On Reanalyzing the Harris-Todaro Model: Policy Rankings in the Case of Sector-Specific Sticky Wages

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In a brilliant and pioneering paper, John Harris and Michael Todaro introduced a model with two sectors, manufacturing (urban) and agriculture (rural), a (sticky) minimum wage in manufacturing and consequent unemployment. They also introduced a labor allocation mechanism under which, instead of the usual equalization of *actual* wages, the actual rural wage was equated with the expected urban wage; the latter was defined as the (sticky) minimum wage weighted by the rate of employment, so that, unlike in the standard rigid-wage models of trade theory (for example, Gottfried Haberler, Bhagwati, Harry Johnson, Louis Lefeber, and Richard Brecher), the unemployment resulting from the minimum wage is to be construed as *specific* to the urban sector.

In the context of this model, Harris and Todaro analyze two policies: 1) a wage subsidy policy in the manufacturing sector (alone); and 2) a labor-mobility restriction policy. They argue that the former, as well as the latter, can be used to improve welfare, defined as a function of available goods in the usual way; but that, to attain the optimal first best solution, *both* policies are necessary. The authors express regret at the necessity of using migration restrictions in view of the "... ethical issues involved in such a restriction of individual choice and the complexity and arbitrariness of administration" and end their exercise with the sentiment that:

> All of the above suggests that altering the minimum wage may avoid the problems of taxation [to finance the wage subsidy in manufacturing], administration, and interference with individual mobility attendant to the policy package just discussed. Income and wage policies designed to narrow the rural-urban wage gap have been suggested by D. P. Ghai, and Tanzania has formally adopted such a policy along with migration restriction. In the final analysis, however, the basic issue at stake is really one of political feasibility and it is not at all clear that an incomes policy is any more feasible than the alternatives. [p. 138]

We argue in this paper that this dilemma is unnecessary *in principle*, the reasons being that:

1) a *uniform* wage subsidy, regardless of the sector of employment, will yield the optimal, first best solution;

2) equivalently, a wage subsidy in manufacturing *plus* a production subsidy to agriculture will yield the optimal, first best solution;

3) in either case, no resort to "ethical compromises" in the direction of sanctioning migration restrictions will be necessary;

4) proposition 2) implies that the authors' argument that the traditional prescription to use shadow pricing of labor (i.e., a wage subsidy in employment) is inapplicable to their model is not correct and their conclusion stems from equating this prescription with the prescription that the wage subsidy be given for employment in the manufacturing sector alone; and

5) proposition 2) also implies that the authors' contention that *two* policies are necessary to attain the first best optimum is not valid *unless* one construes a general wage subsidy to constitute *two* policies when there are *two* sectors employing labor.

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In demonstrating these propositions, we should note that the Harris-Todaro formal model has a demand function which is not related to the utility function in their (later) welfare analysis, so that their analytical system is open to the possibility of being overdetermined. We therefore rewrite their model, with the utility function explicitly incorporated into the model, eliminating the "additional" demand equation of Harris and Todaro.

Since the basic problems with the Harris-Todaro analysis relate to their first best optimal-policy characterization, we begin with analysis of the first best, optimal policy in the model.[1] However, we also take the opportunity to extend the analysis in Section II to two second best policy measures: wage subsidy in manufacturing and production subsidy to agriculture; both policies can be shown to be equivalent, singly or in combination, to all other conceivable policy interventions in the model. However, rather than prove these results with rigor—we have done this elsewhere in a companion paper—we produce numerical examples in the Appendix to establish and illustrate the least intuitive among them.

I. The Model

We may now restate the Harris-Todaro model. First, there are two production functions:

$$X_A \leqq f_A(L_A) \tag{1}$$

$$X_M \leqq f_M(L_M) \tag{2}$$

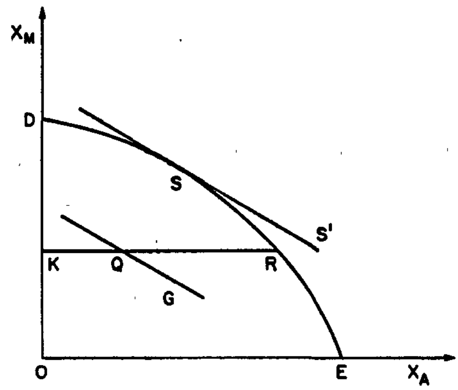
where X_A and X_M are the output levels of agriculture (rural sector) and manufactures (urban sector), respectively, and L_A, L_M are the labor-input levels in the two sectors. The functions are strictly concave. The labor supply is fixed and assumed to be unity by choice of units:

$$L_A + L_M \leqq 1 \tag{3}$$

We then have a standard, social utility function:

$$U = U(X_A, X_M) \tag{4}$$

[1] An error of detail is picked up later in this paper.



DE is the production possibility curve when wage rigidity is absent. With the wage rigidity constraint, equilibrium production under *laissez-faire* can lie only along *RK* instead of *RD*, because equilibrium on *RD* (excluding *R*), as at *S*, implies wage in manufacturing *below* the minimum wage. *Q* is the *laissez-faire* production point under price-ratio *QG* under the wage constraint. For simplicity, the diagram depicts the price-ratio at *S* and *Q* to be identical, implying *either* a linear utility function for a closed economy *or* a "small," open economy with unchanging terms of trade. The formal analysis in the text is not restricted to linear utility functions; but it does *not* apply, without amendment, to a "large" open economy with monopoly power in trade.

FIGURE 1

where U is concave with positive marginal utilities for finite $[X_A, X_M]$.

For a fully competitive economy, the resulting equilibrium can be shown in Figure 1 at S where the production possibility curve DE is tangent to SS' and

$$\frac{U_1}{U_2} = \frac{f'_M}{f'_A} \tag{5}$$

with U_1/U_2 equal to the negative of the slope of SS', and U_1 and U_2 representing the partial derivatives of U with respect to X_A and X_M, respectively.

But we now assume that the wage in manufacturing is fixed as a minimum, so that for this competitive economy, we must have:

$$f'_M(L_M) = \bar{w} \tag{6}$$

If we then assume that this constraint is binding at S, the first best optimal solution is inadmissible and unemployment ensues.[2] The system could then have been characterized nonetheless by the equalization of *actual* wages in the two sectors. Harris and Todaro, however, chose to rewrite the wage-equalization equation in terms of the *expected* wage in manufacturing, defined as the actual wage there weighted by the rate of employment, so that the critical equilibrium conditions in their model, relevant for our analysis, are

$$f_M' = \bar{w} \tag{7}$$

$$\frac{U_1}{U_2} f_A' = \bar{w} \frac{L_M}{1 - L_A} \tag{8}$$

where the total labor force is assumed to be one by choice of units and where consumption and production price of the agricultural good is identical and equal to U_1/U_2.

With $\bar{w}$ specified, (7) and (8) can be solved for L_M and L_A, using the two production functions. The *laissez-faire* equilibrium, with unemployment ($L_M < 1 - L_A$), will then lie in Figure 1 along RK (where X_M and hence L_M are fixed at the value that makes $f_M = \bar{w}$) at Q. (It may be emphasized that the *laissez-faire* equilibrium would so lie along RK even if actual wages were equalized in the two sectors: nothing critical to our interests hangs on the *expected*-wage wrinkle in the Harris-Todaro analysis.)

As for the available policy instruments (that use the price mechanism as distinct from direct allocation mechanisms) in this model, we note now the following:

(i) *laissez-faire*;
(ii) wage subsidy in manufacturing;
(iii) production subsidy to agriculture.

The structure of the model also implies the following equivalences:

(iv) a wage subsidy in agriculture is equal to policy (iii);[3]
(v) a uniform wage subsidy in all employment is a combination of policies (ii) and (iii);
(vi) for a closed economy, a consumption tax-cum-subsidy is equivalent to policy (iii), i.e., a production tax-cum-subsidy;[4]
(vii) for an open economy, a tariff (trade subsidy) policy would, as usual, be equivalent to policy (iii), i.e., a production tax-cum-subsidy policy, *plus* a consumption tax-cum-subsidy policy.[5]

One final point may be noted. Our analysis does *not* explicitly distinguish between a

[2] Needless to say, unemployment is inevitable only if we assume that the unemployed labor will not prefer certain employment at a lower wage in the agricultural sector to uncertain employment in the manufacturing sector at a higher wage. One has to contemplate therefore *either* a randomized process by which everyone in the manufacturing labor force gets an equal crack at the manufacturing jobs, so that *each* on the average gets the expected wage *or* that the unemployed workers return to employment in the agricultural sector. In the latter case, we could wind up with the wage-differential, full employment model which has already been extensively analyzed in trade-theoretic literature.

[3] We are assuming, in writing equation (7), that the producer and consumer prices of the manufacturing good (in terms of any arbitrary unit of account) are the same, i.e., in effect, the producers of the manufacturing good are paying the workers the wage $\bar{w}$ in kind. Hence, the effect of a production subsidy to manufacturing is essentially not to affect any real decisions, as those made *via* equations (7) and (8), but merely to increase each commodity price in terms of the (arbitrary) unit of account. However, if we were to assume instead that the producer and consumer prices of the manufacturing good could be made to differ by policy, then the worker in manufacturing would earn the value of his marginal product at the producer price and then, *qua* consumer, must have enough income (in terms of the unit of account) to buy $\bar{w}$ units of the manufacturing good. In that case, a wage subsidy policy to manufacturing would be equivalent to a production subsidy policy to manufacturing, as is the case in the agricultural sector. Thus note that, if we did shift to the latter, alternative assumption on wage payment in the manufacturing sector, then the analysis would not change but our policy equivalences would. In particular, the first best optimal policy mix would then include: a uniform production subsidy to both sectors; and a production subsidy in manufacturing and a wage subsidy in agriculture.

[4] Thus, let $\pi_p = \bar{w}L_M/(1-L_A)f_A'$ be the production price of the agricultural good and $\pi_c = U_1[X_A, X_M]/U_2[X_A, X_M]$ be the consumption price of the agricultural good. The production tax-cum-subsidy is then $(\pi_p - \pi_c)/\pi_c$; and the consumption tax-cum-subsidy is $(\pi_c - \pi_p)/\pi_p$.

[5] Thus, if π^* is the international price of the (importable) agricultural good, a tariff at *ad valorem* rate t would imply: $\pi^*(1+t) = \pi_p = \pi_c$.

closed and an open economy. Since it relates essentially to the *production* equilibrium in the economy, and since it allows the utility function to be linear or non-linear, it can be interpreted as applying *either* to a closed economy *or* to an open economy with given terms of trade.[6]

II. Optimal Policy Intervention

It is easy to see that the first best optimum can be reached in this model by the use of a uniform wage subsidy *or*, equivalently, by the use of a wage subsidy in manufacturing and a production subsidy to agriculture. Thus, let

$$s^* = \bar{w} - f_M'(L_M^*)$$

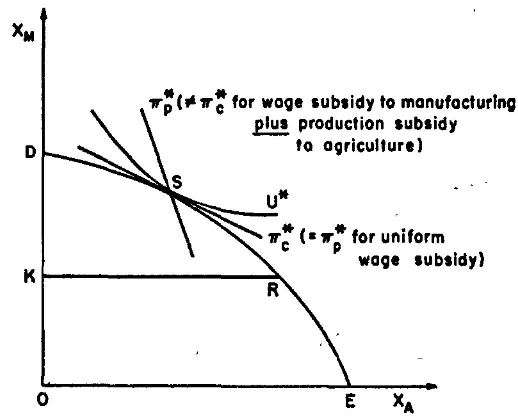
be the wage subsidy (financed by appropriate lump sum taxation) in manufacturing, with the asterisks denoting first best values. If this subsidy is also extended to employment in agriculture, we should write the equilibrium condition in production as:

$$f_M' = \bar{w} - s^* \tag{9}$$

$$\pi_c^* f_A' = \bar{w} - s^* \tag{10}$$

where $\pi_c^* = U_1(X_A^*, X_M^*)/U_2(X_A^*, X_M)$ is the consumption price (equal to the producer's price $\pi_p^* = f_M'/f_A'$) of the agricultural good. It is clear then that the constraints of the model are met (i.e., the wage rate in manufacturing is at $\bar{w}$ *and* the wage rates are equalized at the producer's prices in both sectors) and full employment optimal equilibrium is reached with wage subsidy at level s^* in both sectors. Thus, in Figure 2 (which illustrates for a closed economy case), the resulting full employment, optimal equilibrium is at S, with $\pi_c^* = \pi_p^*$, (and the domestic, marginal rates of transformation in production and in consumption are equal at S).

Alternatively, we could have used a wage subsidy in manufacturing (alone) at level s^*



S is the first best, optimum for a closed economy, with the social utility curve U^* tangent to the production possibility curve DE. A suitable, uniform wage subsidy to both sectors, A and M, will equate the consumption and production prices with the domestic rates of transformation in production and substitution in consumption at S. A suitable wage subsidy to manufacturing *plus* production subsidy to agriculture will not equate the consumption and production prices but will equate the two rates of substitution in consumption and transformation in production at S with each other and with the consumption price alone.

FIGURE 2

and combined it with a production subsidy in agriculture. Thus, with

$$\pi_p^* = \frac{\bar{w}}{f_A'(L_A^*)}$$

as the producer's price of the agricultural good, and π_c^* as the consumer's price of the agricultural good, as before, we have:

$$t^* = \frac{\pi_p^* - \pi_c^*}{\pi_c^*}$$

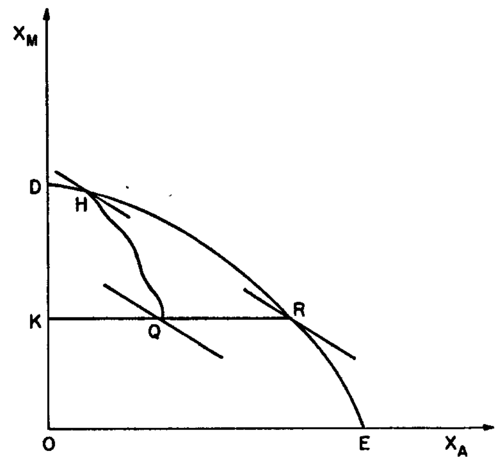
as the optimal subsidy to agriculture. With the optimal values for s^* and π_p^*, we then have:

$$f_M' = \bar{w} - s^* \tag{11}$$

$$\pi_p^* f_A' = \bar{w} = \bar{w} \cdot \frac{L_M^*}{1 - L_A^*} \tag{12}$$

and, once again, we note that the constraints in the model are met, and full employment, optimal equilibrium is reached with wage

[6] The analysis would have to be amended to bring in the foreign reciprocal demand function explicitly into the formal model if we were to consider the case of a country with monopoly power in trade. For a "small," open economy, the analysis in the text for a linear utility function would be applicable without modification.



QH is the locus of production equilibria, traced out by increasing the wage subsidy in manufacturing from $s=0$ to s_{max} yielding full employment at H. QR is the locus of production equilibria, traced out by increasing the production subsidy to agriculture. While the diagram assumes the linear utility function case, as does Figure 1, for sake of simplicity, the formal analysis in the text is not so restricted. Note that, in the restricted case illustrated here, an increasing wage subsidy to manufacturing would necessarily reduce agricultural output; not so, in the general case which admits nonlinear utility functions.

FIGURE 3

subsidy in manufacturing at level s^* and production subsidy to agriculture at rate t^*.

However, while the equilibrium is again optimally at S, it is characterized now by $\pi_p^* \neq \pi_c^*$ (though of course the domestic, marginal rates of transformation in production and substitution in consumption remain equal to each other and identical to that under the uniform wage-subsidy policy at S).

Hence we have established the validity of criticisms 1)–5) leveled at the Harris-Todaro analysis at the outset of this paper.

III. Second Best Policy Intervention

The two second best policies which then can be considered are: a wage subsidy to manufacturing (considered by Harris-Todaro at some length); and a production subsidy to agriculture (not considered by Harris-Todaro, although their "migration-restriction" policy is the "quota-equivalent" thereof).

Wage Subsidy in Manufacturing: We only sketch here briefly the analysis of this policy as the Harris-Todaro results are totally correct.[7] With s as the wage subsidy in manufacturing, the equilibrium is now characterized by:

$$f'_M = \bar{w} - s \tag{13}$$

$$\frac{U_1}{U_2} f'_A = \bar{w} \cdot \frac{L_M}{1 - L_A} \tag{14}$$

Clearly, given $\bar{w}$ and s, (13) and (14) can be solved for L_M and L_A. We can then demonstrate (see our 1973 paper) that:

Starting from a *laissez-faire* equilibrium ($s=0$), on RK at Q in Figure 3, increasing s means shifting the production equilibrium Q steadily north;

the locus of successive production equilibria, mapped out by increasing s, must reach full employment (at an s_{max}) on the production possibility curve: such a locus being QH;[8]

the full employment equilibrium may be inferior welfarewise to *laissez-faire*—a proposition which we illustrate with a numerical example in the Appendix;

a wage subsidy will necessarily improve welfare (i.e., $dU/ds > 0$ at $s=0$); and

the second best wage subsidy need not be characterized by full employment, so that tradeoff possibilities between increased welfare (*via* a standard social utility function of the type deployed by Harris and Todaro, and in this paper) and reduced unemployment may be pertinent.

Production Subsidy to Agriculture: For the case where the policy instrument is a production subsidy to agriculture, the equilib-

[7] We have also developed the second best analysis at much greater length, and with formal rigor, in the companion paper cited earlier. Instead, we give numerical examples in the Appendix to illustrate the major propositions listed here.

[8] Harris and Todaro incorrectly argue, p. 134, that the full employment equilibrium with a wage subsidy in manufacturing can be inside DE, off the production possibility curve. They forget that labor is the only factor in the model, in effect; they seem to have erred by relying on analogy with the standard two-factor model.

rium conditions are clearly rewritten as:

$$f'_M = \bar{w} \tag{15}$$

$$\pi_p f'_A = \frac{\bar{w} L_M}{1 - L_A} \tag{16}$$

where, as before, π_p is the producer's price of the agricultural good and the implied production subsidy is $(\pi_p - U_1/U_2)/(U_1/U_2)$. Clearly, given π_p and $\bar{w}$, we can solve for L_M and L_A. It is also then easy to show that:

Starting from a *laissez-faire* equilibrium ($\pi_p = U_1/U_2$), on RK at Q in Figure 3, increasing π_p will steadily shift the production equilibrium to the right along QR until full employment is reached at $\bar{\pi}_p$ at R;

the equilibrium at R is also the second best optimal equilibrium, so that the full employment, second best equilibrium is reached when $\pi_p = \bar{\pi}_p$ and there is an implied production subsidy to agriculture; and

the second best wage subsidy in manufacturing cannot be ranked uniquely with the second best production subsidy to agriculture—as illustrated by a numerical example in the Appendix.

IV. Concluding Remarks

Where do the migration-restriction policies of Harris and Todaro fit in?

If one is willing to contemplate direct, physical allocations, one can clearly reach the first best, optimal solution, S in Figure 1, by assigning the corresponding labor to the two sectors (L_A^* and L_M^*) and enforcing the rule that all labor be employed regardless of private profitability (thus yielding X_A^* and X_M^*). The Harris-Todaro policy package for reaching S, consisting of a wage subsidy in manufacturing and migration restrictions is thus a "mixed" package: one policy being of the price-mechanism variety and the other of the direct physical-mechanism variety. One could equally turn this mixed package on its head and have manufacturers forced to employ all available labor and let a production subsidy to agriculture allocate the labor force at the optimal values (L_A^* and L_M^*).

Nothing can be said, in principle, about the relative suitability of all these equivalent alternatives without bringing in other considerations, including the ethical considerations mentioned by Harris and Todaro, to introduce asymmetries/nonequivalences among them.

Further, as for second best policies, we might be able to justify the Harris-Todaro concentration on the wage subsidy to manufacturing policy, as against a uniform wage subsidy policy, on feasibility grounds. It may well be that the government's capacity to intervene is confined to the (modern) urban sector and that a wage subsidy in agricultural employment is infeasible. This is, however, a question of empirical import, and it does not really justify the exclusion from the theoretical analysis of the first best price-mechanism variety intervention.

Finally, we may note explicitly that an attempted extension of our policy rankings to actual policy implementation would have to take into account the following, well-known problems:

The administration costs *and* feasibility of alternative policies must be taken into account.

Since taxes must be collected to disburse subsidies, the question arises whether those who ask for minimum real wages will not, even when such taxes are imposed on them in a lump sum fashion, seek to revise the minimum real wage that is demanded. We have assumed, of course, that the minimum real wage demanded is independent of the tax policy chosen.

Appendix

We produce numerical examples to show that:

A full employment yielding wage subsidy in manufacturing may be inferior to *laissez-faire*.

The second best wage subsidy in manufacturing may be inferior or superior to the second best production subsidy to agriculture; the two policies cannot be uniquely ranked.

Let us consider the following production and utility functions: $f_A(L_A) = L_A^{0.75}$, $f_M(L_M) = L_M^{1/2}$, $U = pX_A + X_M$. Let p take two al-

TABLE 1

		$p=1.5$	$p=0.5$
Minimum Wage $=(L_M^*)^{-1/2}$		2.363709	1.119195
First Best Optimum	L_A	0.821017	0.201660
	X_A	0.862510	0.300929
	L_M	0.178983	0.798340
	X_M	0.423064	0.893499
	U	1.716828	1.043963
Laissez-Faire Equilibrium	L_A	0.908222	0.499286
	X_A	0.930345	0.593967
	L_M	0.044746	0.199585
	X_M	0.211532	0.446749
	U	1.607048	0.743733
Second Best Wage Subsidy Equilibrium	L_A	0.904517	0.012604
	X_A	0.927497	0.037617
	L_M	0.046600	0.987396
	X_M	0.215869	0.993678
	U	1.607114	1.012486
Full Employment Wage Subsidy Equilibrium	L_A	0.051314	0.012604
	X_A	0.107814	0.037617
	L_M	0.948684	0.987396
	X_M	0.974004	0.993678
	U	1.135726	1.012486
Second Best Production Subsidy Equilibrium	L_A	0.955254	0.800415
	X_A	0.966249	0.846226
	L_M	0.044746	0.199585
	X_M	0.211532	0.446749
	U	1.660906	0.869862

ternative values 1.5 and 0.5. Let the specified minimum wage (in terms of manufactured good) in manufacturing be twice the equilibrium wage associated with the first best optimum. The following table gives the equilibrium factor allocations, output, and welfare associated with each of the following policies: first best optimum; *laissez-faire*; second best wage subsidy to manufacturing; full employment wage subsidy to manufacturing; and second best production subsidy to agriculture.

It is seen that when $p=0.5$, the second best optimum wage subsidy[9] to manufacturing happens to be the full employment wage subsidy, and it dominates the second best production subsidy (to agriculture) whereas, when $p=1.5$, the second best production subsidy dominates the second best wage subsidy. Further, the full employment wage subsidy is inferior to *laissez-faire*, when $p=1.5$.

[9] Note that the values for U in the table represent a global maximum because p is fixed.

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