Wage inequality in a dual economy*

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April 10, 2002

Discussion Paper No. 02/531

Abstract

This paper presents necessary and sufficient conditions for unambiguous changes in wage inequality in a dual economy, based on analysis of the entire Lorenz curve. These conditions are then used to analyze the distributional consequences of various types of economic growth. In particular, it is shown that capital accumulation or technical progress in agriculture is likely to reduce wage inequality, but the effects of development in non-agriculture are typically ambiguous. The paper also discusses the implications of this analysis for the Kuznets curve.

J.E.L. classification: D30, O15

Keywords: dualism, inequality, growth

*I am grateful to Kaushik Basu, Carl-Johan Dalgaard, David Feldman, Ravi Kanbur, John Knight, James Rauch and Stephen Redding for helpful comments and discussion. A previous version of this paper circulated as "Income distribution in the Harris-Todaro model". Any errors are my responsibility.

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1 Introduction

The central focus of this paper is the effect of economic growth on wage inequality. The analysis in the paper is based on a simple model with two sectors, rural and urban, in which the Harris-Todaro migration equilibrium condition holds. The simplicity of the model allows inequality to be analyzed very easily in terms of movements in Lorenz curves. Compared to much existing work, this is a more general approach, because the findings are not tied to specific summary measures of inequality.

Through the use of Lorenz curves, the paper derives necessary and sufficient conditions for unambiguous changes in wage inequality to occur in the Harris-Todaro model. It turns out that these conditions have an interesting and useful property. They depend upon just two variables, the urban unemployment rate and the number of unemployed. I use this finding to examine the distributional consequences of various kinds of economic development, and of some of the policy interventions frequently suggested in the literature.[1] Since the simple Harris-Todaro model is a special case of more general ones, the paper offers some insight into what kind of results can be expected from more complex models of dual economies. The analysis allows us to distinguish between cases where general results may be possible, and cases where theoretical models are likely to yield ambiguous results, because the old and new Lorenz curves intersect.

Perhaps more importantly, I draw attention to some mechanisms associated with growth and inequality that may be worthy of further attention. The model is based upon a rural agricultural sector, and an urban sector that produces goods and services (the 'modern' sector). In the simplest form of the model, capital accumulation and technical progress in agriculture are found to reduce wage inequality unambiguously. The reason is not simply that growth in agriculture reduces the wage gap between urban and rural workers, because there is also a reinforcing general equilibrium effect. In the long-run migration equilibrium, an improvement in the prospects of agriculture lowers the urban unemployment rate and the overall number of unemployed. Therefore, agricultural productivity growth lowers inequality not only between those in work in the two sectors, but also between the employed and unemployed. The paper shows how these effects combine to yield an inwards shift of the entire Lorenz curve, which is an unusually strong result.

The second main finding is that the effects on inequality of economic development in the urban (modern) sector are often ambiguous, even in a very

[1] The conditions I derive have also been used for this purpose in work by Fields (2001), which builds on an earlier draft of this paper.

basic model. Again the intuition is relatively simple, and familiar from the well-known Todaro paradox. Given capital accumulation or technical progress in the modern sector, there is a rise in the demand for labour by that sector at any given wage. The change in prospects in the urban area creates migration, potentially increasing the number of unemployed and hence wage inequality. Since this mechanism is also likely to be at work in more general models, the analysis indicates that few general results are likely concerning the distributional effects of productivity growth in non-agriculture.

These findings demonstrate the potential relevance of dual economy models when investigating growth and inequality. The case is further supported by the recent empirical work of Bourguignon and Morrisson (1998). They use average labour productivity in agriculture relative to that in non-agriculture as a proxy for labour market imperfections, and find that this variable can explain some of the variation across countries in the distribution of income. This suggests that the intersectoral wage gap potentially has a sizeable effect on aggregate inequality, and reinforces the case for studying inequality within two sector models.

In particular, it seems useful to study a model in which the intersectoral wage gap is determined endogenously. In this paper that is achieved by making use of the long-run migration equilibrium condition introduced by Todaro (1969) and Harris and Todaro (1970). It is perhaps surprising that the distributional implications of economic growth within the Harris-Todaro framework have received so little attention, especially given that Kuznets (1955) saw the process of rural-urban migration as being at the heart of changes in the distribution of income for less developed countries.

In his groundbreaking paper, Kuznets argued that, as a result of migration, inequality is likely first to rise with the level of development, and then fall. This is the famous inverse-U hypothesis, or Kuznets curve. More recent analyses of migration and inequality argue that this kind of general conclusion is rarely possible. It was pointed out by Fields (1979, 1980) that when migration takes place in a simple two sector model without unemployment, the new Lorenz curve crosses the old one. The current paper can be seen as generalizing and extending his analysis, to incorporate a migration equilibrium condition and the possibility of sustained urban unemployment.

This has rarely been done in existing research. Kanbur and McIntosh (1988) argue that the Harris-Todaro model can generate a Kuznets curve, but it is not clear that their brief analysis allows for a variable urban unemployment rate. If the migration equilibrium is to be maintained with a fixed urban wage, their analysis will hence be restricted to cases where the agricultural wage is

constant. More recently, Rauch (1993) has established some sufficient conditions for a Kuznets curve to exist in a two sector model, but only when using the log variance of income as a measure of inequality.[2]

Although my approach is arguably more general, some limitations should be acknowledged at the outset. The analysis rests squarely on the Harris-Todaro framework and, as with most stylized models, this framework is not without its critics. My response is that the Harris-Todaro model continues to be regarded as a powerful explanation of rural-urban migration despite urban unemployment, and has been influential within both development economics and the regional science literature.[3] Although it undoubtedly abstracts from many important aspects of reality, the model can still contribute to a more complete understanding of long-run distributional outcomes.

A more important criticism is that the analysis in the paper compares long-run steady states in which the Harris-Todaro migration equilibrium condition is assumed to hold, and the wage in the urban sector is treated as exogenously given. The first assumption may be controversial given the empirical literature on the 'wage curve', which tends to imply that the Harris-Todaro relation does not hold in the short to medium run (Blanchflower and Oswald 1995, Hoddinott 1996, Kingdon and Knight 1998). The second assumption is unsatisfactory from a theoretical point of view. A more complete account of long-run inequality would allow the urban wage to be determined endogenously, through efficiency wage arguments for example. This has rarely been done, and the approach taken in this paper at least allows the intersectoral wage differential to vary endogenously, rather than holding it fixed as in much previous work.

One strength of this approach is that, by allowing the wage differential to vary, the paper draws attention to general equilibrium effects that will also appear in more general models. Furthermore, the paper is unusual in distinguishing carefully between the consequences of different types of economic growth. This may ultimately be more informative, and more useful to policy-makers, than emphasizing an aggregate reduced-form relationship such as the Kuznets curve. Kanbur (2000) has recently argued that the Kuznets curve has become something of a straitjacket in this field. Studying the distributional consequences of different forms of growth may be one way in which the literature on growth and distribution could usefully move forward.

The remainder of the paper is structured as follows. Section 2 uses the

[2] A few other papers analyse distributional issues in the context of social welfare, the appropriate shadow wage or foreign capital inflows. See Chakravarty and Dutta (1990) and Gupta (1988, 1994).

[3] On this latter point, see Allen (2001) and Ingene (2001).

Lorenz curve to derive sufficient conditions for unambiguous changes in wage inequality. Section 3 puts these conditions to work, in exploring the effects on wage inequality of capital accumulation and technical progress in agriculture and non-agriculture. The remainder of the analysis examines the distributional implications of various policies (section 4) and the extent to which more general assumptions will modify the results (section 5). Section 6 provides further discussion, with a particular focus on the implications for the Kuznets curve. Finally, section 7 concludes.

2 Movements in Lorenz curves

This section derives the conditions under which the Lorenz curve will shift inwards or outwards along its entire length, within a simple version of the Harris-Todaro model. The use of Lorenz curves ensures that the conclusions are not tied to specific inequality measures. The potential strengths of such an approach were demonstrated by Bourguignon (1990) using a more complicated model than the one considered here.

The framework in the present paper is standard. Risk-neutral individuals decide between working in rural agriculture, where they receive a wage w_{a}, or looking for work in urban areas. In the urban areas, they will either be employed for a wage (w_{m}) fixed above the market clearing level, or unemployed with zero income. All those looking for work in urban areas have an equal likelihood of finding work in each period, so that individuals are employed with probability $(1-u)$ and unemployed with probability u, where u is the unemployment rate in the urban sector (the proportion of the urban labour force who are unemployed). I also adopt the standard simplification that the price of agricultural goods relative to non-agricultural goods is exogenously fixed, as in a small open economy in which all goods are traded.[4] Without loss of generality, units for output are chosen so that the relative price is equal to one.

Workers migrate between sectors unless the expected wage in the urban sector is equal to the rural wage. Hence in equilibrium, we have the Harris-Todaro migration equilibrium condition:

$$w_{\mathsf{a}} = (1-u)w_{\mathsf{m}} \tag{1}$$

The total number of workers is normalized to one. The proportions employed in agriculture, employed in the urban (modern) sector, and unemployed are given by L_{a}, L_{m} and L_{u} respectively. For future use, it is helpful to note that

[4] Bourguignon (1990) considers a model where the internal terms of trade are endogenous.

$$L_{\mathsf{u}} = u(1 - L_{\mathsf{a}}) \tag{2}$$

$$L_{\mathsf{m}} = (1 - u)(1 - L_{\mathsf{a}}) \tag{3}$$

Mean wage income μ is given by

$$\mu = w_{\mathsf{a}} L_{\mathsf{a}} + w_{\mathsf{m}} L_{\mathsf{m}} = w_{\mathsf{a}} \tag{4}$$

where the second equality follows from use of (1) and (3).

We are now in a position to analyze the Lorenz curve. For now, assume that individuals only receive income from wages. The Lorenz curve will clearly be piecewise linear with two kinks, as in figure 1. Segment one is based on the income (zero) of the unemployed, segment two on the income of those in agriculture, and segment three on the income of those working in the modern sector.

It is easy to show that the slope of each segment of a Lorenz curve is given by the ratio of that group's wage to the average wage of the whole population.[5] In this case, the slope of each segment will be given by the ratio of that group's wage to the agricultural wage, by (4) above. In particular, note that whatever the distribution of income, the slope of segment two is fixed at unity, given that the wage in agriculture is equal to the mean wage of the whole population.

We can now derive two necessary conditions for an unambiguous increase in wage inequality, represented by an outward shift of the entire Lorenz curve. First, the number of unemployed should increase or stay the same. Secondly, the slope of segment three should also increase or stay the same. If we use a subscript to discriminate between two time periods, so that for instance w_{at} means the rural wage at period t, the two conditions can be written as:

$$L_{\mathsf{u2}} \geq L_{\mathsf{u1}} \tag{5}$$

$$\frac{w_{\mathsf{m2}}}{w_{\mathsf{a2}}} \geq \frac{w_{\mathsf{m1}}}{w_{\mathsf{a1}}} \tag{6}$$

Furthermore, since the slope of segment two is fixed at unity, it should be clear from figure 1 that if both these inequalities hold and one holds strictly, that will be sufficient for an unambiguous increase in inequality.

Using (1), the inequality (6) can be simplified as follows:

$$\frac{1}{1 - u_2} \geq \frac{1}{1 - u_1}$$

$$\text{or } u_2 \geq u_1$$

[5] Bourguignon (1990) provides a formal derivation of this result.

Hence necessary and sufficient conditions for an unambiguous rise in wage inequality in the Harris-Todaro model are very simply stated. If one of the following statements holds, inequality will rise:

(U1) the urban unemployment rate rises, and the number of unemployed goes up.

(U2) the urban unemployment rate is constant, and the number of unemployed rises. Modern sector employment rises, and agricultural employment falls.

(U3) the urban unemployment rate rises, and the number of unemployed is constant. Modern sector employment falls, and agricultural employment rises.

A symmetric analysis can be used to derive the necessary and sufficient conditions for the Lorenz curve to shift inwards, and hence for inequality to be unambigously reduced. Inequality falls if one of the following statements holds:

(D1) the urban unemployment rate falls and the number of unemployed goes down.

(D2) the urban unemployment rate is constant, and the number of unemployed goes down. Modern sector employment falls, and agricultural employment rises.

(D3) the urban unemployment rate falls, and the number of unemployed is constant. Modern sector employment rises, and agricultural employment falls.

These conditions indicate that, to know what happens to inequality in the Harris-Todaro model, all we need to know is the urban unemployment rate and the number of unemployed. Together, these two variables capture all the information in the Lorenz curve. The conditions also indicate that only knowing the direction of change of employment in the modern sector or agriculture does not allow us to draw conclusions about inequality. In particular, urbanization, which corresponds to a fall in agricultural employment, can potentially be associated with a rise or fall in wage inequality.

The main conclusion, that only the urban unemployment rate and the number of unemployed matter, can be seen more explicitly if we consider a Lorenz-consistent summary measure of inequality. For instance, in this model, the Gini coefficient is given by:

$$G = \frac{L_{\mathsf{a}} L_{\mathsf{m}} (w_{\mathsf{m}} - w_{\mathsf{a}}) + w_{\mathsf{a}} L_{\mathsf{u}}}{w_{\mathsf{a}}}$$

as derived in Gupta (1988). However, it does not seem to have been previously noted that this expression can be simplified further using equations (1), (2) and (3). The following are all valid expressions for the Gini coefficient:

$$G = u(1 - L_{\mathsf{a}}^2) \tag{7}$$

$$= L_{\mathsf{u}}(1 + L_{\mathsf{a}}) \tag{8}$$

$$= L_{\mathsf{u}}(2 - \frac{L_{\mathsf{u}}}{u}) \tag{9}$$

Differentiation of (9) confirms that the Gini coefficient is increasing in L_{u} and u, in line with the conditions derived above. It should be emphasized at this point that expressions like (7) will not be a good indicator of inequality in empirical applications, because they ignore inequality within the rural sector, and under-estimate that within the urban sector. Unsurprisingly, back-of-the-envelope calculations show that the expressions above do not yield Gini coefficients of the magnitude actually observed. This does not preclude them from being useful in the theoretical analysis of inequality, social welfare, and shadow wages.

The results also indicate a potential testable implication of the Harris-Todaro model. In the cross-country data, summary measures of inequality should be associated more strongly with the urban unemployment rate than one would expect in a model without dualism. This is because in the Harris-Todaro model the degree of inequality between urban workers and rural workers is an increasing function of the urban unemployment rate, as well as inequality between the employed and unemployed. In principle, leaving aside data availability considerations, the urban unemployment rate could be a better indicator of dualism than the indicator of relative average products of labour used by Bourguignon and Morrisson (1998). This is because the urban unemployment rate is connected to the relative *marginal* products of urban and rural workers. It may therefore capture the extent of dualism and wage inequality better than a variable based on relative average products.

In other respects, the approach outlined here strongly supports the arguments of Bourguignon and Morrisson. They suggest that the observed effect of dualism on inequality could reflect more than simply a difference in average incomes between the rural and urban populations. In the model analyzed here, there is no differential between the average income of the rural and urban populations, if we include the unemployed in the urban population. Dualism still gives rise to inequality, because it is associated with greater inequality between the employed and unemployed, and between those in work in urban and in rural areas.

3 Economic growth and distribution

The results in this section are one of the main contributions of the paper. Using the conditions derived above, I analyze the effects of various kinds of growth on

wage inequality. The section considers productivity gains and capital accumulation in agriculture, and in the modern sector. One of the main findings is that agricultural development has an unambiguously beneficial impact on wage inequality. In contrast, the effect of development in the modern sector is typically ambiguous.

As in earlier work on the Harris-Todaro model, I distinguish between two cases: a model with sector-specific capital, and one with capital that is mobile between the urban and rural sectors. For simplicity, I will assume that capital income is distributed so that it raises all incomes in the same proportion. This simple trick means that inequality in wage income corresponds to inequality in all income. Alternatively, one can see the following analysis as limited to the distribution of wage income.

3.1 The model with sector-specific capital

It turns out that it is relatively straightforward to use (U1)-(U3) and (D1)-(D3) to study wage inequality in the Harris-Todaro model with sector-specific capital. We can base the analysis around a simple and now well-known diagram introduced by Corden (1974) and Corden and Findlay (1975), shown as figure 2.

MM' is the marginal product curve in modern sector, AA' that in agriculture. The ingenious feature of the diagram is the rectangular hyperbola qq'. The intersection of qq' with AA' represents an equilibrium in which the Harris-Todaro equilibrium condition (1) is satisfied. To see this, note that the area under the curve at this intersection is equal to $w_{\mathsf{a}}(1 - L_{\mathsf{a}})$ or alternatively $w_{\mathsf{a}}(L_{\mathsf{m}} + L_{\mathsf{u}})$. Given that the qq' curve is a rectangular hyperbola, this area must be equal to the area under the curve at point H, namely $w_{\mathsf{m}}L_{\mathsf{m}}$. It is easy to show that equality between the area $w_{\mathsf{m}}L_{\mathsf{m}}$ and the area $w_{\mathsf{a}}(L_{\mathsf{m}} + L_{\mathsf{u}})$ implies that the Harris-Todaro equilibrium condition (1) is satisfied at the intersection of qq' with AA'.

This diagram is now used to analyze the effects of growth on wage inequality. Assume that the urban wage rate is fixed, and that returns in agriculture are diminishing, so that AA' slopes downwards. Capital accumulation or technical progress in agriculture will shift AA' upwards and raise the agricultural wage. By (1), the urban unemployment rate must be lower in the new equilibrium. Since modern sector employment is unchanged, while agricultural employment goes up, the number of unemployed must fall. With a fall in both the urban unemployment rate and the number of unemployed, it is clear that growth in the agricultural sector leads to an unambiguous reduction in wage inequality.

Now consider the case of capital accumulation or technical progress in the modern sector. The demand for labour at any given wage increases. MM' and qq' shift upwards, so modern sector employment goes up, agricultural employment goes down, and the agricultural wage rises. In the new equilibrium the urban unemployment rate will be lower, again by (1). This means that growth in the modern sector cannot generate an unambiguous rise in wage inequality, given diminishing returns in agriculture. What happens to inequality will depend on whether the number of unemployed goes up or down. If it does not rise, there will be an unambiguous reduction in wage inequality. Otherwise, the old and new Lorenz curves will intersect.

I now consider the case where returns to labour in agriculture are constant, so that the AA' line is horizontal. Capital accumulation or technical progress in agriculture shifts the AA' line upwards. With unchanged labour demand in the modern sector, employment in the modern sector stays the same, while agricultural employment and wages go up. The number of unemployed must be lower in the new equilibrium, as is the urban unemployment rate. There is again an unambiguous reduction in inequality.

Capital accumulation or technical progress in the modern sector shifts the MM' and qq' curves upwards. With both the agricultural and modern sector wages constant, the urban unemployment rate must be constant. Modern sector employment will be higher in the new equilibrium, and agricultural employment lower. For the urban unemployment rate to remain constant, the number of unemployed must rise. Using condition (U2) above, this is sufficient for an unambiguous rise in wage inequality.

3.2 The model with mobile capital

I now turn to the case of the Harris-Todaro model with mobile capital, drawing heavily on the classic analysis of Corden and Findlay (1975). They point out that when capital is mobile between sectors, an increase in the aggregate capital stock or a change in the size of the labour force will leave the urban unemployment rate unchanged. Thus, when factor endowments vary, it is only movements in the number of unemployed that determine the outcome for wage inequality.

I follow Corden and Findlay in assuming that the modern sector is relatively capital intensive. With this assumption, Corden and Findlay show that capital accumulation will increase the number of unemployed, even though the urban unemployment rate remains constant. By condition (U2) above, this yields a rise in inequality. Modern sector employment must also be higher in the new equilibrium, otherwise the urban unemployment rate would not be constant. Hence

capital accumulation is associated with both greater inequality and increased urbanization.

As pointed out by Corden and Findlay, the effects of capital accumulation may be modified by land scarcity. This is considered in more detail by Yabuuchi (1998). He concludes that, under certain conditions, capital accumulation may decrease the number of unemployed. Hence in a more general model, it may well be difficult to draw firm conclusions about the effect of capital accumulation on inequality.

In the simpler model without land, the effects of technical progress in either agriculture or modern sector can also be analyzed. Now, the urban unemployment rate may vary. Corden and Findlay show that Hicks-neutral technical progress in agriculture lowers the urban unemployment rate and the number of unemployed. Using condition (D1) above, this is sufficient for an unambiguous reduction in wage inequality. They also show that Hicks-neutral technical progress in the modern sector has the reverse effect: it raises the urban unemployment rate and the number of unemployed.[6] Inequality must rise. Since agricultural employment must fall, economic growth is again associated with urbanization and greater inequality.

3.3 Summary of the results

The main results of this section can be summarised as follows. In all the cases considered, technical progress in agriculture leads to an inwards shift of the entire Lorenz curve. The reason is not simply a reduction in the intersectoral wage gap between those in work in urban and rural areas. There is also a reinforcing general equilibrium effect. In the new migration equilibrium, growth in the agricultural sector implies that the extent of inequality between the employed and unemployed is lower.

The effect of technical progress in the modern sector is more complex, and depends on the underlying assumptions. There will be an unambiguous rise in wage inequality if capital is mobile across sectors, or if capital is sector-specific and returns in agriculture are constant. With sector-specific capital and diminishing returns in agriculture, the urban unemployment rate falls. The Lorenz curve will shift inwards, or intersect with the old one, depending on whether the number of unemployed goes up or down. The reason for this complexity is again general equilibrium effects. An improvement in prospects in the urban sector encourages migration from agriculture, and this affects the extent of un-

[6] Beladi and Naqvi (1988) show that the conclusions about the rate of unemployment apply to any kind of technical progress in manufacturing or agriculture, not just Hicks-neutral.

employment, and hence the extent of inequality between the employed and the unemployed.

Other interesting results concern urbanization, defined here as a fall in rural employment. In most of the cases considered, falling rural employment will occur at the same time as unambiguous increases in wage inequality. The exception is urbanization driven by capital accumulation or technical progress in the modern sector, in the case with diminishing returns to agricultural labour and sector-specific capital. Then reductions in wage inequality may occur at the same time as urbanization.

4 Distributional effects of policy intervention

The introduction of the dual economy model of Harris and Todaro (1970) was soon followed by analysis of various policy interventions. One omission in this literature is that it typically concentrates on aggregate output, and ignores distributional effects. This section will show that policy changes which fall short of achieving the first-best may in fact lead to a rise in wage inequality, suggesting an ambiguous effect of the policy intervention on social welfare. For simplicity, I focus on the case of sector-specific capital.

The first observation is that inequality in the model arises only because of unemployment, which in turn arises because of the exogenously fixed wage in the urban sector. One reason the urban wage may be fixed is through minimum wage legislation, under the control of the government. It is therefore interesting to consider the distributional impact of lowering this wage, and that task will be achieved by section 4.1 below.

The urban wage may, however, be rigid downwards for reasons other than minimum wage legislation. With this in mind, various authors have considered a range of policy interventions that take the wage received by urban workers as given. Policies that can potentially eliminate unemployment altogether include a modern sector wage subsidy (Srinivasan and Bhagwati 1975), an agricultural wage subsidy (Corden and Findlay 1975) and a uniform wage subsidy (Bhagwati and Srinivasan 1974, Corden 1974, Basu 1980). In practice, such policies are likely to be difficult to implement. The wage subsidy may lie below the level needed to achieve the first-best outcome, and again it is interesting to explore the distributional impact of such a policy. That will be the task of section 4.2 below.

4.1 Inequality and minimum wages

Given that the motivation for introducing a minimum wage is often to reduce inequality, it is interesting to note that the origin of inequality in simple versions of the Harris-Todaro model is precisely the setting of a minimum wage above the market clearing level. In this very simple framework, abandoning the minimum wage will lead to an unambiguous reduction in wage inequality.[7] It might be thought that lowering the minimum wage, but keeping it above the market-clearing level, would have the same effect. In this section, I show that this is usually true, but not always. The reason is that a reduction in the minimum wage can actually increase the number of unemployed in the sector covered by the minimum wage legislation, as previously demonstrated by Feldman (1989) and Fields (1997).

It can be shown that a reduction in the minimum wage always lowers the urban unemployment rate. In contrast, the effect on the number of unemployed is ambiguous, because the reduced risk of unemployment may lead to migration from rural areas. The urban sector may increase in size sufficiently that the net effect is a rise in the number of people unemployed. To see this more formally, denote the constant wage elasticities of labour demand in the modern sector and agriculture by η and ϵ respectively (both defined to be positive). Feldman (1989) shows that the change in unemployment, in response to a percentage change in the minimum wage of $\hat{w}_{\mathsf{m}}$, is given by:

$$dL_{\mathsf{u}} = \left[\frac{L_{\mathsf{a}}\epsilon(1-\eta)}{1+\epsilon(L_{\mathsf{a}}/(1-L_{\mathsf{a}}))} + L_{\mathsf{m}}\eta \right] \hat{w}_{\mathsf{m}}$$

It is clear that if $\eta > 1$, the term in square brackets could possibly be negative, in which case a reduction in the minimum wage will lead to an increase in the number of unemployed, if the minimum wage remains above the market-clearing level. The next question is the likelihood of this outcome in practice. Using (3) and simplifying, it can be shown that the critical value of η is given by

$$\eta^* = \frac{\epsilon}{u\epsilon + \left(1 - \frac{1}{L_{\mathsf{a}}}\right)(1-u)} \tag{10}$$

Only if the wage elasticity of labour demand in modern sector is at or below η^* will a reduction in the minimum wage lead to an unambiguous reduction in wage inequality. Differentiation of (10) reveals that η^* is decreasing in ϵ,

[7] Note that the introduction of a minimum wage may have very different effects in a more complicated model. For instance Rodrik (1996) demonstrates that the introduction of a minimum wage may have beneficial effects on output in a model with multiple equilibria, and that the minimum wage need not bind in equilibrium.

agricultural employment (L_{a}) and the unemployment rate (u). Even choosing high values for these parameters, a few simple calculations indicate that $\eta > \eta^*$ is unlikely. For instance, setting $L_{\mathsf{a}} = 0.8$, $u = 0.3$, and $\epsilon = 2$ means that η^* is 4.7. This means that the threshold is unlikely to be reached in practice: the elasticity of labour demand in the urban sector is often assumed to be less than one, as in Agénor (1996, fn. 21). This suggests that for most plausible parameter values, any reduction in the minimum wage will lead to an unambiguous reduction in wage inequality in this simple model. In practice, however, it is essential to emphasize that this effect could be more than offset by a host of others.

4.2 A uniform wage subsidy

In the first best allocation there is no unemployment, and the marginal product of labour in the modern sector is equal to that in agriculture. In an elegant paper Basu (1980) shows that any uniform wage subsidy S greater than or equal to a threshold S^* (to be defined below) will achieve the first-best allocation. Basu also shows that any smaller subsidy $S \in (0, S^*)$ will raise social welfare, where social welfare is measured by total output. This section extends his work by introducing distributional considerations into the welfare analysis.

More specifically, it will be shown that a small uniform subsidy $S \in (0, S^*)$ has an ambiguous effect on the distribution of income. Output in each sector is a function of labour input,

$$\begin{aligned} X_{\mathsf{a}} &= f_{\mathsf{a}}(L_{\mathsf{a}}); \quad f'_{\mathsf{a}} > 0, f''_{\mathsf{a}} < 0 \\ X_{\mathsf{m}} &= f_{\mathsf{m}}(L_{\mathsf{m}}); \quad f'_{\mathsf{m}} > 0, f''_{\mathsf{m}} < 0 \end{aligned}$$

where as before a denotes agriculture and m denotes the modern sector. Labour is the only variable input, consistent with the presence of fixed sector-specific capital stocks.

If labour is paid its marginal product, and there is a uniform subsidy S, then we have

$$f'_{\mathsf{m}}(L_{\mathsf{m}}) = w_{\mathsf{m}} - S \tag{11}$$

$$f'_{\mathsf{a}}(L_{\mathsf{a}}) + S = (1-u)w_{\mathsf{m}} \tag{12}$$

Note that the optimal subsidy is $S^* = w_{\mathsf{m}} - f'_{\mathsf{m}}(L^*_{\mathsf{m}})$ where L^*_{m} is the level of modern sector employment in the first best allocation. The number of unemployed is given by

$$L_{\mathsf{u}} = 1 - L_{\mathsf{m}} - L_{\mathsf{a}}$$

The effect of the subsidy is given by

$$\frac{dL_{\mathsf{u}}}{dS} = -\frac{dL_{\mathsf{m}}}{dS} - \frac{dL_{\mathsf{a}}}{dS}$$

Using results in Basu (1980, p. 194) and equation (11), it can be shown that

$$\frac{dL_{\mathsf{u}}}{dS} = \frac{f'_{\mathsf{m}} - f'_{\mathsf{a}} + (1 - L_{\mathsf{a}})(f''_{\mathsf{m}} + f''_{\mathsf{a}})}{f''_{\mathsf{m}}\left[(1 - L_{\mathsf{a}})f''_{\mathsf{a}} - f'_{\mathsf{a}} - S\right]} \tag{13}$$

Since $f'_{\mathsf{m}} > f'_{\mathsf{a}}$ outside the first best allocation, the sign of (13) is ambiguous, and so a uniform wage subsidy below S^* will have an ambiguous effect on the number of unemployed and hence on wage inequality. The possibility is open that a uniform subsidy below the optimal level may do more harm than good, although the generality of this result is not clear.

5 Some extensions

I now consider the effects of extending the simple model studied above. First, I consider an unemployment benefit funded by an income tax on urban workers. Secondly, the paper considers how the analysis will be modified by a non-zero wage for the unemployed, reflecting the possibility that they could find work in an informal sector. Unambiguous changes in wage inequality are found to be unlikely in these more general models. This has implications for the generality of Kuznets curve results, a point that will be discussed at greater length in the next section.

5.1 Unemployment benefits

So far, it has been assumed that the unemployed have no income. I now consider extending the model to incorporate unemployment benefit. The benefit is funded by a proportional income tax on urban employees, at a fixed rate $0 < t < 1$. The underlying assumption is that it may be easier to tax the incomes of urban workers than the incomes of those working in agriculture.

With the tax in place, the income of each urban worker is $(1-t)w_{\mathsf{m}}$. If the entire tax revenue is used to fund the unemployment benefit, the income of each unemployed person will be $w_{\mathsf{u}} = \frac{1-\mathsf{u}}{\mathsf{u}}\, tw_{\mathsf{m}}$. Since the tax just redistributes income within urban areas, it does not affect the expected income of urban living. Hence the allocation of workers between rural and urban areas is independent of the tax under the assumption of risk neutrality, and in the absence of labour supply effects of the tax.

This can be demonstrated very simply: the new Harris-Todaro equilibrium condition

$$uw_{\mathsf{u}} + (1-u)(1-t)w_{\mathsf{m}} = w_{\mathsf{a}}$$

simplifies to the condition in the absence of a tax,

$$(1-u)w_{\mathsf{m}} = w_{\mathsf{a}}$$

confirming that the tax does not affect the intersectoral allocation of workers. Similarly, average income remains w_{a}. To ensure that some workers are employed in each sector, I assume that

$$w_{\mathsf{u}} < w_{\mathsf{a}} < w_{\mathsf{m}}$$

which can be written as:

$$\left(\frac{1-u}{u}\right) tw_{\mathsf{m}} < w_{\mathsf{a}} < (1-t)w_{\mathsf{m}}$$

for which a necessary condition is $t < u$.

The main difference to the earlier analysis is now that the first segment of the Lorenz curve slopes upwards, with slope t/u. Hence this segment gets steeper as the unemployment rate falls, and this makes the necessary and sufficient conditions for an unambiguous change in (after-tax) wage inequality much more complicated. The most interesting finding is that a rise in the number of unemployed is potentially compatible with a decrease in wage inequality, provided the urban unemployment rate falls sufficiently far.

Obviously a rise in the tax rate will lead to an unambiguous reduction in wage inequality, because it reduces inequality between the employed and unemployed, and after-tax inequality between urban and rural workers. The Gini coefficient in this model is given by

$$G = L_{\mathsf{u}}\left(1 - \frac{t}{u}\right)\left(2 - \frac{L_{\mathsf{u}}}{u}\right)$$

which is lower than in (9) unless the tax rate is zero, as required.

5.2 The informal sector

This section considers an alternative and more general assumption about the income of the unemployed. I assume that those not employed in the modern sector can find work in the informal sector, and hence earn a wage $w_{\mathsf{u}} < w_{\mathsf{a}} < w_{\mathsf{m}}$. Once again, mean income will be given by w_{a} in the Harris-Todaro equilibrium.

The introduction of an informal sector makes the necessary and sufficient conditions rather more complicated. Perhaps the main point to note is that an unambiguous reduction in inequality now has an additional necessary condition:

$$\frac{w_{\mathsf{u}2}}{w_{\mathsf{a}2}} \geq \frac{w_{\mathsf{u}1}}{w_{\mathsf{a}1}}$$

In other words, if the Lorenz curve is to shift inwards, the ratio of the informal sector wage to the agricultural wage must increase. If we assume that the agricultural wage rises with the level of development, as seems likely, then an unambiguous reduction in wage inequality is not possible unless the informal sector wage is also increasing.

That the conditions for changes in inequality are more complicated can also be seen from the Gini coefficient. It is not difficult to show that the Gini coefficient in this model is given by:

$$G = L_{\mathsf{u}} \left(2 - \frac{L_{\mathsf{u}}}{u}\right) \left(1 - \frac{w_{\mathsf{u}}}{w_{\mathsf{a}}}\right)$$

This expression makes clear that knowing what happens to the number of unemployed and the urban unemployment rate is no longer sufficient to tell us what happens to wage inequality. Now, we need to know something about the evolution of the agricultural and informal sector wages as well. A natural assumption is that w_{u} is fixed, perhaps because the production technology in the informal sector has constant returns to labour and does not benefit from technical progress. If w_{u} is fixed then a sufficient condition for inequality as measured by the Gini coefficient to rise is that at least one of w_{a}, L_{u} and u increase and none decrease.

6 Discussion

This section provides some further discussion. The aim is to put the findings of the paper in context, and highlight the various strengths and weaknesses of the present approach. I also consider the implications of the analysis for the Kuznets curve hypothesis.

One of the main contributions of the paper has been to follow Fields (1979, 1980) in demonstrating that general statements about wage inequality are difficult to make even in very simple models. Usually, the movement to a new long-run equilibrium is associated with a new Lorenz curve that intersects the old one. This ambiguity is present even though the paper abstracts from many important aspects of the real world, including remittances, migration decisions made at the household level rather than by individuals, and heterogeneity within

the urban and rural sectors. Stark (1991) has drawn attention to the importance of such considerations. Lipton (1980) pointed out that the introduction of heterogeneity can alter the relation between migration and changes in wage inequality.

Lipton also suggested that "most neoclassical economists would expect voluntary population movements to reduce both inefficiency and inequality" (Lipton 1980, p. 1). As we have seen, Lipton's neoclassical economist would be wrong if there are imperfections in the urban labour market, such as an exogenously fixed wage. Economic development in the urban sector, or a removal of barriers to migration, can generate population movements that sometimes lead to a greater number of unemployed in urban areas. If this is the case, then at best the new Lorenz curve will intersect with the old one, and at worst lie entirely outside it. This suggests that migration policy will sometimes involve an efficiency-equity trade-off.

Analysis of the entire Lorenz curve can also shed light on other hypotheses, notably the Kuznets curve. In principle, one could distinguish between two versions of the Kuznets hypothesis. A model yielding a 'measure-independent' Kuznets curve would be one in which all Lorenz-consistent inequality measures indicated a worsening of distribution with economic growth, followed by an improvement. This would require the Lorenz curves to shift in and out without ever intersecting, and as we have seen, this is unlikely in all but the simplest models. Hence more usually the Kuznets curve will be 'measure-specific'. The pattern of rising and then falling inequality will only be observed, if at all, for a subset of Lorenz-consistent summary measures.[8]

The framework used in this paper indicates that the Kuznets curve is unlikely to be a general outcome of two sector models in which wage inequality is driven by sectoral productivity growth and migration. The effects of development on wage inequality were found to depend on the source of growth, agriculture or the modern sector. It is true that productivity growth in the agricultural sector unambiguously reduces wage inequality, but only if the unemployed receive no income.

As noted previously, a full understanding of these questions would require a richer model. Previous analyses of the Kuznets curve in two sector models have

[8]One well-known result in this area is the finding of Anand and Kanbur (1993) that, for the decomposable measures of inequality they consider, the distribution of income must worsen at the start of development. Although this result seems quite powerful, it is less strong than it first appears. Anand and Kanbur define the start of the process as an increase in the share of population in the modern sector from zero. Arguably, the initial state of the Kuznets migration process should be seen as a steady state with at least some modern sector employment, even in the very poorest countries.

often assumed a fixed wage differential between the urban and rural areas, where the source of the differential is left unexplained. In this paper, I have allowed the differential to be determined endogenously through a long-run migration equilibrium condition, but have assumed that the urban wage is exogenously fixed. In analysing a long-run phenomenon such as the Kuznets curve, it would obviously be preferable for the urban wage to be determined endogenously. Analysis along these lines has been carried out by MacLeod and Malcomson (1998) using a more complex model. They show how the generation of jobs in the urban sector has implications for inequality as measured by the Gini coefficient. Again, though, it seems likely that the Lorenz curves will sometimes intersect, ruling out unambiguous statements about movements in wage inequality.

7 Conclusions

The starting point for this paper is the observation that, although the Harris-Todaro model has been much studied, its implications for inequality have been examined only rarely. The paper remedies this omission, using a simplified version of the model to investigate the effects of growth on wage inequality. Compared to many earlier studies of inequality in dual economies, a considerable strength of the paper is the use of Lorenz curves rather than summary measures. Hence the analysis in this paper is based on less restrictive assumptions, and allows a more reliable assessment of where unambiguous conclusions may be possible, and where theoretical ambiguity is inevitable. The paper derives a set of necessary and sufficient conditions for unambiguous movements in wage inequality, based on just two variables, the urban unemployment rate and the number of unemployed.

These conditions are then used to study the consequences of economic growth. In the simplest version of the model, the most interesting result is that growth in the agricultural sector leads to an unambiguous reduction in wage inequality. The effects of growth in the non-agricultural sector are less clear-cut. Despite this ambiguity, the analysis remains useful, in that it draws attention to some of the general equilibrium effects that are associated with productivity growth in two sector models. For example, an improvement in prospects in the urban sector will often be associated with rural-urban migration, and potentially greater inequality as a result.

As with previous research in this field, the paper provides only partial insight into the relationship between growth and wage inequality. Nevertheless, it is clear that two sector models can make a useful contribution to understand-

ing these issues. A particular strength of the two sector approach is that one can easily distinguish between the effects of different types of economic growth. This is likely to be a more productive research strategy than one restricted to reduced form, Kuznets-type relationships between levels of GDP per capita and inequality.

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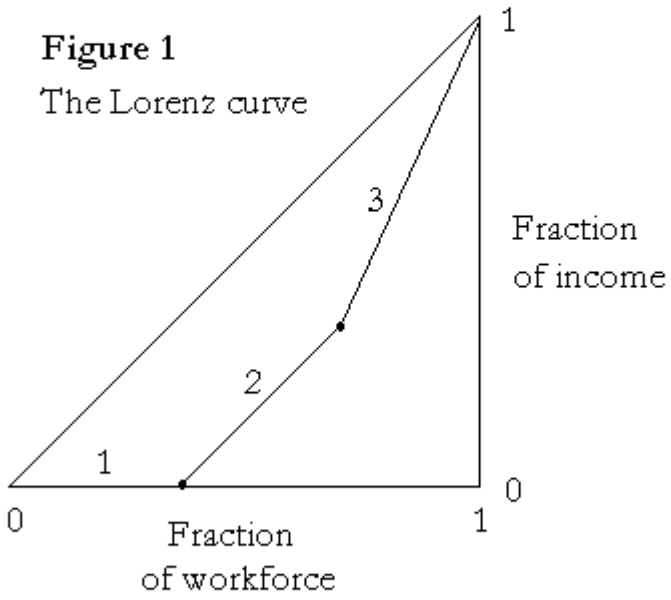

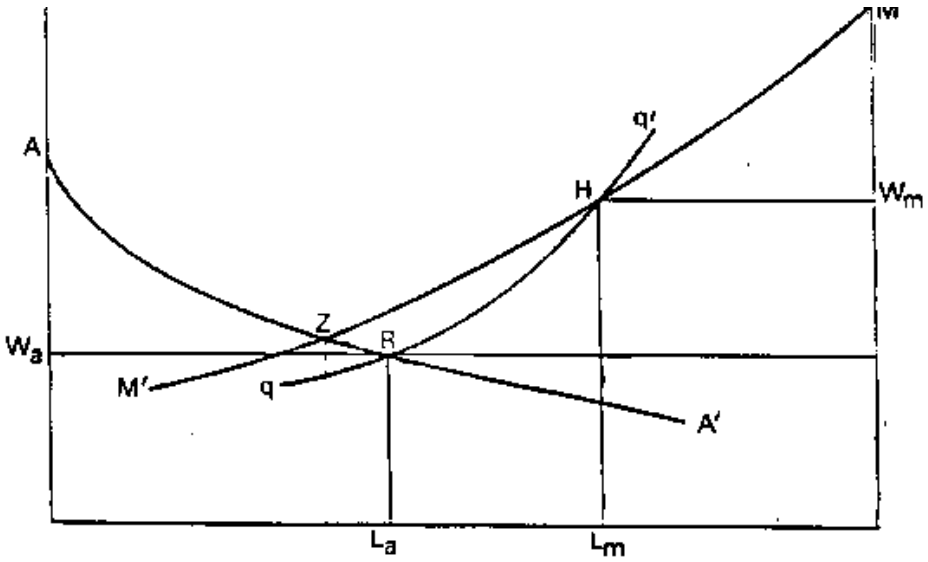

FIGURE 2 - Intersectoral labour allocation in the Harris-Todaro model