) = 0$.

We now need to establish the existence of the fixed points of $G(\cdot)$ other than zero. At any such be such a fixed point, the associated interest rate r^* must satisfy $F(\frac{a_C(r^*)}{\beta}) = 1$ and $r^* \leq \hat{r}$. Suppose there is a fixed point (call it $\bar{R}$) associated with the interest rate $\hat{r}$. As this is a stationary point, there can be no migration when $R = \bar{R}$. Therefore, supply must be equated to the highest level of demand generated by $\hat{r}$ (refer back to Figures 2 and 3) and we have

$$\beta\bar{w}[\bar{R} + (1-\bar{R})\lambda] = qm[1-(1-\bar{R})F(\frac{a_C(\hat{r})}{\lambda\beta})]. \tag{4.2}$$

Now choose R^* below $\bar{R}$. The corresponding equilibrium interest rate r^* must also lie below $\hat{r}$ (supply increases while demand decreases). So long as $F(\frac{a_C(r^*)}{\beta}) = 1$, R^* is also a fixed point of $G(\cdot)$. Indeed, there will be an interval (possibly degenerate) of fixed points $[\underline{R}, \bar{R}]$, where the interest rate $\underline{r}$ associated with $\underline{R}$ satisfies $a_C(\underline{r}) = \beta\bar{\bar{w}}$. Thus we need only establish the existence of a nonzero solution to (4.2) in order to guarantee that $G(\cdot)$ has stationary points bounded away from zero.[23]

Solving (4.2) for $\bar{R}$ yields

$$\bar{R} = \frac{\frac{\lambda\beta\bar{w}}{qm} + F(\frac{a_C(\hat{r})}{\lambda\beta}) - 1}{\frac{(\lambda-1)\beta\bar{w}}{qm} + F(\frac{a_C(\hat{r})}{\lambda\beta})};$$

[23]For $R > \bar{R}$, the interest rate remains at $\hat{r}$. Raising R decreases supply and raises the upper bound of demand at $\hat{r}$, so the interest rate cannot fall. On the other hand, if r rises, it must satisfy

$$qm(1-R)[1-F(\frac{a_C(r)}{\lambda\beta})] = \beta\bar{w}[R + (1-R)\lambda];$$

solutions to this equation are decreasing in R, a contradiction.

this expression lies in the allowable range if and only if $\frac{\lambda\beta\bar{w}}{qm}+F(\frac{\alpha c(\hat{r})}{\lambda\beta})-1>0$. It is not hard to find parameter values for which this condition holds. Thus we have

Proposition 4.2. *Suppose that* $\frac{\lambda\beta\bar{w}}{qm}+F(\frac{\alpha c(\hat{r})}{\lambda\beta})-1>0$. *Then there exists an interval* $[\underline{R},\bar{R}]$ *of rural population levels which remain constant over time once the economy arrives there.*

Since $\bar{R}>0$, at least some of these levels are positive: full modernization does not occur. We therefore refer to the interval $[\underline{R},\bar{R}]$ as the "undermigration trap."

How might the economy actually arrive in an undermigration trap? We could start by returning to our original question and asking whether long-run undermigration is possible starting from a pure rural economy. Figure 4 illustrates possible shapes that $G(R)$ might assume, given that the undermigration trap exists. As noted in footnote 23 above, when $R\geq\bar{R}$, the interest rate is $\hat{r}$. Thus, $G(R)$ is linear there and can have either slope, depending on the sign of $\frac{\beta\bar{w}}{qm}(1-\lambda)+1-F(\frac{\alpha c(\hat{r})}{\lambda\beta})$. If the slope is positive (Figure 4(a)), then an economy starting at $R=1$ will converge to $\bar{R}$; income inequality will increase over time, perhaps decreasing a small amount toward the end (the so-called inverted J-curve).

But for most parameter values the slope will be negative (see Figure 4(b)). Thus the only way a pure rural economy would fall into the undermigration trap is if $G(1)=\frac{\beta\bar{w}}{qm}\geq\underline{R}$: as shown in Figure 4(b), when this condition is satisfied, the economy jumps to the undermigration trap as soon as the urban sector opens. If this condition fails, the economy jumps past the undermigration trap when the urban sector opens and then eventually fully modernizes (Figure 4(c)). In these cases, trickle-down remains strong enough to eventually modernize the economy.

We have been asking whether long run undermigration is possible assuming that the economy starts out purely rural. This is a useful thought experiment, but is not necessarily the only relevant case. Many instances of modernization and development, especially in modern times, correspond to opening an already large urban sector to the rural sector. Thus initial conditions with $R<1$ are also of interest. As indicated in Figure 4(c), the basin of attraction of the undermigration trap is considerably larger than the trap itself, so a failure to modernize is reasonably likely: if the economy begins with the size of the rural sector in the interval $[\underline{R},\bar{\bar{R}}]$, it falls into the trap. We therefore have a dynamic analogue to the conditions leading to undermigration in the static case discussed in the previous section. Opening a moderate-sized city to the village may not effect further development of the economy, at least if one relies on the laissez-faire migration mechanism.

4.3. Other Dynamics with Self-Selection

As we stated at the outset, there has been considerable controversy surrounding the validity of the Kuznets hypothesis. We have seen that it is possible for the migratory dynamics generated by the trade-off between high modern sector productivity and efficient traditional sector institutions to yield an inverted-U curve. What we show now, is that even if we maintain the same basic "engine" of modernization that Kuznets and Lewis described, it is possible under plausible specifications to generate rather different patterns for the evolution of inequality. In particular, the way individuals *select* for migration will be crucial.

Suppose that agents learn the level of their earnings at date 0, *before* they make their location decision. Assume this information is public. Then each period, migration follows the pattern described by Proposition 3.1 and Figure 1. In particular, note that low-skill agents migrate while medium-skill agents remain in the rural sector. Imagine that the low-skilled in the city actually end up earning close to what the medium-skilled are earning back in the village. Then, assuming the fraction of very high-skill agents (those who migrate even though they could get insurance in the rural sector) is small, the possibility arises that opening the urban sector could actually *decrease* the level of inequality; subsequently, as the rural sector empties out, inequality increases again. The result is an "upright" U, rather than Kuznets's inverted U.

To see how this mechanism operates, suppose that there are just two skill levels, w and λw (these are the earnings of an agent in the village; in the city he would earn λw and $\lambda^2 w$). An agent's chance of having the high skill is χ, assumed independent of the wealth he inherits. Make the following parametric assumptions:

$$(\lambda + \beta)w > qs - (\lambda - 1)\lambda w \tag{4.3}$$

$$q(s - m) > (\lambda - 1)\lambda w \tag{4.4}$$

$$\beta w > qm - \frac{\lambda w q m}{qs - (\lambda - 1)\lambda w} \tag{4.5}$$

$$qm - w > \lambda \beta w \tag{4.6}$$

Assumption (4.3) ensures that high-skill agents in the rural sector can repay loans at date 3 when the interest rate is $\hat{r}(\lambda w)$; (4.4) is the analog of (3.1) and ensures that inefficient undermigration is possible; (4.5) implies that the high-skill agents always have enough wealth to obtain insurance (i.e., their wealth, which is at least βw, exceeds $a_V(\lambda w, \hat{r})$), while (4.6) ensures that the low-skill agents are below $a_V(w, 1)$ and therefore always migrate.[24] Figure 5, which is just Figure 1 specialized to the current example, depicts the possible wealth-wage combinations that can occur as the economy evolves. Before the modern sector opens, wages are either w or λw, and wealth always lies somewhere below $\beta\lambda w$ (so wealth-wage pairs lie on the heavy segments).[25] Note that by choosing π_C sufficiently close to 1, one can guarantee that the high-skill agents born in the village will be unable to obtain insurance in the city (i.e., their wealth will lie below $a_C(\lambda w, r)$ for all r).

Assumption (4.6) ensures that as long as some of the population remains in the rural sector, a positive fraction χ of their children will be born poor and low-skilled enough to migrate. Eventually, therefore, the economy fully modernizes. Observe that in this example, in contrast to those considered in the previous subsections, it is the low types who migrate; modernization comes from below rather than above (more generally, as we have pointed out, it tends to come from the tails of the distribution, not the middle).

In any period, only two wages are earned: either w and λw or λw and $\lambda^2 w$. Thus, if ρ is the fraction of the population earning the higher wage, the coefficient of variation is $\frac{\sqrt{\rho(1-\rho)}(\lambda-1)}{\rho\lambda+1-\rho}$, which achieves a unique maximum at $\rho = \frac{1}{\lambda+1}$. The initial distribution of wages has χ at λw and $1-\chi$ at w; since there is full modernization, eventually the distribution approaches χ at $\lambda^2 w$ and $1-\chi$ at λw. Thus, inequality is the same at the start and end of the development process.

Now consider the periods in between. As the urban sector opens, the low-skill agents migrate to the city, where they earn λw. They pass on bequests of $\beta\lambda w$; their children will earn either λw or $\lambda^2 w$, bequeathing $\beta\lambda w$ and $\beta\lambda^2 w$. Meanwhile, the children of the high-skilled agents who remain in the village inherit wealth $\beta\lambda w$ and skill w or λw. From these considerations, there are five possible wealth-wage pairs that can occur once the modern sector is opened (but before location choices are made); these are denoted by the X's in Figure 5.

[24] It is not difficult to find parameters satisfying (4.3)-(4.6). For instance, $\lambda = 2$, $w = 1$, $q = 0.5$, $m = 3$, $s = 8$, $\beta = 0.2$.

[25] Without actually calculating any particular distribution of wealth —such as a steady state — for the pure rural economy (unlike in sections 4.1 and 4.2, this computation is complicated by the fact that under the parametric assumptions (4.3)-(4.6), at interest rates larger than $\hat{r}(\lambda w)$, loans cannot necessarily be repaid out of date-3 earnings alone), it is not hard to verify that an upper bound for any agent's wealth is $\beta\lambda w$, since from what we said at the beginning of the section, λw is the most that an agent would have at date 4 from which to produce a bequest.

For certain levels of χ,[26] market clearing entails that $r = \hat{r}(\lambda w)$ and that some (call the fraction τ) of the high-skill agents also migrate (the demand and supply functions for this case are shown in Figure 6).[27] Suppose that $\chi = \frac{1}{\lambda+1}$ (or nearly so); after the urban sector opens we have $\chi\tau$ at $\lambda^2 w$ and $1 - \chi\tau$ at λw. Since $\chi = \frac{1}{\lambda+1}$ yields the maximum level of inequality , we find that in this case that *the initial impact of the development process is to decrease inequality.*

As before, let R_t denote the beginning-of-period-t rural population. As t increases, R_t decreases monotonically to zero; the supply of wealth is therefore increasing. Demand, meanwhile, cannot increase above its maximum initial level χqm, since only high-skill agents (whether rural or urban) can exceed the respective threshold wealth levels. Therefore, interest rates cannot increase over time. If the interest rate in some period t is less than $\hat{r}(\lambda w)$, the fraction of the population earning the high wage is $\chi(1 - R_t)$, which increases with time. With $\chi = \frac{1}{\lambda+1}$, this implies that inequality must increase over time as well.[28] In the limit as the economy evolves toward full modernization, inequality returns to its initial level: *the path of inequality follows an upright U*, contrary to Kuznets's hypothesis.

Essentially the same conclusion holds if initially market clearing occurs at $r = 1$ (i.e., when χ fails to satisfy condition (4.7)), in which case none of the high-skill migrate in the first period. Then everyone earns λw: there is perfect equality ($\rho = 0$) as soon as the modern sector opens. Then a similar argument gives us a monotonic increase of ρ back to its initial level. Inequality then traces out an upright U, at least if $\lambda\beta < 1$.[29]

[26] Specifically, maximum demand at $\hat{r}(\lambda w)$, χqm, must exceed supply $[\chi\lambda + 1 - \chi]\beta w$; using (4.6), this is equivalent to

$$\chi > \frac{\beta w}{qm - (\lambda - 1)\beta w}. \quad (4.7)$$

[27] The figure is drawn supposing that there are just two wealth levels at the time the city opens; the key point is that a finite number is typical. Readers may be bothered by the discontinuity in the demand which results from the atoms in the wage distribution. If instead the distribution was atomless and supported on two small intervals centered about w and λw, then demand would be continuous and the interest rates would always assume values very close to $\hat{r}$, r_1, and r_2 depicted in the diagram. The present example can be thought of as an approximation to that case. (Of course, by (4.6) r_1 and r_2 are less than 1, so equilibrium always exists in the first period after the city opens; but the approximation is valid more generally.)

[28] In case r remains at $\hat{r}(\lambda w)$, the fraction of high wage earners is still increasing over time, but the argument is slightly more complicated, and we omit it.

[29] If not, then if $\chi > \frac{1}{\lambda+1}$, inequality will overshoot its final (and original) level before declining back to it, thereby following a "sleeping S."

For other values of χ, however, the initial impact of opening the modern sector *can* lead to an increase in inequality, à la Kuznets. To take an extreme example, suppose that χ is nearly equal to 1 (so there is nearly perfect equality to begin with). Then the interest rate following the opening of the modern sector will be $\hat{r}(\lambda w)$. A large fraction of the rural population migrates and earns the high wage $\lambda^2 w$: inequality has increased.[30] Eventually, of course, everyone will end up in the city, so inequality will have to decline to its original level, yielding the inverted U.

5. Conclusion

The implications of the dynamic examples in Section 4.3 may be summarized by saying that the characteristics of those who choose to migrate may have important implications for the evolution of inequality in developing countries. Moreover, as the example there shows, the dynamics of inequality can depend delicately on the parameters of the distribution of these characteristics. In addition, as a comparison with the results Sections 4.1 and 4.2 reveals, seemingly irrelevant changes in the timing of location decisions can have a dramatic impact on the evolution of the aggregate variables. We conclude that there is no broad theoretical reason — even if we adhere to a sectoral shifting story of development — to believe in the universality of the inverted U.

The model in this paper, while suggestive in several respects, leaves out much to be a useful predictive model of the process of modernization. Some of these omitted factors, such as congestion effects in the modern sector and the fact that one does not get completely cut off from the traditional sector when one first starts working in the modern sector, go against our results. Others, like the fact that the ability of the traditional sector to provide better insurance may depend on how many people are left in the traditional sector, may reinforce our results. A truly predictive model of the process of modernization must build in all of these effects.

At a more theoretical level, the whole idea of an informational network that makes better insurance possible is not really modeled in the paper. To really understand the stability of the traditional sector one want to model how such network is sustained. This is an important direction for future work.

[30] With χ close to 1, the fraction of the population which migrates and receives $\lambda^2 w$ upon the opening of the modern sector is close to $1 - \lambda\frac{\beta w}{qm}$; using (4.6), this exceeds $\frac{1}{1+\lambda}$. Noting that inequality is decreasing on $[\frac{1}{1+\lambda}, 1]$ proves the claim.

References

[1] Adelman, I. and S. Robinson (1989), "Income Distribution and Development," ch. 19 in H. Chenery and T.N. Srinivasan, eds., *Handbook of Development Economics*, vol. II.

[2] Aghion, P. and P. Bolton (1994), "A Theory of Trickle-Down Growth and Development," mimeo, Nuffield College, Oxford.

[3] Banerjee, A.V., T. Besley and T. Guinnane (1994), "Thy Neighbor's Keeper: the Design of a Credit Cooperative with Theory and a Test," *Quarterly Journal of Economics*, CIX: 491-516.

[4] Banerjee, A. V. and A. F. Newman (1993), "Occupational Choice and the Process of Development," *Journal of Political Economy*, 101: 274-298.

[5] Baumol, W. J. (1990), "Entrepreneurship: Productive, Unproductive, and Destructive," *Journal of Political Economy*, 98: 893-921.

[6] Bloom, D. E. and O. Stark (1985), "The New Economics of Labor Migration," *American Economic Review Papers and Proceedings*, 173-178.

[7] Das Gupta, M. (1987), "Informal Security Mechanisms and Population Retention in Rural India," *Economic Development and Cultural Change*, 36: 101-120.

[8] Fei, J. and G. Ranis (1964), *Development of the Labor Surplus Economy: Theory and Policy*, Homewood, Illinois: Irwin.

[9] Fields, G. S. (1980), *Poverty, Inequality, and Development*, Cambridge: Cambridge Univerity Press.

[10] —— (1994), "The Kuznets Curve: A Good Idea But...," mimeo, Cornell University.

[11] Harris, J. and M. P. Todaro (1969), "Migration, Uniemployment, and Development: a Two-Sector Analysis," *American Economic Review* 59: 126-142.

[12] Kehoe, T. and D. K. Levine (1993), "Debt-Constrained Asset Markets," *Review of Economic Studies*.

[13] Kuznets, S. (1955), "Economic Growth and Income Inequality," *American Economic Review* 45: 1-28.

[14] Lewis, W.A. (1954), "Economic Development with Unlimited Supplies of Labor," *The Manchester School* 22: 139-91.

[15] Mokyr, J. (1990), *The Lever of Riches*, Oxford: Oxford University Press.

[16] North, D. and R.P. Thomas (1972), *The Rise of the Western World: A New Economic History*, Cambridge: Cambridge University Press.

[17] Putnam, R.D. (1993), *Making Democracy Work*, Princeton: Princeton University Press.

[18] Rosenberg, N. and L.E. Birdzell (1986), *How the West Grew Rich*, New York: Basic Books.

[19] Sen, A. K. (1966), "Peasants and Dualism with or without Labor Surplus," *Journal of Political Economy* 74: 425-450.

[20] Stark, O. (1991), *The Migration of Labor*, London: Basil Blackwell.

[21] Stiglitz, J. (1990), "Peer Monitoring and Credit Markets," *World Bank Economic Review*, 351-366.

[22] Townsend, R. (1994), "Risk and Insurance in Village India," *Econometrica*, 62 (3): 539-592.

[23] Udry, C. (1994), "Risk and Insurance in a Rural Credit Market: An Empirical Investigation in Northern Nigeria" *Review of Economic Studies*, 61 (3): 495-526.

[24] Varian, H. (1990), "Monitoring Agents with Other Agents," *Journal of Institutional and Theoretical Economics*, 153-174.

[25] Williamson, J.G. (1988), "Migration and Urbanization", in H. Chenery and T.N. Srinivasan (ed) *Handbook of Development Economics*, North Holland, Amserdam.

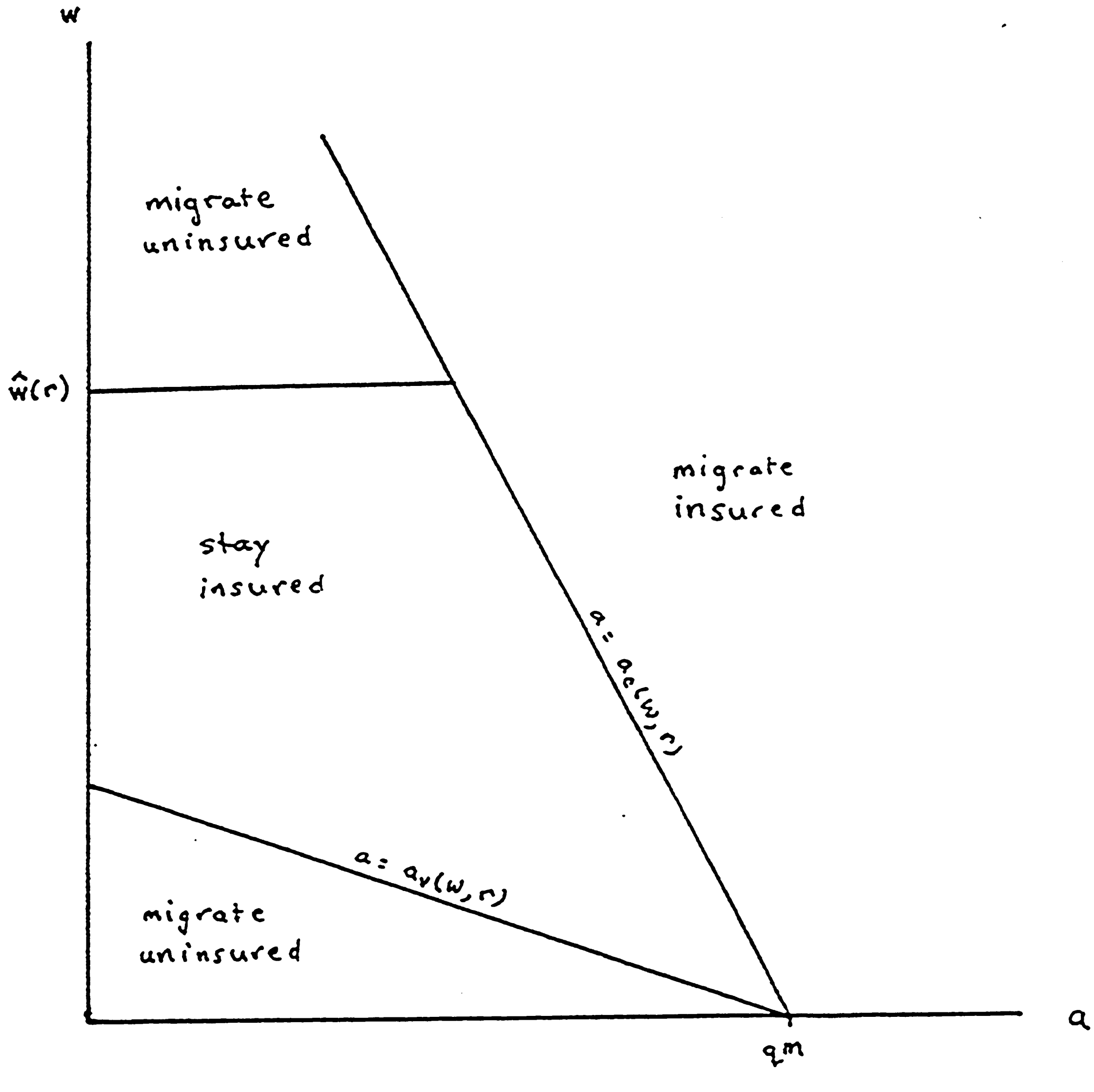
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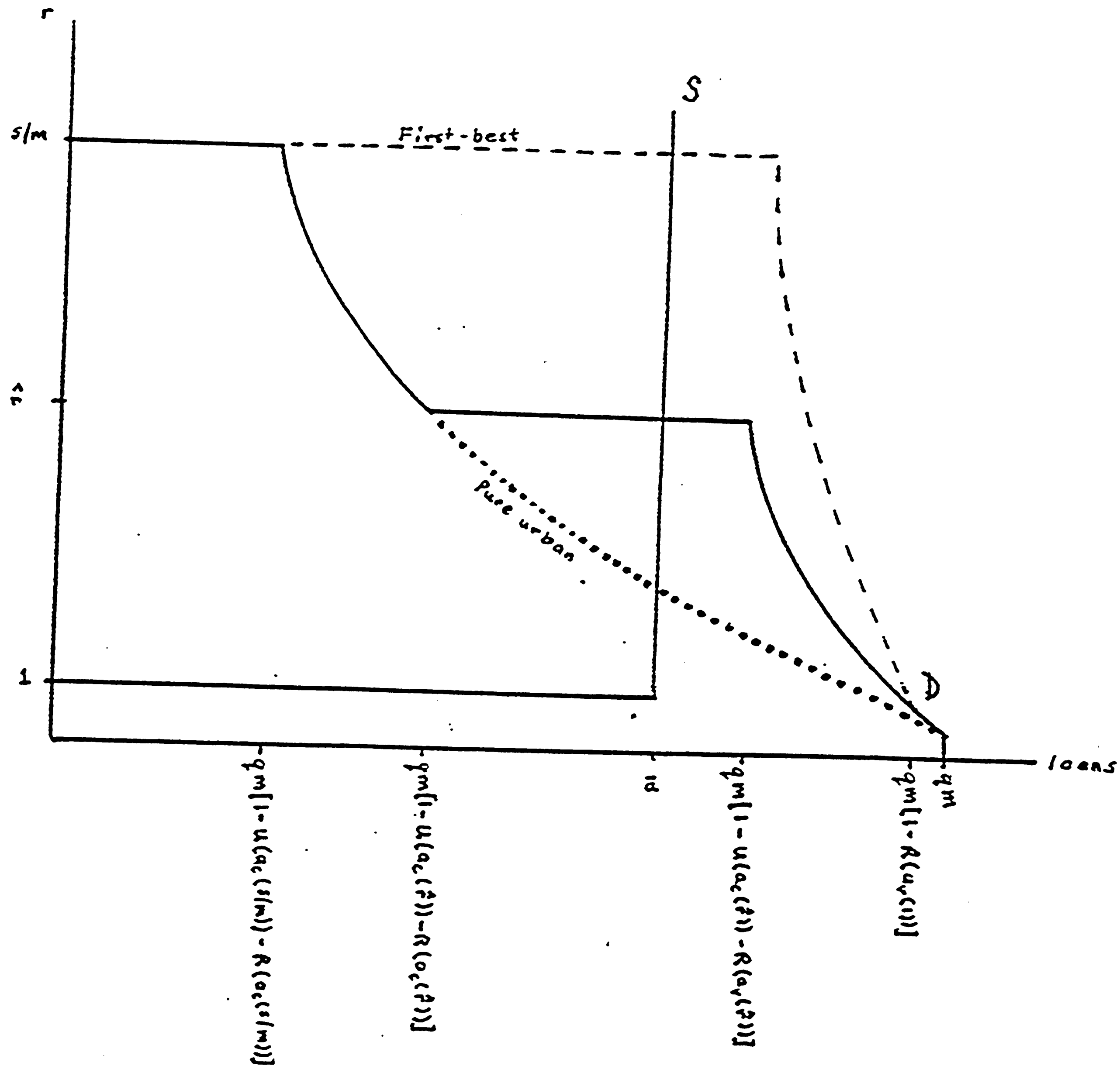
Figure 1



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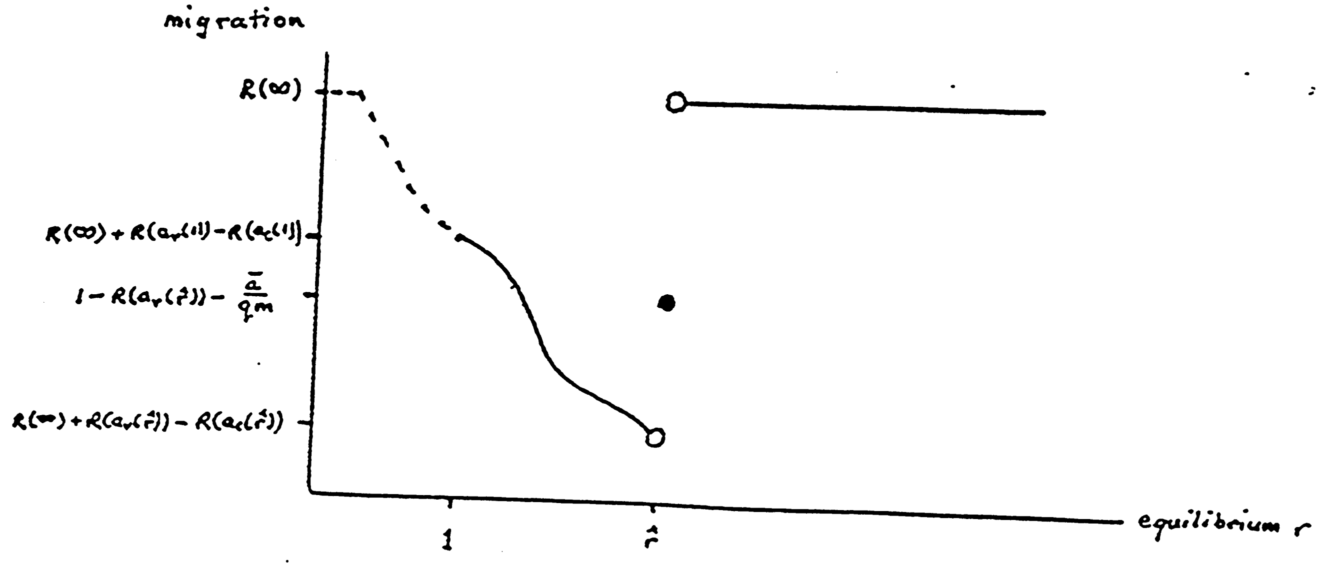

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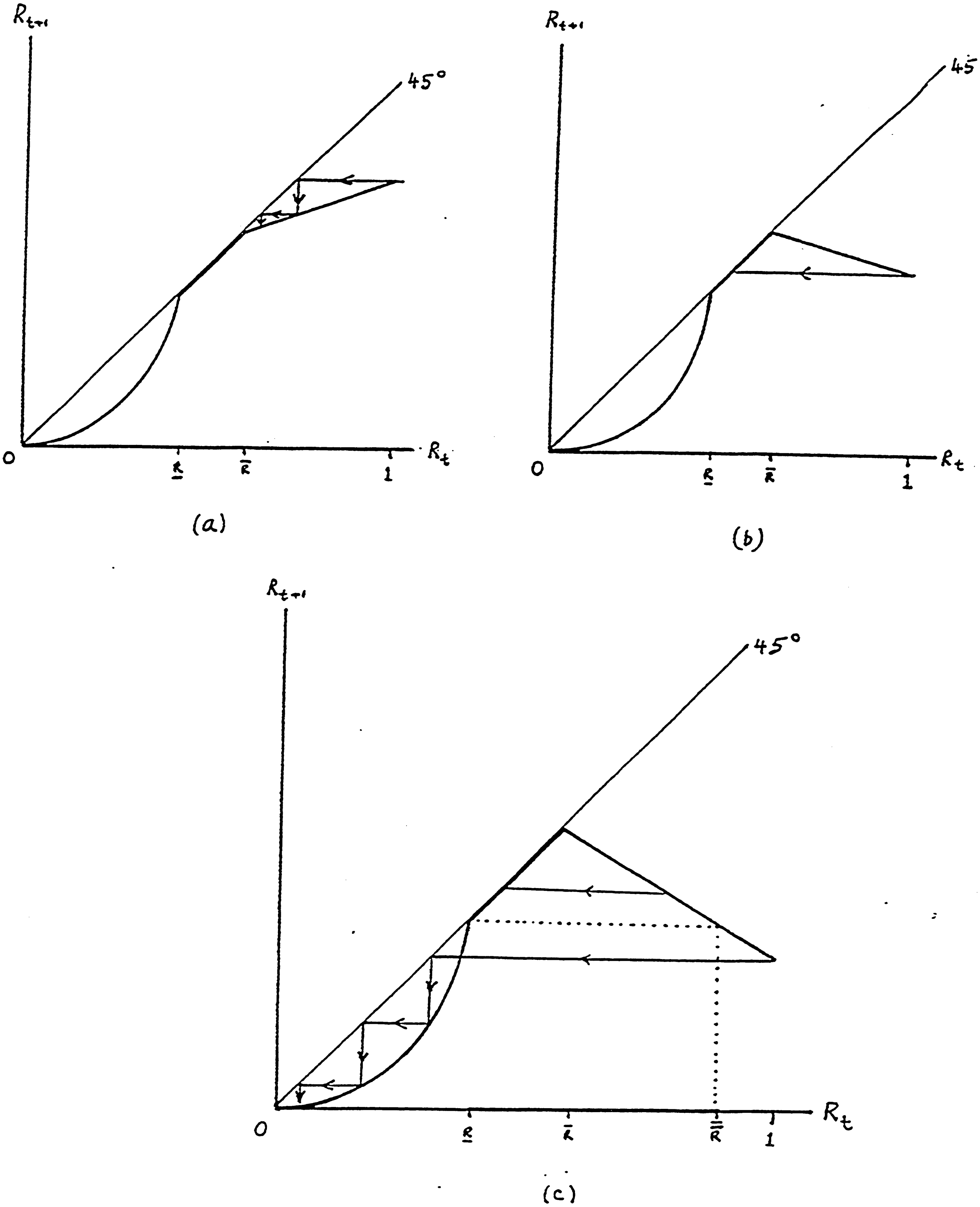

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Figure 4

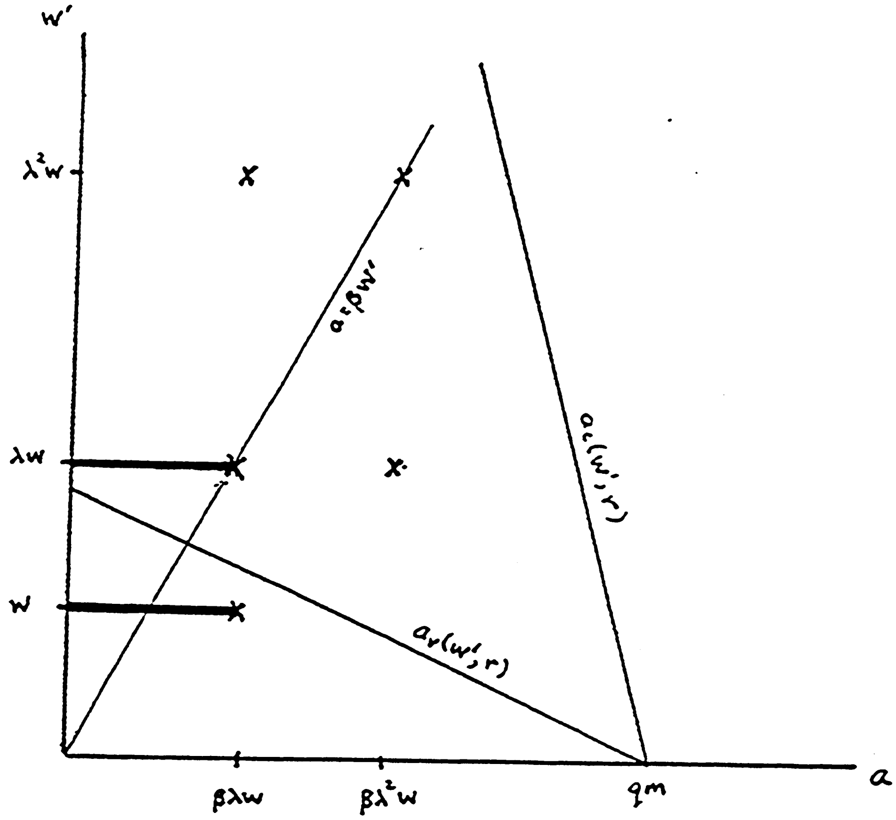

Figure 5

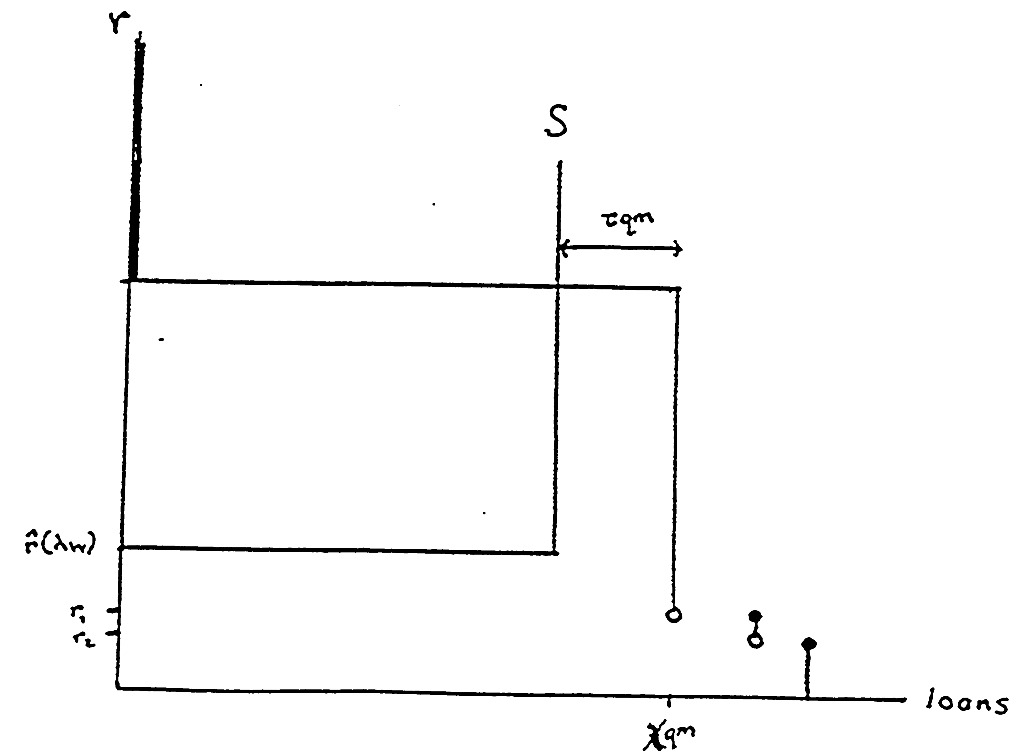

Figure 6

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