Export restrictions, urban unemployment, and the location of processing activities

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Received 22 February 2000; accepted 20 September 2000

Abstract

In a general equilibrium model with processing and urban unemployment, we demonstrate that export restrictions enhance welfare only when processing is labor intensive and located rurally. When processing is capital intensive or located in the urban region, welfare necessarily falls. © 2001 Elsevier Science B.V. All rights reserved.

Keywords: Processing incentives; Export restrictions; Unemployment

JEL classification: F13; O15

1. Introduction

Export restrictions have long been used to promote domestic processing and employment, and to diversify developing economy exports. Instead of exporting large quantities of raw materials, developing economies have frequently sought to guarantee a low-cost and ample supply of inputs to domestic secondary industry. Well-known examples of such policies include those adopted by Brazil on exports of coffee and leather, and the log export restraints of Indonesia, Malaysia, and the Philippines.

In this note we consider whether dual labor markets provide a rationale for export restrictions — i.e. whether the employment effects of such processing incentives are positive. We use a neoclassical, Harris and Todaro (1970; henceforth HT) model with multiple production levels.

The note is related to a number of interesting recent contributions to the extensive HT literature. Chao and Yu (1992) consider issues relating to imported intermediates, while Dean and Gangopadhyay (1997) consider export restrictions as a processing incentive, concluding that welfare

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improves in the long run. Marjit (1991) has also presented a model where supporting an urban processing industry (through a wage subsidy) is welfare-improving. We present an analysis where capital is mobile between the intermediate and processing activities, and that considers the location of processing, both of which have important impacts on the efficacy of intervention.

In Section 2 of the paper we set out the structure of our general equilibrium model, and derive our results. The key result is that export restrictions can raise welfare only when there is a labor-intensive processing industry located in the rural region, stability considerations rule out the possibility of a welfare enhancing export restriction with processing in the urban region. There is also a general tendency for rural-based processing to be superior to urban-based, even when the processing activity is not labor-intensive. Concluding comments are contained in Section 3.

2. The model and analysis

We have a three-sector/two-region economy. Good $M$ is produced in the urban region using labor ($L$) and capital of type 1 ($K_1$). Good $I$, a pure intermediate, is produced in the rural region using labor and capital of type 2 ($K_2$). Good $P$, the processed good, is initially assumed to be produced in the rural region using labor, capital of type 2, and $I$. Production functions are linearly homogeneous. Capital is fully utilized, but labor is fully employed only in the rural region, where the wage ($w$) is flexible. In the urban region, where the wage ($\bar{w}$) is fixed, there is unemployment. All goods are traded, and by the small country assumption prices ($p$, a superscript * denotes world prices) are exogenous. The trade pattern is such that $M$ is imported and $I$ and $P$ are exported. The social welfare function is quasi-concave and increasing in consumption of both $M$ and $P$. Perfect product markets and fixed factor supplies are assumed. The general equilibrium system is described by the following set of equations:

$$c_M(w, r_1) = 1$$  \hspace{1cm} (1)

$$c_I(w, r_2) = p_I$$  \hspace{1cm} (2)

$$c_P(w, r_2, p_I) = p_P$$  \hspace{1cm} (3)

$$a_{ML}M + \pi a_{II}I + \pi a_{PI}P = \pi \bar{L}$$  \hspace{1cm} (4)

$$a_{MK}M = \bar{K}_1$$  \hspace{1cm} (5)

$$a_{IK}I + a_{PK}P = \bar{K}_2$$  \hspace{1cm} (6)

The production model is closely related to that used by Marjit and Beladi (1996) and, in the context of urban unemployment, Marjit et al. (1997). The key difference is that we assume that domestic production of the intermediate exceeds domestic consumption, and that the intermediate is produced in the rural region rather than the urban. Similar results can be obtained with fully mobile capital and a specific factor (say, natural resources) in $I$, but then locating $M$ and $P$ in urban simultaneously is not possible (see Gilbert and Wahl (2000)).
\[ a_p P = Q_i \]  
\[ w = \pi \tilde{w} \]  
\[ G(p_j, \tilde{K}_1, \bar{K}_2, L_v) + (p_j^* - p_j)X_i + (p_p^* - p_p)X_p = E(p_M, p_P, u) \quad i = M, I, P. \]

Eqs. (1)–(3) are zero profit conditions, and can be solved for factor returns. We let \( p_M \) be the numéraire. Eqs. (4)–(8) describe intermediate and factor market equilibrium, the \( a_{ij} \) being the unit demands obtained by the derivative properties of the unit cost functions. Eq. (8) is the additional HT labor market equilibrium requirement that the rural wage equal the urban wage multiplied by the probability of obtaining a job in the urban sector (\( \pi \)). These equations can be solved for outputs, intermediate usage (\( Q_i \)), and the employment rate. Finally, the budget constraint of the economy is set in terms of the GNP and expenditure functions in (9), allowing us to solve for the level of social welfare (\( u \)).

We begin by deriving a general expression for welfare changes. Totally differentiating (9), and utilizing (8) and the definition of exports, yields:

\[ dW = (p_j^* - p_j)dx_i + (p_p^* - p_p)dx_p + \tilde{w}dL_M + \pi \tilde{w}(dL_u + dL_p) \]  
\[ \text{where} \quad dW = E, du, \text{and} \quad X_i \text{ is exports from sector} \ i. \]  

Following Corden and Findlay (1975), we define total labor in the urban region as \( L_u \), then \( dL_M = \pi dL_u + L_u d\pi \). Substituting into (10) we have:

\[ dW = (p_j^* - p_j)dx_i + (p_p^* - p_p)dx_p + \tilde{w}L_u d\pi \]  
\[ \text{where we have simplified by making use of the fact that} \quad dL_u + dL_p = 0. \]  

Thus the incremental change in welfare is the sum of two Harberger effects, and the effect of changes in the probability of employment. As is well-known, free trade is sub-optimal, since \( dW = 0 \) when \( p_j = p_j^* \).

Let \( t \) be an export tax imposed on \( I \), so that \( p_j(1+t) = p_j^* \). Using this, letting \( p_p = p_p^* \), and dividing both sides of (11) by \( dt \) we have:

\[ \frac{dW}{dt} = tp_j \left( \frac{dx_i}{dt} \right) + \tilde{w}L_u \left( \frac{d\pi}{dp_j} \right) \frac{dp_j}{dt} \]  
\[ \text{which is the basic decomposition of the welfare effect of an export restriction on} \ I. \]

We now proceed to determine the signs of the terms in (12). Evidently from (1), \( r_i \) is fixed in nominal terms by the rigid wage in the urban sector. However, the other two factor returns can vary. Differentiating (2) and (3) and solving we obtain:

\[ \hat{\tilde{w}} = -\tilde{p}_j \left( \frac{\theta_{jK} \theta_{pI} + \theta_{pK}}{\theta} \right) \]  
\[ \hat{\tilde{r}}_z = \hat{p}_j \left( \frac{\theta_{jL} \theta_{pI} + \theta_{pL}}{\theta} \right) \]  

where a ‘\( \hat{\cdot} \)’ denotes a proportional change, the \( \theta_i \) are cost shares and \( \theta = \theta_{jK} \theta_{pL} - \theta_{jL} \theta_{pK} \). If \( P \) is labor intensive, the wage rises and the return to capital type 2 falls. Since from (8) \( \hat{\pi} = \hat{\tilde{w}} - \tilde{w} \), the probability of finding urban employment improves. The reverse is true if \( P \) is capital intensive.
Differentiating (4)–(6) and solving for the changes in gross output we obtain after some manipulation:

\[
\dot{f} = \frac{\sigma_f(\hat{w} - \hat{r}_2)(\lambda_{PK}\lambda_{IK}\theta_{IK} + \lambda_{PL}\lambda_{IK}\theta_{IL}) + \lambda_{PK}[\hat{\pi}\lambda_{UL} + \lambda_{PL}[\eta_{KK}^{p}\hat{r}_2 + \eta_{KL}^{p}(\hat{w} - \hat{r}_2) - \eta_{LL}^{p}\hat{w}]])}{|\lambda|} < 0
\]

(15)

\[
\hat{p} = \frac{\lambda_{IK}\lambda_{IL}\sigma_f(\hat{r}_2 - \hat{w}) - \lambda_{IK}[\hat{\pi}\lambda_{UL} - \lambda_{PL}(\eta_{KL}^{p}\hat{w} + \eta_{KL}^{p}\hat{r}_2)] + \lambda_{IL}\lambda_{PK}(\eta_{KL}^{p}\hat{w} + \eta_{KK}^{p}\hat{r}_2)}{|\lambda|} > 0
\]

(16)

where \( \lambda_{ij} \) is the proportion of factor \( j \) used in industry \( i \), \( |\lambda| = \lambda_{IL}\lambda_{PK} - \lambda_{IK}\lambda_{PL} < 0 \) with \( P \) labor intensive, \( \sigma_f \) is the elasticity of substitution between \( K \) and \( L \) in \( I \) and \( \eta_{ij}^{p} = \theta_{ij}\sigma_{ij}^{p} \) is the elasticity of demand for input \( i \) with respect to the price of input \( j \) in \( P \). We have assumed fixed proportions technology in the use of intermediates for simplicity, but equivalent results hold under less stringent technological assumptions. From (5), with the stock of \( K_i \) fixed and input prices to \( M \) unchanged, output of \( M \) is unaffected by the export restriction. However, from (15) and (16) gross output of \( I \) falls and gross output of \( P \) rises, so exports of \( I \) fall.

Now, \( \dot{dX}/dt < 0; \dot{dp}_j/dt = -p_j/(1 + t) < 0 \); and \( d\pi/dp_j < 0 \). Hence \( dW/dt \) in (12) is of indeterminate sign in general. However, if initially \( t = 0 \) then \( dW/dt > 0 \). Therefore we have the following result:

**Proposition 1.** With a labor-intensive processing industry located in the rural region, a sufficiently small export tax will raise welfare.

Now consider an economy with the same basic structure, but assume that the processing industry located in the urban region, and hence pays the fixed urban wage. We need to adjust Eqs. (3) and (4):

\[
c_p(\hat{w}, r_2, p_U) = p_P
\]

(3a)

\[
a_{ML}M + \pi a_{IL}I + a_{PL}P = \pi L.
\]

(4a)

It is a simple matter to solve the amended system for the factor price responses. Once again, \( r_1 \) will not change, but now \( \hat{w} \) and \( \hat{r}_2 \) become:

\[
\hat{w} = \hat{p}_I \frac{(\theta_{IK}\theta_{PL} + \theta_{PK})}{(\theta_{IL}\theta_{PK})} \quad (13a)
\]

\[
\hat{r}_2 = -\hat{p}_I \frac{\theta_{PL}}{\theta_{PK}}. \quad (14a)
\]

Hence the wage rate will fall regardless of factor intensities. It follows immediately that \( \hat{\pi} < 0 \) if \( P \) is located in the urban region. The solutions for the changes in gross output are now:

\[
\dot{f} = \frac{\lambda_{PK}[\hat{\pi}\lambda_{UL} + \hat{r}_2\lambda_{PL}(\eta_{KK}^{p} - \eta_{KL}^{p})] + \sigma_f(\hat{w} - \hat{r}_2)(\theta_{IK}\pi a_{IL}\lambda_{PK} + \theta_{IL}\lambda_{PL}\lambda_{IK})}{\pi\lambda_{IL}\lambda_{PK} - \lambda_{PL}\lambda_{IK}}
\]

(15a)
The numerator of (15a) is strictly negative, and the numerator of (16a) is strictly positive. Hence we have an apparent paradox — if \( P \) is labor-intensive, the export tax fails to expand processing. However, Neary (1981) shows that stability in the HT model requires \( \frac{K}{L} (1 + \gamma) \), where \( \gamma \) is the unemployment rate. This is equivalent to \( \pi \lambda_{IL} \alpha_{PK} - \lambda_{PL} \lambda_{IK} > 0 \). The paradox holds only in a dynamically unstable equilibrium, and so is of little consequence. If \( P \) is located in urban, it will be capital intensive and therefore exports of \( I \) will fall. Hence, in this case \( \frac{dX_i}{dt} < 0 \); \( \frac{dp_i}{dt} = -p_i/(1 + \pi) < 0 \) so \( \frac{dW}{dt} \) in (12) is negative:

**Proposition 2.** With the processing industry located in the urban region there must be a monotonic and negative relationship between social welfare and the level of the export tax.

A final question is, given that \( P \) is capital intensive, will welfare fall by more if the processing activity is located in the rural or the urban region? There is no definite answer. It is evident from (13) and (13a) that the rate of employment falls proportionately more when \( P \) is located in rural (a consequence of the rigid wage imposed on \( P \) when it is in urban). However, normalizing \( w \) initially to unity, we know that \( \frac{dW}{dt} = L_u \dot{\pi} \) (ignoring the DWL term). Given the same initial values of \( L_i \) and \( L_i \) in each scenario, it is likely that having the processing industry located in rural is preferable given the expanded size of the urban labor-force otherwise. The less capital is employed in the intermediate industry, the stronger the argument for rural processing since (13a) converges to (13) as \( \theta_{IK} \to 0 \).

### 3. Concluding remarks

Clearly, the results discussed in this paper reflect second-best policy choices. In the HT framework optimal policy will involve an appropriate wage subsidy program (or the elimination of urban wage inflexibility). Given a processing objective, optimal policy will involve a combination of wage and output subsidies. Nonetheless, the policy choices of developing economies are often constrained, and the prevalence of export restrictions makes the effect of second-best interventions the most relevant object of analysis.

We have shown that urban unemployment can provide an argument for export restrictions only when the processing industry is rural-based and labor intensive. This is an intuitively appealing result, since in this case expanding domestic processing provides more opportunities for rural workers, and stems the tide of migration to the urban region. When processing is urban-based, export restrictions draw capital away from the rural economy, lower the marginal productivity of rural labor, encourage expanded migration and thus swell the ranks of urban unemployed. Hence, in the long-run, we have a strong argument against assisting urban processing activities in the HT framework.

### References