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Food Aid Delivery, Food Security and Aggregate Welfare in a Small Open Economy: Theory and Evidence

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Abstract

A small-open-economy model is developed to examine how the method of food aid disbursement affects labor employment, food security and aggregate welfare, in recipient countries, in an environment in whih private sector firms pay efficiency wages to induce effort. Two forms of food aid delivery are considered: first is project food aid, under which food aid is used to finance infrastructure development and consumers are required to participate in public projects in order to receive food aid; the second is non-project food aid, which we use to capture all forms of food aid distributed to consumers free of charge. The model suggests that, when food aid is used to finance infrastructure development, it has no labor disincentive effects in the food industry, increases food security and decreases the level of unemployment in the recipient country. When food aid is distributed to consumers free of charge, however, the model predicts that it creates labor disincentive effects in the food industry, increases the unemployment level and decreases food security. Under both methods of distribution, the effect of food aid on aggregate welfare is ambiguous. Empirical results provide suggestive evidence for the hypothesis that project food aid increases food security while non-project food aid decreases food security.

Résumé

L’auteur modélise une petite économie ouverte pour examiner la façon dont le mode de remboursement de l’aide alimentaire agit, dans les pays bénéficiaires, sur l’emploi, la sécurité alimentaire et le bien-être global, dans un environnement où les entreprises du secteur privé paient des salaires d’efficience en vue d’encourager l’effort. Il prend en considération deux formes de prestation d’aide alimentaire. Il examine en premier lieu l’aide alimentaire fournie dans le cadre d’un projet d’assistance. Dans ce mode de livraison, l’aide est utilisée pour financer des projets d’infrastructure, et les consommateurs sont appelés à participer à des projets publics pour la recevoir. En second lieu, l’auteur aborde l’aide alimentaire non liée à un projet, qui englobe toutes les formes d’aide alimentaire distribuée gratuitement aux consommateurs. Le modèle donne à penser que, lorsque l’aide alimentaire est utilisée pour financer des projets d’infrastructure, elle n’a pas pour effet de décourager l’emploi dans le secteur alimentaire. Elle accroît plutôt la sécurité alimentaire et abaisse le niveau du chômage dans le pays bénéficiaire. En revanche, lorsque l’aide alimentaire est fournie gratuitement, le modèle laisse entendre qu’elle a pour effet de déprimer l’emploi dans le secteur alimentaire et qu’elle accroît le chômage et réduit la sécurité alimentaire. Dans les deux modes de distribution de l’aide alimentaire, l’effet que l’aide alimentaire a sur le bien-être global est ambigu. Les résultats empiriques laissent croire que l’aide alimentaire fournie dans le cadre d’un projet augmente la sécurité alimentaire, alors que l’aide alimentaire n’entrant pas dans le cadre d’un projet la réduit.

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I: Introduction

Since the United States Congress passed Public Law 480 (henceforth PL480) in 1954, policy makers and economists have been concerned with the role of food aid in the economic development of recipient countries.[1] In particular, the role of food aid in achieving long-term food security and alleviating the adverse effects of IMF or World Bank Structural Adjustment Programs on vulnerable groups in developing countries has been a major issue in the last two decades (see, for example, Clay, 1991; Shaw and Singer, 1988). Part of the renewed interest in food aid policy stems from the disenchantment of some policy makers and food aid analysts with the record of past food aid programs and concerns that food aid may contribute to long-term food insecurity in recipient countries.[2] Given this interest in food aid policy, there is the need to develop economic models that illuminate the potential effects of different forms of food aid delivery and how they affect food security and aggregate welfare in recipient countries.

Almost all developing countries have received international food aid at one time or the other. In 1991, the total value of food aid to developing countries was approximately 3.6 billion US dollars, a figure equivalent to about 6.1 per cent of total Official Development Assistance (ODA). Of this amount, 77 per cent came from bilateral sources, with the United States maintaining its position as the main provider of bilateral food aid (Shaw and Clay, 1993).[3] Statistics on bilateral/multilateral food aid, types of food aid, and the

[1] Public Law 480 is basically the 'Agricultural Trade Development and Assistance Act', signed by President Eisenhower in 1954. Although there were political and social factors behind the legislation, the main goal of the act was to dispose of US farm surpluses abroad. It was believed that, by using surplus agricultural commodities to aid developing countries, the US government would save on storage costs, reduce human misery and promote agricultural trade. For a brief, but interesting, analysis of the evolution of food aid, see Falcon (1991) or Hopkins (1992).

[2] Food insecurity is defined as the lack of access to enough food for an active healthy life. It is classified as chronic or transitory. Chronic food insecurity is the persistent decline in a household's access to enough food, whereas transitory food insecurity refers to a temporary decline in a household's access to enough food. For detailed analyses of food security policy in LDCs, see Reutlinger (1985), FAO (1985), and Cathie and Dick (1987).

[3] Other significant food aid donors include the European Economic Community (EEC), Canada, and the World Food Programme. Canadian and US PL480 food aid programs are bilateral, whereas the donations from the World Food Programme and the EEC are multilateral. The major difference between bilateral and multilateral food aid is that the former has foreign policy objectives beyond that of enhancing the economic development of recipients while the latter does not.

geographic distribution of food aid are presented in Figures 1-3.[4]

A major critique of PL480 and other food aid programs is that they have potential disincentive effects in recipient countries (Schultz, 1960; Isenman and Singer, 1977; Maxwell and Singer, 1979; Cathie, 1982; Clay and Stokke, 1991).[5] The problem with these papers is that they are generally descriptive. Abbott and McCarthy (1982, 1983) analyzed the effects of tied food aid in an open economy. They showed that the primary gain from tied food aid is the foreign exchange saved by the recipient country due to the fact that food aid is provided as a grant or on soft repayment terms. Their model portrays the fact that "usual marketing requirements" imposed by donors create distortions by forcing recipients to shift consumption and imports away from their efficient allocation levels. The authors argued that if these constraints are severe enough, the cost of the aid may outweigh the primary benefit, resulting in "immiserization" of the recipient country. Srinivasan (1989) examined the potential effects of food aid on price and output in a small open economy. He showed that food aid could increase welfare in recipient countries, even if it has price disincentive effects.

The present study contributes to the literature in two ways. First, it develops a framework that simultaneously incorporates the different methods of food aid disbursement and how they affect labour employment, food security and aggregate welfare in recipient countries. In particular, it shows that countries relying on project food aid as a method of food aid disbursement have better performance, in terms of achieving food security objectives, than those that rely on non-project food aid. Under project food aid, the

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[4] Figure 2 shows that food aid has traditionally been classified into three categories: Project, Programme, and Emergency. The first category represents food aid ear-marked for specific projects while the second category captures all forms of food aid used in support of development programs. The last category represents food aid ear-marked for famine relief. Figure 3 shows that a large proportion of total cereal food aid to developing countries, for the period 1981-93, went to Africa.

[5] There are at least three ways in which food aid could create disincentive effects in a recipient country: (i) by depressing producer prices, it could result in lower domestic agricultural output; (ii) by encouraging governments to postpone politically difficult, but necessary, agricultural reforms it creates a policy disincentive effect; and (iii) when used in support of labour-intensive public projects, it could raise private sector wages, thereby forcing firms to hire less labour and creating a labour disincentive effect.

recipient country uses food aid either to finance labour-intensive development projects or in support of human resource development. Workers employed in these public projects are paid either all or part of their wages in kind.[6] Non-project food aid, in this paper, refers to the type of food aid that consumers receive as a lump-sum transfer. The recipient country either distributes the food to consumers directly or sells it and distributes the revenue to consumers in a lump-sum manner.[7]

The second contribution of this paper is that it stresses the role of infrastructure as a critical factor in examining the relationship between food aid and food security and provides one reason why an economy that receives aid might respond to the aid through quantity as opposed to price adjustments. The focus on infrastructure is important because one of the theoretical arguments against project food aid is that it creates labour disincentive effects in the agricultural sector thereby leading to a fall in agricultural output (Clay and Stokke, 1991). However, most empirical studies that have examined this issue in regions where project food-aid-supported activities have been carried out do not find any conclusive evidence of a labour disincentive effect in the agricultural sector (FAO, 1982; Bezuneh, Deaton and Norton, 1988; and Maxwell, Belshaw and Lirenso, 1994). The present paper shows that taking into cognisance the role of project food aid in the creation of infrastructure and the productivity-enhancing effects of infrastructural development activities reconciles this apparent discrepancy between predictions of theoretical models and the empirical evidence.[8]

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[6] In practice, workers on food aid projects may not be paid all their wages in kind because of the International Labour Organization's (ILO) Convention No. 95, passed in 1926, which requires that wages in kind should not be more than 50 per cent of the wage received by a worker, unless the work is of a voluntary nature (see Cathie, 1982, p. 77).

[7] The distinction between project and non-project food aid made in this paper is based solely on the way in which food aid is distributed to consumers in recipient countries and should not be confused with similar distinctions made in the literature (see Figure 2). We have adopted this approach because the distinction made in the literature, between the various types of food aid, has become increasingly blurred. For instance, in some countries part of the revenue from sales of programme food aid is used to finance project-type activities, and project food aid may be used to support sector-wide programmes (see Shaw and Clay,1993).

[8] Food aid has been extensively used to finance irrigation works, erosion control, land reclamation, reforestation, soil conservation and other social and economic development projects in developing countries. However, not all food aid projects are in the infrastructure category. For example, there are relief and

In the framework developed in this paper there is a manufacturing industry that uses capital and labour as inputs and a food industry that uses labour and a public good, infrastructure, as inputs. The model rests on the premise that firms in the food and manufacturing industries (henceforth the private sector) pay efficiency wages in order to induce effort. When food aid is distributed in the form of project aid, the model has an unemployment and a full employment equilibria. In the unemployment equilibrium, the public sector workers are paid a reservation wage, which is constant. Given this, an increase in project food aid increases labour employment in the public sector, thereby reducing the unemployment level and the penalty for shirking in the private sector. To prevent shirking, the private sector wage increases. The increase in the private sector wage reduces employment in the manufacturing industry, thereby creating a labour disincentive effect. In the food industry, however, the decrease in labour employment caused by an increase in the private sector wage is completely dominated by an increase in labour employment resulting from the fact that the change in public sector employment increases the stock of infrastructure, thereby increasing the marginal product of labour in the food industry and creating an incentive for the food industry to hire more labour. The increase in labour employment increases food output and hence food security.

When food aid is distributed as non-project aid, the stock of infrastructure is constant. Given the production technology in the food industry, this implies that the marginal product of labour and the equilibrium efficiency wage in the food industry are constant. An increase in non-project food aid increases the lump-sum transfer to each unemployed agent, thereby reducing the penalty for shirking in the food and manufactured good industries. Since the equilibrium efficiency wage in the food industry is a constant, the only way in which the food industry can discourage shirking is to increase the cost of shirking by laying off workers. This reduction in food industry employment, that is a labour disincentive effect, reduces food output and food security. Under both methods of dis-

nutrition or school-feeding projects. I focus on infrastructure because it has important implications for agricultural production. China and India are examples of countries in which food-for-work programs were used to develop the rural economy by strengthening rural infrastructure. For an in-depth analysis of the use of food aid to create infrastructure, see Clay (1986); Costa (1973); and von Braun, Teklu and Webb (1992). The African experience is documented in Stevens(1979).

bursement, the effect on aggregate welfare depends on the size of the labour disincentive effect. Preliminary tests of the predictions of the model provide suggestive evidence for the proposition that project food aid increases food security while non-project food aid decreases it.

The use of an efficiency wage model to capture the process of wage determination in agrarian societies can be rationalized on the following grounds: First, in most countries that have, historically, benefitted from food aid, farms rely on hired labour and there are serious moral hazard problems associated with the use of hired labour on such farms.[9] For instance, Eswaran and Kotwal (1985) argue that hired labour is not an effective input and that, for hired labour to be an effective input, it has to be supervised. The moral hazard problem arises from the fact that firms cannot perfectly monitor workers' effort. In the agricultural sector this is a problem because an employer cannot infer workers' individual effort levels by observing the output, which is a function of weather conditions, soil quality, and group work effort. An efficiency wage framework mirrors one way in which farm owners try to overcome these moral hazard problems associated with the use of hired labour.

Second, food aid projects attract mostly underemployed or unemployed workers and wages paid for jobs created through food-aid-supported activities are much lower than those in other sectors of the economy. To model the relationship between food aid delivery and food security we need a framework in which unemployment and wage gaps arise endogenously in equilibrium. An efficiency wage framework captures these features.

The Shapiro-Stiglitz efficiency wage framework adopted in this paper differs from the nutrition-based efficiency wage model. Unlike the nutrition-based efficiency wage model, which rests on the premise that there is a positive relationship between calorie intake and the ability to work, the Shapiro-Stiglitz framework treats unemployment as a discipline device.[10] We did not use the nutrition-based efficiency wage model because there are a number of empirical studies with results that are inconsistent with its predictions. Bliss

[9] In India, for example, about 89 per cent of farms surveyed reported hiring in labour (Berry and Cline, 1979, p.165). For evidence from Bangladesh, see Taslim (1989).

[10] For examples of papers that have used either the nutrition-based or the Shapiro-Stiglitz efficiency wage framework to describe labour market behaviour in LDCs see Stiglitz, 1976; Esfahani and Mookherjee, 1995; Riveros and Bouton, 1994.

and Stern (1978) document some of the problems associated with using nutrition-based efficiency wage models to mimic the process of wage determination in agrarian societies. More recent evidence is in Swamy (1997).

The rest of the paper is organized as follows. Section II describes a theoretical framework for analyzing the effects of project food aid on employment, food security and aggregate welfare. In section III, we modify the basic model, presented in section II, for non-project food aid by assuming that unemployed agents receive food aid as a lump-sum transfer and examine the implications of this alternative method of delivery for employment, food security and aggregate welfare in the recipient country. Section IV presents preliminary results of empirical tests of the main thesis of the paper. In section V, we discuss the policy implications of the analysis and conclude the paper.

II: PROJECT FOOD AID FORM OF DELIVERY

IIa. Theoretical Framework

The model presented here borrows from three strands of literature. It draws heavily from the efficiency wage literature because it captures some crucial aspects of the process of wage determination in agrarian economies where there is widespread use of hired labour and provides a useful framework for analyzing the impact of food aid projects on employment in the agricultural sector. Additional insights come from the food aid literature and the growing number of studies that emphasize the inclusion of intermediate goods, such as infrastructure, as inputs in the production function (see, for example, Arrow and Kurz, 1970; or the more recent contribution by Glomm and Ravikumar, 1992).[11]

Consider a small open economy made up of two sectors: private and public (or project). The private sector is composed of a food industry and a manufactured good industry while the public sector uses unemployed labour to improve the quality, or increase the stock, of an intermediate good which is an external input in the food industry. The intermediate good (I) has public goods characteristics in the sense that once it is produced, it enhances the productivity of all firms in the food industry. For ease of exposition, we assume that the manufactured good (M) is the numeraire good and that Food (F) is the aid good.

There are two primary factors of production in this economy: capital (k) and labor (l). The manufactured good is produced using capital and labour while food is produced using an intermediate good and labour. The use of a specific factor model is appropriate for two reasons. First, intermediate goods produced through food-aid-supported projects, such as irrigation works and erosion control, play very important roles in food production as opposed to manufacturing. A specific factor model captures this relative importance of intermediate goods in food production. Second, it enables us to focus on a non-specialized equilibrium. Letting $M(k_m, l_m)$ and $f(I)l_f$ represent production functions for the manufactured good and food respectively, we assume that the two final goods are produced

[11] Garcia-Mila and McGuire (1988) and Aschauer (1989) provide empirical evidence suggesting that infrastructure has a strong positive impact on output.

under constant returns to scale with respect to private inputs and that M and f have the following properties: $M_{22} < 0$, $M_{12} > 0$, and $f^{'} > 0$. Given constant returns to scale and the fact that all firms in the same industry solve the same problem, we focus on the problem faced by a representative firm in each industry. The production function for the intermediate good, $I(l_p)$, is increasing in labor (i.e. $I^{'} > 0$) and the public sector finances the production of this public intermediate good with food aid.

Following Shapiro and Stiglitz (1984), Hoon (1991) and Kimball (1994), we assume that there are moral hazard problems associated with the use of hired labour in the private sector. This reflects the idea that employers in the private sector cannot observe workers' on-the-job effort costlessly. Unlike the private sector, we model the public sector as one with no moral hazard problems. This reflects the fact that food-aid-supported infrastructure projects are mainly activities in which, by observing a worker's output level, an employer can infer his/her effort level.[12] This differs from the situation in, say, the food industry where, by observing a low output, an employer cannot tell whether it is a consequence of indolence on the part of a worker or bad luck. Other features of the model are described in the sub-sections below.

IIa1. Preferences

The economy is inhabited by N risk neutral and identical workers. Each worker is infinitely lived and endowed with one unit of labour time and one unit of physical capital. Each unit of capital earns a competitively-determined rental rate (r). Workers derive utility from consuming food and the manufactured good, but dislike effort. The instantaneous utility function for each worker is defined as: $U = d_m^{\theta} d_f^{1-\theta} - e$, where e is the disutility of effort and d_m and d_f represent consumptions of the manufactured good and food respectively. In line with the efficiency wage literature, we assume that workers can supply either zero effort or one unit of effort and that they can neither borrow nor

[12] In such an environment, an employer can costlessly verify whether or not a worker shirked. Another way of rationalizing this assumption is to argue that since jobs created on food-aid-supported projects are menial it is reasonable to assume that monitoring is costless, at least at the margin. See Bulow and Summers (1986) or Copeland (1989) for justifications of this approach in a different environment.

lend.[13] Workers have labour and non-labour income. However, the amount of labour income that each worker receives depends on whether he/she is employed in the private sector or the public sector. A worker employed in the private sector earns w_j (j=f,m) and a worker employed in the public sector earns w_p.

The information structure is as follows. At the beginning of the period, private sector firms decide the number of workers to hire and the critical wage necessary to encourage workers to provide effort. Employed workers decide whether to shirk or not. If they shirk, output is zero. Those workers not employed in the private sector seek alternative employment in the public sector.

IIb: Equilibrium Conditions

IIb1: Effort Decision of a Worker in the Private Sector

Each worker employed in the private sector selects an effort level to maximize expected lifetime utility. If a worker shirks, he is caught and fired with probability λ. There is also the probability b that a worker would lose his job for reasons other than shirking. This is known as the separation rate and is necessary to ensure that vacancies occur in the private sector.[14] Since the development project undertaken by the public sector is financed with food aid, the number of workers employed in this sector depends on the quantity of food aid received. To capture this we define α as the probability that a worker unable to find employment in the private sector will not be hired by the public sector.[15] Since the moral

[13] The assumption that workers can neither borrow nor lend is reasonable since the fact that the instantaneous utility function is linear in aggregate consumption implies that workers have no incentive to smooth consumption.

[14] In the standard efficiency wage model, workers are infinitely lived and, in equilibrium, there is no shirking. Therefore, if there is no exogenous separation rate, no vacancies would occur. Another way of getting around this problem is to assume that workers have finite lives. This results in vacancies occuring as workers die. This is the approach adopted by Davidson, Martin, and Matusz (1994).

[15] We can also interpret α as the probability of the public project terminating at any date. In this case α represents project duration and captures the idea that the projects could be temporary or permanent. In the framework suggested it does not matter whether α is endogenous or exogenous because, in equilibrium,

hazard problem is the same in the food and manufacturing industries, there is no reason for one industry to pay workers an efficiency wage that is more than what they could earn in the other industry. Therefore, in equilibrium, it must be the case that $w_f = w_m = w$.[16]

The fundamental asset equation for a non-shirker in the private sector is:

$$\delta V_e^n = \varepsilon(w + r)p^{\theta-1} - e + b[(1-\alpha)V_p + \alpha V_u - V_e^n] \tag{1}$$

where δ is the subjective discount rate and ε is a function of the preference parameter θ. V_e^n is the expected lifetime utility of an employed non-shirker in the private sector and V_p is the expected lifetime utility of a worker employed in the public sector. The expected lifetime utility for an unemployed worker is represented by V_u. Equation (1) says that the interest rate times the asset value equals flow benefits plus expected capital gains (or losses). The first term in equation (1), $\varepsilon(w + r)p^{\theta-1}$, is the indirect utility function for a worker employed in the private sector. p is the relative price of food in terms of the numeraire good (manufactured good). In this small open economy, the domestic relative price of food is equal to the world price because the economy does not have to satisfy any "usual marketing requirements" in order to benefit from food aid. We did not incorporate "usual marketing requirements" partly because we want to focus on labour disincentives, and partly due to the fact that, in some developing countries, food aid substitutes for commercial imports, suggesting that some potential recipients do not have to satisfy any "usual marketing requirements" in order to receive food aid (see Stevens, 1979).

For a shirker employed in the private sector, the fundamental asset equation is:

$$\delta V_e^s = \varepsilon(w + r)p^{\theta-1} + (b + \lambda)[(1-\alpha)V_p + \alpha V_u - V_e^s] \tag{2}$$

Equation (2) has the same interpretation as equation (1) except that V_e^s represents

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the aggregate no-shirking condition is independent of α (see proof of lemma 1).

[16] The model can be made to capture the observation that manufacturing wages are higher than agricultural wages by assuming that the cost of monitoring in the manufactured good industry is more than the monitoring cost in the food industry. However, doing this does not add any significant insight into the analysis, and introduces a host of issues (e.g. migration) which are outside the scope of this paper.

the expected lifetime utility of an employed shirker in the private sector.

To discourage workers from shirking, equilibrium wages, employment, and unemployment spells must be such that non-shirking workers have a higher expected lifetime utility than shirkers. In other words, a worker employed in the private sector will not shirk if $V_e^n \geq V_e^s$. However, a profit maximizing firm has no incentive to pay a worker more than is necessary to deter him or her from shirking. This implies that in equilibrium

$$V_e^n = V_e^s \tag{3}$$

Using (3) in (1) and (2), we obtain (after some manipulations):

$$V_e^n = (1-\alpha)V_p + \alpha V_u + \frac{e}{\lambda} \tag{4}$$

Rearranging equation (4) yields:

$$\lambda[V_e^n - (1-\alpha)V_p - \alpha V_u] = e \tag{4a}$$

The expression on the left in equation (4a) is the expected cost of shirking to a worker currently employed in the private sector. The term on the right is the benefit from shirking. Equation (4a) says that if employers are to prevent workers from shirking, it must be the case that in equilibrium the expected cost of shirking is equal to the benefit.

The fundamental asset equation for unemployed workers is:

$$\delta V_u = \varepsilon(r)p^{\theta-1} + a(V_e^n - V_u) + (1-a)(1-\alpha)(V_p - V_u) \tag{5}$$

Where a is an endogenously determined job acquisition rate. The first term in equation (5) is an unemployed individual's current utility, while the second term is the expected capital gain from obtaining employment in the private sector next period. The last term is the expected capital gain if he/she is employed in the public sector next period. Note that the indirect utility function for unemployed workers is a function of non-labour income because all workers are assumed to be endowed with one unit of physical capital.

The expected lifetime utility for a worker currently employed in the public sector must satisfy the asset equation:

$$\delta V_p = \varepsilon(w_p + r)p^{\theta-1} - e + a(V_e^n - V_p) + (1-a)\alpha(V_u - V_p) \tag{6}$$

The derivation of equation (6) is straightforward. A worker employed in the public sector obtains utility $(\varepsilon(w_p + r)p^{\theta-1} - e)$ this period. If he/she gets a job in the private sector next period, the expected capital gain is $a(V_e^n - V_p)$. However, if he/she is not offered a job in the private sector and the public project is discontinued, the expected capital loss is $(1-a)\alpha(V_u - V_p)$.

Substituting equation (4) into equations (1), (5) and (6) and rearranging terms, yields the following set of equations:

$$V_p + \alpha(V_u - V_p) = \frac{1}{\delta}[\varepsilon(w + r)p^{\theta-1} - (1 + \frac{b}{\lambda} + \frac{\delta}{\lambda})e] \tag{7}$$

$$a[(1-\alpha)V_p + \alpha V_u] = (\delta + a)V_u - \varepsilon(r)p^{\theta-1} - \frac{ae}{\lambda} - (1-a)(1-\alpha)(V_p - V_u) \tag{8}$$

$$a[(1-\alpha)V_p + \alpha V_u] = [\delta + a]V_p - \varepsilon(w_p + r)p^{\theta-1} + e - \frac{ae}{\lambda} - (1-a)\alpha(V_u - V_p) \tag{9}$$

From equations (8) and (9), we can solve for V_u and V_p. The results are:

$$V_u = V_p + \frac{(e - \varepsilon(w_p)p^{\theta-1})}{(1+\delta)} \tag{10}$$

$$V_p = \frac{1}{\delta}[\varepsilon(w_p + r)p^{\theta-1} - e + \frac{ae}{\lambda} + \frac{\alpha(e - \varepsilon(w_p)p^{\theta-1})}{(1+\delta)}] \tag{11}$$

Equation (10) is fairly intuitive. It says that workers employed in the public sector will be better off than those unemployed if and only if the current utility gain from employment in the public sector is greater than the disutility of effort. Equations (10), (11) and (7) can be manipulated to obtain:

$$\varepsilon(w)p^{\theta-1} = (1-\alpha)\varepsilon(w_p)p^{\theta-1} + \frac{(\alpha\lambda + \delta + a + b)e}{\lambda} \tag{12}$$

In a steady state, the flow out of employment in the private sector $b(l_f + l_m)$ must be equal to the flow into employment in the private sector $a(N - l_f - l_m)$. Therefore, in a steady state, the job acquisition rate is endogenously determined as

$$a = \frac{b(l_f + l_m)}{N - l_f - l_m} \tag{13}$$

The aggregate no-shirking condition, which represents the 'cut-off' wage below which no worker is motivated to put forth any productive effort at employment level $(l_f + l_m)$, is derived by substituting equation (13) into (12). This yields:

$$\varepsilon(w)p^{\theta-1} = (1-\alpha)\varepsilon(w_p)p^{\theta-1} + (\alpha\lambda + \delta + \frac{bN}{N - l_f - l_m})\frac{e}{\lambda} \tag{14}$$

An important feature of the no-shirking condition (equation 14) is that it is independent of non-labour income (r). This follows from the fact that each worker is endowed with one unit of physical capital and the assumption of homothetic preferences.

IIb2. Public Sector

We model the public sector as one that uses unemployed labor to improve the quality, or increase the stock, of an intermediate good, which is an external input in private production technology in the food industry.[17]

It is assumed that there are no moral hazard problems in the public sector. This implies that any worker employed in the public sector cannot shirk. The public sector chooses w_p and l_p to solve a constrained output maximization problem defined as:[18]

[17] Although development projects are publicly supported, they are not necessarily implemented by governments. In some cases, they are implemented by non-governmental organizations or through community-level initiatives (see von Braun, Teklu and Webb, 1992). In this paper, it does not matter whether the project is implemented by the government or non-governmental organizations. The crucial factor is that the projects are financed with external aid.

[18] Specifying the public sector as maximizing output rather than minimizing cost can be rationalized on the grounds that the effective constraint to project execution in recipient countries is finance. Besides, specifying the public sector's objective as one of minimizing cost is tantamount to assuming that the public sector is constrained by a fixed output; this is an argument that is difficult to justify(see Chambers and Lee, 1986).

$$Max \quad I(l_p) \tag{15}$$

s.t.

$$w_p l_p \leq pA \tag{16}$$

$$\varepsilon(w_p)p^{\theta-1} \geq e \tag{17}$$

$$l_p \leq N - l_m - l_f \tag{18}$$

Where, l_p is the quantity of labour employed in the public sector and A is the quantity of food aid received. The production function for the intermediate good is assumed to be increasing in its argument. Equation (16) is the finance constraint. It reflects the fact that the total labour cost is constrained by the value of food aid received. The second inequality (equation 17) is the participation constraint for workers. It ensures that the utility workers derive from participating in public projects is greater than or equal to the disutility of effort. If this condition is not satisfied, no worker will participate in the project. Equation (18) is the labour supply constraint. It says that the total labour employed in the public sector must be less than or equal to the quantity of labour not employed in the private sector. This mirrors the stylized fact that food-for-work projects attract a residual labour force not engaged in other (superior) wage-earning activities at the time of participation.[19]

In equilibrium $w_p l_p = pA$. To establish this, suppose that the optimal wage and labour combination that solves the public sector's problem is such that $w_p l_p < pA$ and labour is not fully employed. Then the public sector can employ more labour at the going wage and increase output, thereby contradicting the assumption that the initial wage-labour combination is optimal. Also, if $w_p l_p < pA$ and labour is fully employed, the public sector can increase output by increasing the public sector wage. To see this, note that an increase in the public sector wage will reduce the penalty for shirking in the private sector and force

[19] See Bezuneh, Deaton and Norton, 1988, for the types of participants in a food-for-work project in the Baringo district in Kenya.

firms in the private sector to raise wages and layoff some workers. Because the output of infrastructure is increasing in labour, the public sector has an incentive to absorb workers laid off by the private sector until the finance constraint binds, thereby increasing public sector output. Therefore, $w_p l_p < pA$ cannot occur in equilibrium.

Using $w_p l_p = pA$, we can rewrite the public sector's problem as:

$$Max \quad I(l_p) \tag{19}$$

s.t.

$$\varepsilon(\frac{pA}{l_p})p^{\theta-1} \geq e \tag{20}$$

$$l_p \leq N - l_m - l_f \tag{21}$$

The public sector's problem has three types of solutions.

(a) $l_p = N - l_f - l_m$ and $\varepsilon(w_p)p^{\theta-1} > e$.

This is a case in which the public sector employs all labour not employed in the private sector and pays a wage that is higher than the reservation wage. In this case, workers not offered employment in the private sector prefer public sector employment to being unemployed.

(b) $l_p = N - l_f - l_m$ and $\varepsilon(w_p)p^{\theta-1} = e$.

Case (b) represents a situation in which the public sector employs all workers that cannot find employment in the private sector, but pays a reservation wage. In this case, workers are indifferent between working in the public sector and being unemployed.

(c) $l_p < N - l_f - l_m$ and $\varepsilon(w_p)p^{\theta-1} = e$.

This is a scenario in which the public sector employs only a fraction of workers that were not offered jobs in the private sector and pays a reservation wage. In this setting there are unemployed workers, but they have the same utility level as those workers employed in the public sector.

The case where $l_p < N - l_f - l_m$ and $\varepsilon(w_p)p^{\theta-1} > e$ can be easily ruled out. Suppose that this is an optimal solution to the public sector's problem. By reducing w_p such that $\varepsilon(w_p)p^{\theta-1} = e$, the public sector can employ more workers and increase the output of the public good, thereby contradicting the assumption that the initial wage-labour combination is optimal.

Lemma 1: *In equilibrium,* $w > w_p$.

Proof: Equation (14) can be expressed as:

$$\varepsilon(w)p^{\theta-1} = \varepsilon(w_p)p^{\theta-1} + \alpha[e - \varepsilon(w_p)p^{\theta-1}] + (\delta + \frac{bN}{N - l_f - l_m})\frac{e}{\lambda} \tag{22}$$

In an unemployment equilibrium, the public sector wage must be such that $\varepsilon(w_p)p^{\theta-1} = e$. Similarly, in a full employment equilibrium, all individuals that could not find jobs in the private sector are hired by the public sector; in other words, the probability of not obtaining a job in the public sector (α) is equal to zero. Since the second term in equation (22) is equal to zero, in both equilibria, it is easy to show that the aggregate no-shirking condition can be expressed as:

$$\varepsilon(w - w_p)p^{\theta-1} = (\delta + \frac{bN}{N - l_f - l_m})\frac{e}{\lambda}$$

Clearly, the right-hand side is positive. Since ε and $p^{\theta-1}$ are also positive, it follows that (w-w_p) > 0.

Lemma 1 is interesting because it shows that the framework used in this paper is consistent with the evidence that most jobs created through food-aid-supported projects are menial and are less attractive to workers than private sector jobs.

The equilibrium conditions for the project food aid model are represented by the following set of equations.

$$\varepsilon(w)p^{\theta-1} = \varepsilon(w_p)p^{\theta-1} + (\delta + \frac{bN}{N - l_f - l_m})\frac{e}{\lambda} \tag{23}$$

$$M_1(N, l_m) = r \tag{24}$$

$$pf[I(l_p)] = w \tag{25}$$

$$M_2(N, l_m) = w \tag{26}$$

$$w_p l_p = pA \tag{27}$$

$$l_f + l_m + l_p \leq N \tag{28}$$

$$\frac{d_m}{d_f} = \frac{\theta}{(1-\theta)p^{-1}} \tag{29}$$

Where subscripts 1 and 2 refer to derivatives with respect to the first and second arguments respectively. The aggregate no-shirking condition is represented by equation (23). Equation (24) says that the marginal product of capital is equal to the rental rate. Equations (25) and (26) reflect the fact that the two industries or firms face the same moral hazard problems and, therefore, pay the same wage in equilibrium.[20] Equation (27) arises from the idea that the public sector's finance constraint must bind in equilibrium. Equation (28) ensures that the sum of employment in all sectors is less than or equal to total labour supply in the economy. Equation (29) is derived from maximizing the instantaneous utility function with respect to the two consumption goods, subject to an income constraint. The equality follows from the assumption of a small open economy and homothetic preferences.

IIb3: Full Employment Equilibrium

To derive the comparative statics results, consider an equilibrium in which $l_p = N - l_f - l_m$. Note that the consumption ratio $\frac{d_m}{d_f}$ is determined by a preference parameter θ and an externally determined world relative price for food p. Therefore, equation (29) does not affect the comparative statics results. The effect of project food aid in this economy can be obtained by noting that equations (23)-(28) can be reduced to a system of four equations in four unknowns, namely w, l_f, l_m, and r. This is accomplished by substituting for w_p and l_p in equations (23)-(26). Performing the required substitutions and totally differentiating the resulting system of equations yields:

[20] Note that, although the intermediate good is an input in the food industry, firms take its quantity as given when solving their problems. This follows from the fact that it is a public good.

$$\begin{pmatrix} \varepsilon p^{\theta-1} & -T & -T & 0 \\ 0 & 0 & M_{12} & -1 \\ 1 & pf^{'}I^{'} & pf^{'}I^{'} & 0 \\ 1 & 0 & -M_{22} & 0 \end{pmatrix} \begin{pmatrix} \frac{dw}{dA} \\ \frac{dl_f}{dA} \\ \frac{dl_m}{dA} \\ \frac{dr}{dA} \end{pmatrix} = \begin{pmatrix} \frac{\varepsilon p^{\theta}}{N-l_f-l_m} \\ 0 \\ 0 \\ 0 \end{pmatrix} \tag{30}$$

where the determinant of the matrix is given by:

$$\triangle = \varepsilon(f^{'}I^{'})p^{\theta}M_{22} + TM_{22} < 0$$

$$T = (\varepsilon p^{\theta}A + \frac{ebN}{\lambda})\frac{1}{(N-l_f-l_m)^2} > 0$$

Proposition 1: *In a full employment equilibrium, a small increase in project food aid creates labour disincentive effects in the manufactured good industry, but has no labour disincentive effects in the food industry.*

Proof: We want to show that $\frac{dl_m}{dA} < 0$ and $\frac{dl_f}{dA} = 0$. Solving equation (30) for the endogenous variables yields:

$$\frac{dw}{dA} = \frac{\varepsilon p^{\theta+1}(f^{'}I^{'})M_{22}}{\triangle(N-l_f-l_m)} \tag{31}$$

$$\frac{dl_f}{dA} = \frac{-\varepsilon p^{\theta}}{\triangle(N-l_f-l_m)}(M_{22} + pf^{'}I^{'}) \tag{32}$$

$$\frac{dl_m}{dA} = \frac{\varepsilon p^{\theta+1}}{\triangle(N-l_f-l_m)}(f^{'}I^{'}) \tag{33}$$

$$\frac{dr}{dA} = \frac{\varepsilon p^{\theta+1}M_{12}}{\triangle(N-l_f-l_m)}(f^{'}I^{'}) \tag{34}$$

By invoking the properties of the production functions we can show that $\frac{dw}{dA} > 0$, $\frac{dr}{dA} < 0$, and $\frac{dl_m}{dA} < 0$. For the second part of the proposition, note that equation (26) implies that $\frac{\partial w}{\partial l_m} = M_{22}$. Differentiating both sides of equation (25) with respect to l_m, noting that in equilibrium $l_p = N - l_f - l_m$, we conclude that $M_{22} = -pf^{'}I^{'}$. Using this in equation (32) yields the result stated in proposition 1.

The intuition behind this proposition is as follows: Due to homothetic preferences and the small open economy assumption, an increase in project food aid has no effect on

$\frac{d_m}{d_f}$. Therefore, the only channel through which food aid can affect the equilibrium of this economy is the no-shirking condition (NSC). In a full employment equilibrium if the level of food aid is increased, private sector firms expect the public sector wage to increase, thereby reducing the penalty for shirking in the private sector. To prevent this from happening the private sector responds by increasing the wage rate in the private sector. This increase in the private sector wage leads to a decrease in labour employment in the manufactured good industry. In the food industry, however, the increase in food aid has two opposing effects: the first is the increase in the private sector wage which tends to reduce labour employment in the food industry; the second is the increase in the supply of infrastructure arising from the fact that when labour is displaced from the private sector, the public sector will increase employment (see lemma 2). The increase in the supply of infrastructure increases the marginal product of labour in the food industry, thereby creating an incentive for the industry to hire more labour. In the economy under consideration, the two opposing effects cancel each other out, leaving total labour employment in the food industry unaffected.

Lemma 2: *Project food aid increases public sector employment, but its ultimate effect on the public sector wage depends on the elasticity of public sector employment with respect to food aid.*

Proof: In the equilibrium under consideration, $l_p = N - l_f - l_m$. Since we have shown that project food aid has no effect on labour employment in the food industry, it follows that $\frac{dl_p}{dA} = -\frac{dl_m}{dA} > 0$. For the second part of the lemma, note that $w_p = \frac{pA}{l_p}$. Given the definition of w_p, it can be shown that $\frac{dw_p}{dA} = \frac{p}{l_p}(1 - \phi)$, where ϕ is the elasticity of public sector employment with respect to project food aid. Therefore,

$$\frac{dw_p}{dA} = \begin{cases} 0, & \text{if } \phi = 1; \\ > 0, & \text{if } \phi < 1; \end{cases}$$

An increase in project food aid has two effects on the public sector wage: a direct and an indirect effect. The direct effect is positive and captures the idea that when the level of project food aid is increased, in a full employment equilibrium, its initial effect is to increase the public sector wage rate (follows from $w_p = \frac{pA}{l_p}$). The indirect effect is negative and arises from the fact that an increase in the public sector wage requires that private sector firms increase the equilibrium private sector wage, in order to satisfy the no-shirking condition, resulting in layoffs in the private sector. The decrease in private sector employment increases the supply of labour to the public sector. Since the public sector's output is increasing in labour, it is optimal for the public sector to increase public sector employment. The increase in public sector employment l_p tends to decrease the public sector wage (see the equation for w_p). Since the direct and indirect effects have opposing signs the ultimate effect of project food aid on the public sector wage depends on whether or not the direct effect dominates the indirect effect. If the elasticity of public sector employment with respect to project food aid is equal to one, both effects cancel each other out leaving the public sector wage unaltered. However, if the elasticity is less than one, the direct effect swamps the indirect effect, and the ultimate effect of project food aid on the public sector wage will be positive.[21]

IIb4: Unemployment Equilibrium

To derive the comparative statics results in an unemployment equilibrium, let l_u be the unemployment level in this economy. We know that in an unemployment equilibrium $\varepsilon(w_p)p^{\theta-1} = e$. Using this equality, we can show that the public sector wage is a constant and hence unaffected by a small increase in project food aid.

Proposition 2: *In an unemployment equilibrium, a small increase in project food aid creates labour disincentive effects in the manufactured good industry, but has no labour disincentive effects in the food industry.*

Proof: Given that the public sector wage is a constant, the comparative statics results can be obtained by solving the system of equations represented by equations (23)-(27) and

[21] The case of $\phi > 1$ can be ruled out since it implies a decrease in the public sector wage from its initial equilibrium level, which is not possible in an initial equilibrium in which public sector workers receive reservation wages.

the equation $l_f + l_m + l_p + l_u = N$. The results are:

$$\frac{dl_p}{dA} = \frac{p}{w_p} > 0 \tag{35a}$$

$$\frac{dw}{dA} = \frac{p^2 f^{'} I^{'}}{w_p} > 0 \tag{35b}$$

$$\frac{dl_m}{dA} = \frac{p^2 f^{'} I^{'}}{w_p M_{22}} < 0 \tag{35c}$$

$$\frac{dl_f}{dA} = [\frac{\lambda(N - l_f - l_m)^2 \varepsilon p^{\theta-1}}{bNe} - \frac{1}{M_{22}}]\frac{dw}{dA} > 0 \tag{35d}$$

$$\frac{dr}{dA} = \frac{p^2 f^{'} I^{'} M_{12}}{w_p M_{22}} < 0 \tag{35e}$$

$$\frac{du}{dA} = -[\frac{\lambda(N - l_f - l_m)^2 \varepsilon p^{\theta-1}}{bNe}]\frac{dw}{dA} - \frac{dl_p}{dA} < 0 \tag{35f}$$

To understand this proposition note that, in the unemployment equilibrium, the public sector wage w_p is a constant. Given this, an increase in project food aid increases labour employment in the public sector l_p, thereby reducing the unemployment level and the penalty for shirking in the private sector. To prevent shirking, the private sector wage increases. The increase in the private sector wage reduces employment in the manufacturing industry, thereby creating a labour disincentive effect. In the food industry, however, the decrease in labour employment caused by an increase in the private sector wage is completely dominated by an increase in labour employment resulting from the fact that the change in public sector employment increases the supply of infrastructure, thereby increasing the marginal product of labour in the food industry and creating an incentive for the food industry to hire more labour.

IIc. Project Food Aid, Food Security and Aggregate Welfare

There are three components of food security: increasing food production; stabilizing food supplies; and improving access to food. In view of the fact that the framework suggested in this paper cannot handle the last two components, we shall adopt the first component as our measure of food security. From propositions 1 and 2, lemma 2, and the solution to the public sector's problem, we know that the optimal values of l_f, l_m, and l_p are functions of the level of food aid (A). We also know that, in equilibrium, capital will be fully employed and is independent of the level of food aid. Therefore, the equilibrium outputs of food and the manufactured good can be expressed as:

$$M^* = M(N, l_m) \tag{35}$$

$$F^* = f[I(l_p)]l_f \tag{36}$$

Proposition 3: *In both the full employment and unemployment equilibria, a small increase in project food aid increases food security, but its effect on the output of the manufactured good is negative.*

Proof: Differentiating equations (35) and (36) with respect to A we can show that:

$$\frac{\partial M^*}{\partial A} = M_2 \frac{\partial l_m}{\partial A} < 0 \tag{37a}$$

$$\frac{\partial F^*}{\partial A} = (l_f f^{'} I^{'}) \frac{\partial l_p}{\partial A} + f \frac{\partial l_f}{\partial A} > 0 \tag{37b}$$

Equation (37a) follows from the result that project food aid creates "labour disincentive effects" in the manufacturing industry, in both the unemployment and full employment equilibria, and the idea that capital will be fully employed in equilibrium. The first term on the right in equation (37b) is the "productivity effect" of food aid resulting from the fact that project food aid affects the supply of the intermediate good, which is a productivity-enhancing input in the food industry. The productivity effect is positive. The second term in equation (37b) represents the effect of project food aid on labour employment in the food industry. In an unemployment equilibrium the second term in equation (37b) is positive, but in a full employment equilibrium it is zero. Therefore, in both equilibria, project food aid increases food production and decreases the output of the manufactured good. However, the magnitude of the effect of project food aid on food production is higher in an unemployment equilibrium relative to a full employment equilibrium. Proposition 3 lends credence to the view of food aid advocates that project food aid is a good source of food security in developing countries, especially those with high unemployment levels and poor infrastructure.

Proposition 4: *In both the full employment and unemployment equilibria, the effect of project food aid on aggregate welfare depends on the magnitude of the labour disincentive effect created in the manufacturing industry.*

Proof: To derive the welfare properties of the equilibria in this model, note that, with homothetic preferences, aggregate welfare can be expressed as:

$$V = \varepsilon(rN + w(l_f + l_m) + w_p l_p)p^{\theta-1} - e(l_f + l_m + l_p) \quad (38)$$

where, $Y = rN + w(l_f + l_m) + w_p l_p$ is national income. Since the two consumption goods are produced under constant returns to scale, it must be the case that: $rN + w(l_f + l_m) + w_p l_p = M^* + pF^*$. Consider a full employment equilibrium. Differentiating equation (38) with respect to A noting that, in a full employment equilibrium, $l_f + l_m + l_p = N$ we obtain:

$$\frac{\partial V}{\partial A} = \varepsilon p^{\theta-1}(w + NM_{12})\frac{\partial l_m}{\partial A} + \varepsilon(w_p)p^{\theta-1}\frac{\partial l_p}{\partial A} + \varepsilon p^{\theta-1}[\frac{\partial w}{\partial A}(l_f + l_m) + \frac{\partial w_p}{\partial A} l_p] \quad (39)$$

Equation (39) is intuitive. It suggests that food aid affects aggregate welfare through three channels. The first term is negative and captures the change in welfare resulting from the fact that food aid decreases total employment in the manufactured good industry; this term is the labour disincentive effect. The second term is positive and represents the welfare effect due to a change in public sector employment. The last term is positive and mirrors the idea that project food aid increases the private sector wage and its ultimate effect on the public sector wage is either positive or zero (see lemma 2). Therefore, in such an equilibrium, the net effect of project food aid on aggregate welfare is likely to be positive if the labour disincentive effect is small.

For the unemployment equilibrium, the result is:

$$\frac{\partial V}{\partial A} = [\varepsilon p^{\theta-1}(w + NM_{12}) - e]\frac{\partial l_m}{\partial A} + [\varepsilon(w)p^{\theta-1} - e]\frac{\partial l_f}{\partial A} + \varepsilon p^{\theta-1}\frac{\partial w}{\partial A}(l_f + l_m) \qquad (40)$$

The first term in equation (40) is the labour disincentive effect of project food aid, which affects welfare negatively. The second term is the positive welfare effect due to the idea that project food aid increases employment in the food industry in an unemployment equilibrium. The last term is also positive and captures the result that project food aid increases the equilibrium private sector wage and, hence, aggregate welfare. Clearly, a sufficient condition for project food aid to increase aggregate welfare in an unemployment equilibrium is that the labour disincentive effect be relatively small.

III: NON-PROJECT FOOD AID FORM OF DELIVERY

In this part we consider an alternative delivery or distribution mechanism. In particular, we assume that all unemployed workers receive food aid as a lump-sum transfer. The amount received by each unemployed worker is determined by the total quantity of food aid divided by the number of unemployed workers. In the non-project food aid environment there is no infrastructure development activity. Therefore, the economy has fixed supplies of infrastructure and capital. Firms in the food industry use the fixed stock of infrastructure and labour for production, while manufacturing industry firms combine labour with the stock of capital to produce manufactured goods. Since the private sector pays efficiency wages to induce effort, and there are no public sector jobs, an equilibrium with full employment of labour cannot exist in this environment. Therefore, the equilibrium of an economy with non-project food aid is characterized by the following set of equations:

$$M_1(N, l_m) = r \qquad (41)$$

$$pf(I) = w \qquad (42)$$

$$M_2(N, l_m) = w \tag{43}$$

$$\varepsilon(w)p^{\theta-1} = \varepsilon(\frac{A}{l_u})p^{\theta} + (\lambda + \frac{bN}{l_u} + \delta)\frac{e}{\lambda} \tag{44}$$

$$l_u = N - l_f - l_m \tag{45}$$

$$\frac{d_m}{d_f} = \frac{\theta}{(1-\theta)p^{-1}} \tag{46}$$

Equations (41), (43) and (46) are the non-project food aid versions of equations (24), (26) and (29). Equation (42) sets the marginal product of labour in the food industry equal to the private sector wage. This equation differs from the corresponding equation specified for project food aid because, under project food aid, the intermediate good I depends on the level of public sector employment while under non-project food aid it is a constant. Equation (44) is the no-shirking condition in an economy with non-project food aid and $\frac{A}{l_u}$ is the per capita food aid received by each unemployed worker. Equation (45) ensures that total employment in the economy $(l_f + l_m)$ plus the number of unemployed workers l_u is equal to the total number of workers in the economy.

Using equation (45) in equation (44), we can reduce the equilibrium conditions to a system of four equations in four endogenous variables: w, r, l_f and l_m. Differentiating the resulting system totally, we obtain:

$$\begin{pmatrix} \varepsilon p^{\theta-1} & -T & -T & 0 \\ 0 & 0 & M_{12} & -1 \\ 1 & 0 & 0 & 0 \\ 1 & 0 & -M_{22} & 0 \end{pmatrix} \begin{pmatrix} \frac{dw}{dA} \\ \frac{dl_f}{dA} \\ \frac{dl_m}{dA} \\ \frac{dr}{dA} \end{pmatrix} = \begin{pmatrix} \frac{\varepsilon p^{\theta}}{N-l_f-l_m} \\ 0 \\ 0 \\ 0 \end{pmatrix} \tag{47}$$

where the determinant of the matrix is given by: $\triangle = TM_{22} < 0$

Proposition 5: *A small increase in non-project food aid creates labour disincentive effects in the food industry, but has no labour disincentive effects in the manufactured good industry.*

Proof: By Cramer's rule,

$$\frac{dw}{dA} = \frac{dl_m}{dA} = \frac{dr}{dA} = 0 \tag{48a}$$

$$\frac{dl_f}{dA} = \frac{-\varepsilon p^{\theta} M_{22}}{\triangle(N - l_f - l_m)} < 0 \tag{48b}$$

Proposition 5 follows from the idea that, in this economy, the marginal product of labour in the food industry is a constant. This implies that the equilibrium efficiency wage in the food industry is independent of labour employment in the food industry (see equation (42)). An increase in non-project food aid increases the lump-sum transfer to each unemployed agent, thereby reducing the penalty for shirking in the food and manufactured good industries. Since the wage in the food industry is a constant, the only way in which the food industry can discourage shirking is to reduce employment until the no-shirking condition is satisfied at the initial private sector wage. Given that, in the new equilibrium, the private sector wage is unchanged there will be no change in manufacturing industry employment. The important point to note in this proposition is that it provides a reason why an economy that receives a transfer may adjust to the transfer by varying quantity rather than price. Note that Proposition (5) implies that non-project food aid increases the level of unemployment in the recipient country. To see this, differentiate equation (45) with respect to non-project food aid. This yields: $\frac{\partial l_u}{\partial A}$ = - $\frac{\partial l_f}{\partial A} > 0$.

IIIa: Non-Project Food Aid, Food Security and Aggregate Welfare

Proposition 6: *An increase in non-project food aid decreases food security, but has no effect on the output of the manufactured good.*

<u>Proof:</u> To understand the proposition, note that $M^* = M(N, l_m)$; $F^* = f(I)l_f$; and that the stock of infrastructure or intermediate good in the economy is fixed and independent of the level of non-project food aid. Given this, it can be shown that $\frac{\partial M^*}{\partial A} = 0$; and $\frac{\partial F^*}{\partial A} = f(I)\frac{\partial l_f}{\partial A} < 0$. Proposition 6 follows from the idea that non-project food aid creates labour disincentive effects in the food industry, but has no labour disincentive effects in the manufactured good industry.

Proposition 7: *Non-project food aid increases aggregate welfare in the recipient country if the associated labour disincentive effect is small relative to the direct welfare benefit. If the labour disincentive effect is sufficiently large, non-project food aid decreases aggregate welfare.*

Proof: In an economy with non-project food aid, aggregate income is made up of two components: income from production $rN + w(l_f + l_m) = M^* + pF^*$; and transfer income pA. Therefore, aggregate welfare V is represented by: $V = \varepsilon(rN + w(l_f + l_m) + pA)p^{\theta-1}$ - $e(l_f + l_m)$. Differentiating the aggregate welfare equation with respect to the level of non-project food aid, noting that $\frac{dw}{dA} = \frac{dl_m}{dA} = \frac{dr}{dA} = 0$, we obtain:

$$\frac{\partial V}{\partial A} = [\varepsilon(w)p^{\theta-1} - e]\frac{\partial l_f}{\partial A} + \varepsilon p^{\theta} \tag{49}$$

The first term in equation (49) captures the labour disincentive effect of non-project food aid, which affects welfare negatively. The second term is the direct welfare benefit of non-project food aid. Given the signs of these terms, the effect of non-project food aid on aggregate welfare in the recipient country is ambiguous in general. If the labour disincentive effect is sufficiently small, the direct welfare benefit will dominate the labour disincentive effect, resulting in an increase in aggregate welfare. However, if the labour disincentive effect is large relative to the welfare benefit of non-project food aid, the ultimate effect on aggregate welfare is likely to be negative.

IV: EMPIRICAL EVIDENCE

In this section, we present preliminary results of empirical tests of the predictions of the model regarding the effects of food aid delivery on agricultural wages and employment, the stock of infrastructure and food security. The model predicts that project food aid increases agricultural employment and wages as well as the stock of infrastructure and food security. It also predicts that non-project food aid has no effect on agricultural wages and the stock of infrastructure. However, it decreases agricultural employment and food security. As stated in section IIc, our measure of food security is proxied by cereal food production. The predictions of the model could be tested by estimating either the structural model or reduced-form equations derived from the structural model. In this paper, we adopt reduced-form estimation rather than structural estimation for two reasons: (a) the predictions of the model that we are testing are based on comparative statics results and these correspond to reduced-form effects; and (b) data limitations prevent us from estimating a full structural model of direct effects.

The estimated models are represented by the following reduced-form regression equations:

$$CP_t = \rho_{10} + \rho_{11}A_t + \rho_{12}NA_t + \rho_{13}y_{t-1} + \rho_{14}x_t + \rho_{15}e_{t-1} + \varepsilon_{1t} \tag{50}$$

$$I_t = \rho_{20} + \rho_{21}A_t + \rho_{22}NA_t + \rho_{23}y_{t-1} + \rho_{24}x_t + \rho_{25}e_{t-1} + \varepsilon_{2t} \tag{51}$$

$$W_t = \rho_{30} + \rho_{31}A_t + \rho_{32}NA_t + \rho_{33}y_{t-1} + \rho_{34}x_t + \rho_{35}e_{t-1} + \varepsilon_{3t} \tag{52}$$

$$E_t = \rho_{40} + \rho_{41}A_t + \rho_{42}NA_t + \rho_{43}y_{t-1} + \rho_{44}x_t + \rho_{45}e_{t-1} + \varepsilon_{4t} \tag{53}$$

where, CP is the log of cereal food production, A is the log of project food aid and NA is the log of non-project food aid. I, E and W are the logs of the stock of infrastructure, agricultural employment and wages respectively. y, x and e represent growth rates of real gross domestic product, the exchange rate and agricultural employment respectively. The two explanatory variables of interest are A and NA. The other explanatory variables are basically control variables. y_{t-1} was included to capture the effects of business cycle fluctuations and x_t was included to capture the fact that changes in exchange rates affect macroeconomic variables in a small open economy. The variable e_{t-1} attempts to control for labour market conditions. Based on the theory developed in this paper, we expect the following signs: ρ_{11}, ρ_{21}, ρ_{31}, and $\rho_{41} > 0$; ρ_{12} and $\rho_{42} < 0$; and $\rho_{22} = \rho_{32} = 0$.

IVa: The Data

Empirical tests of the predictions of the model will be performed using annual data for India and Mauritius. These two countries were chosen because of data limitations and the fact that one is a small country while the other is a large country. Data on cereal production, in thousand metric tons, were obtained from the computerized information series (FAOSTAT.PC) distributed by the Food and Agriculture Organization of the United Nations (FAO). In the FAO series, total cereal production is made up of the output of wheat, paddy rice and coarse grains. Coarse grains include barley, maize, rye, oats, millet, sorghum, popcorn, buckwheat, fonio, triticale, canary seed and mixed grains.

Identification of a suitable source of infrastructure data proved problematic. To overcome this problem, we used time-series data on irrigated land area as a proxy for infrastructure. This makes sense since project food aid has been used to support irrigation development projects in most food aid recipient countries. Irrigation data were obtained from the computerised information series on Land Use (FAOSTAT.PC, Volume 3) distributed by the FAO in 1995. In the FAO series, data on irrigation relate to areas purposely provided with water, including land flooded by river water for crop production or pasture improvement, whether this area is irrigated several times or only once during the year stated.

Project food aid data were obtained from the World Food Programme's office in Rome. The data represent total food aid shipments by the World Food Programme for development projects in recipient countries. Although other international organizations, governments and non-governmental organizations also provide project food aid, the World Food Programme (WFP) is the major provider of such aid (see Shaw and Clay, 1993). Therefore, it is reasonable to use WFP shipments as a proxy for total project food aid.

The FAO publication, *Food Aid in Figures* (1993 and 1983), contains total cereal food aid data for all recipient countries. However, because the series do not contain disaggregated data by method of disbursement, it is difficult to determine the amount of food aid shipment that each recipient country received in the form of non-project food aid. To overcome this problem, we subtracted total WFP food aid shipments to a recipient country for development projects from the total food aid data for the same recipient country and year, and used the difference as a proxy for non-project food aid.

Agricultural employment and wage data were obtained from the 1995 and 1986 editions of the *Yearbook of Labour Statistics* published by the International Labour Organisation. Exchange rate data were obtained from the 1996 edition of the *International Financial Statistics Yearbook* published by the IMF. Data on gross domestic product in constant 1987 US dollars were obtained from the 1995 edition of *World Tables* published by the World Bank.

IVb: Preliminary Estimation Results

All equations were estimated by OLS and the standard errors were computed using Newey and West (1987). Since project and non-project food aid may affect the endogenous variables with lags rather than instantaneously, we estimated various specifications of the general model using lagged values of A and NA. That is, the results presented are based on a general-to-specific testing methodology. Preliminary results of the estimated equations using annual Indian data spanning the period 1976-89 are reported in Tables 1 and 2.

For the cereal food production equation, the final specification has project aid lagged one period and non-project food aid lagged two periods. The adjusted R^2 for this equation is 0.620 suggesting that the overall fit of the model is satisfactory. The coefficients on project and non-project food aid have the expected signs and are statistically significant at the 1 percent level. The result suggests that a 100 percent increase in project food aid in period $t-1$ increases cereal food production by 8.8 percent in period t. However, a 100 percent increase in non-project food aid in period $t-2$ decreases cereal food production by 7.6 percent in period t. For the infrastructure equation, the project food aid variable has the expected sign (positive) and is statistically significant at the 5 percent level. A 100 percent increase in project food aid in period $t-1$ increases the stock of infrastructure by 2 percent. The non-project food aid variable is negative and statistically significant at the 1 percent level. In contrast, the theory suggests that it should be insignificant.

Both food aid variables have the expected signs in the agricultural employment equation. However, while the non-project food aid variable is significant at the 1 percent level, the project food aid variable is insignificant. The adjusted R^2 for this equation is 0.622. For the wage equation, the project food aid variable has the right sign (positive) but is statistically insignificant. The non-project food aid variable is negative and statistically significant at the 1 percent level while the theory suggests that it should be insignificant.

To further examine the implications of the theory we performed another set of estimations using time-series data for Mauritius (1976-93). The results are reported in Tables 3 and 4. In the cereal food production equation, the project and non-project food aid variables have signs consistent with the theory and they are statistically significant at 1 and 5 percent significance levels. The adjusted R^2 for this equation is 0.491. For the infrastructure equation, the project food aid variable is positive and statistically significant at the 5 percent level while the non-project food aid variable is statistically insignificant. These results are consistent with the predictions of the theory that project food aid increases the stock of infrastruture while non-project food aid has no effect on it. Based on the results, a 100 percent increase in project food aid in period $t-1$ increases the stock of infrastructure by 5 percent.

For the agricultural wage equation, the project food aid variable has the right sign (positive) and is statistically significant at the 5 percent level. The non-project food aid variable is statistically insignificant, which is consistent with the prediction of the theory. The agricultural employment equation has coefficients on the project and non-project food aid variables that are inconsistent with the predictions of the theory.

Although the results presented in this section provide support for the predictions of the theoretical model, the evidence should be regarded as suggestive rather than conclusive given the small sample size used in the estimations. Due to the paucity of data, particularly on non-project food aid, we were unable to use a larger sample size. In future research, it would be useful to examine data for more countries and, perhaps, use a pooling-regression methodology.

V: POLICY IMPLICATIONS AND CONCLUSION

This paper presents a theoretical model illustrating the effects of food aid on labour employment, food security, and aggregate welfare in an environment in which private sector firms pay efficiency wages in order to overcome the moral hazard problems associated with the use of hired labour. Two forms of food aid delivery are considered: first is project food aid, under which food aid is used to finance infrastructure development projects and unemployed workers are required to participate in public projects in order to receive food aid; second is non-project food aid, which is used in this paper to refer to all food aid that unemployed workers receive as a lump-sum transfer.

The model suggests that when food aid is used to finance infrastructure development projects it has no labour disincentive effects in the food industry. Furthermore, it increases food security and has an ambiguous effect on aggregate welfare in the recipient country. When food aid is distributed to unemployed workers as a lump-sum transfer, however, the model predicts that it creates labour disincentive effects in the food industry and decreases food security, but its effect on aggregate welfare depends on the magnitude of the labour disincentive effect. Preliminary tests of the predictions of the model provide support for the proposition that project food aid increases food security while non-project food aid decreases food security.

An important implication of the results of this study for policy is that the use of food aid to finance infrastructure development projects is potentially an effective way of enhancing food security in recipient countries characterized by widespread use of hired labour in the agricultural sector. In the environment considered, distributing or allocating food aid to unemployed workers as a lump-sum transfer creates labour disincentive effects in the food industry and puts the food security of recipient countries at risk. The model provides a rationale for the increasing use of the project approach to food aid disbursement by international donor agencies - such as the World Food Programme (WFP) and the Canadian International Development Agency (CIDA).

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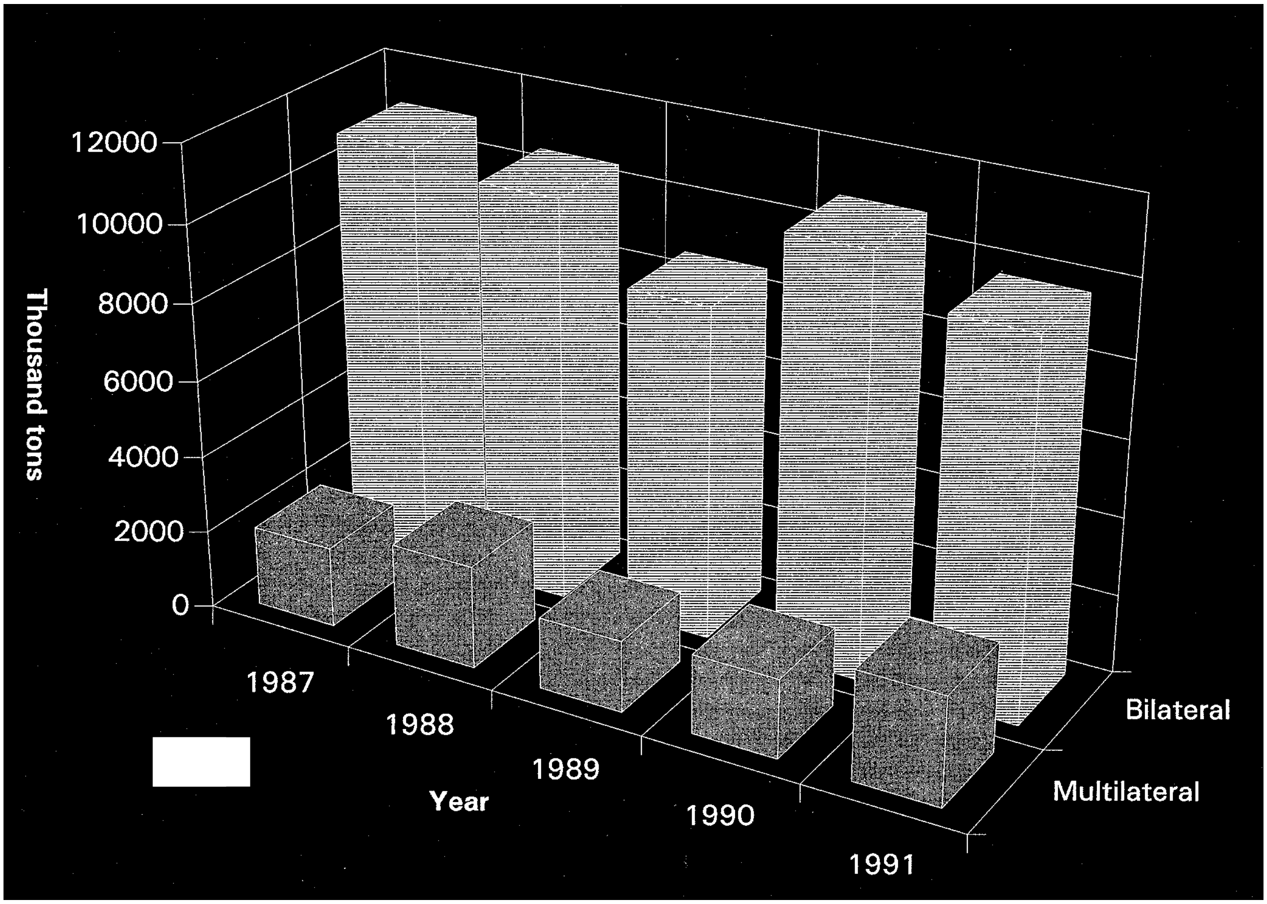
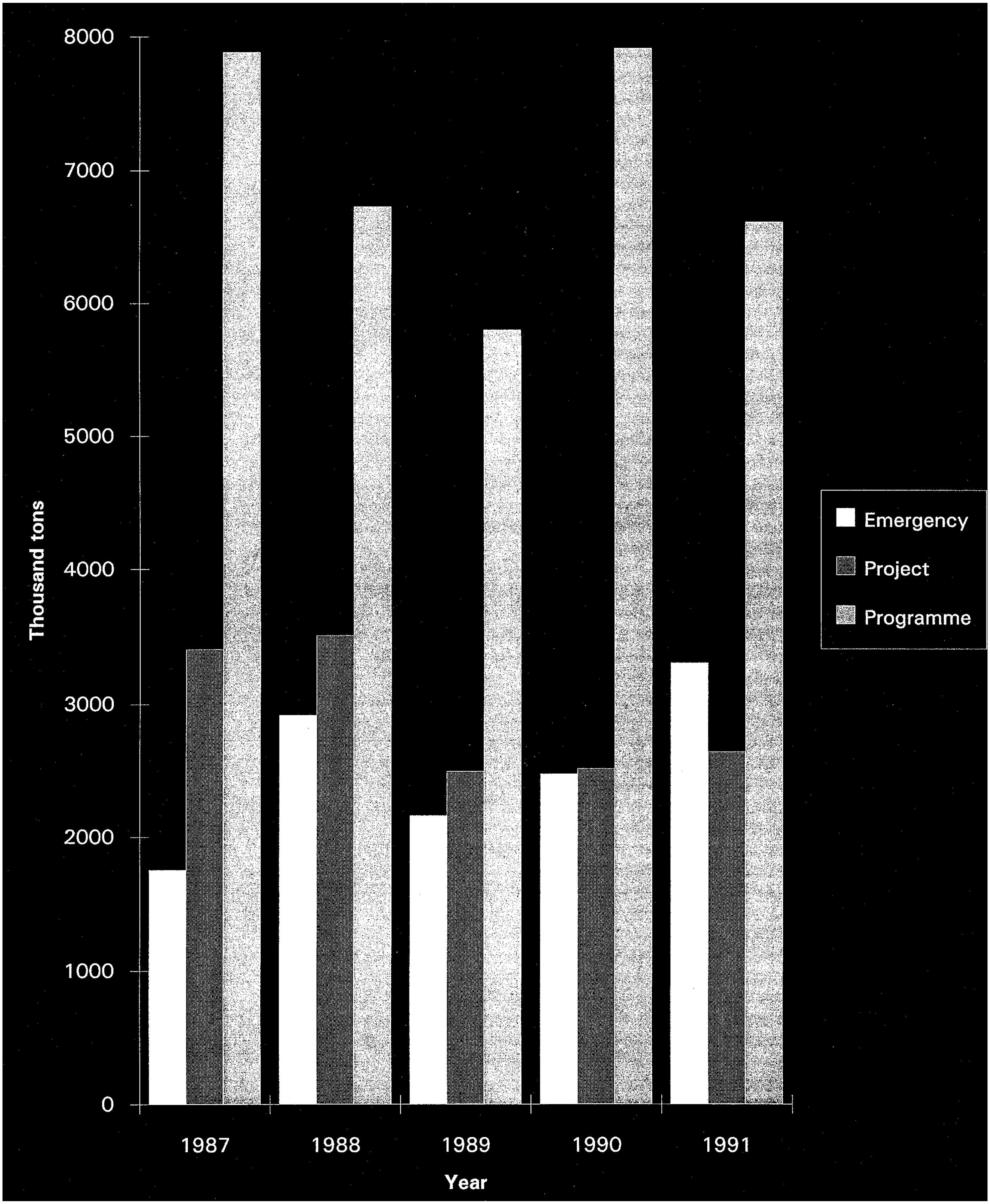
Figure 1: Bilateral and Multilateral Food Aid (1987-91)



Source: Figure generated using raw data from Shaw and Clay (1993)

Figure 2: Types of Food Aid (1987-91)



Source: Figure generated using raw data from Shaw and Clay (1993)

Figure 3: Geographic Distribution of Cereal Food Aid (1981-93)

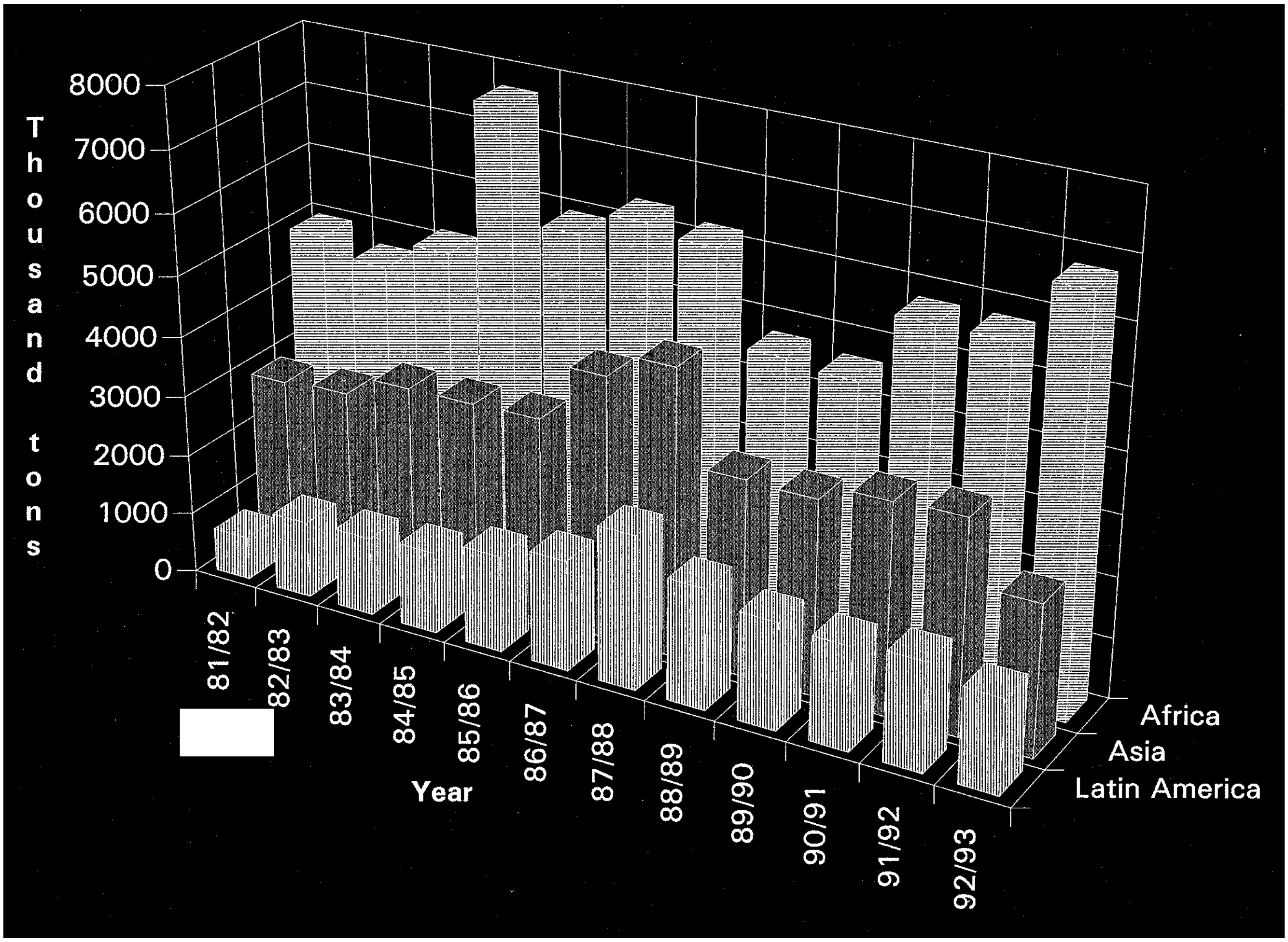


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Table 1: Estimation Results (India)

Explanatory Variable	Dependent Variable: CP	Dependent Variable: I
A_{t-1}	0.089 (0.001)	0.021 (0.044)
NA_{t-2}	-0.077 (0.004)	-0.060 (0.000)
y_{t-1}	-0.272 (0.562)	-0.082 (0.581)
x_t	1.061 (0.008)	0.338 (0.000)
e_{t-1}	-1.077 (0.456)	0.048 (0.909)
Constant	11.988 (0.000)	10.852 (0.000)
$\overline{R}^2$	0.620	0.687

P-values are in parenthesis. Standard errors computed using Newey and West (1987).

Table 2: Estimation Results (India)

Explanatory Variable	Dependent Variable: E	Dependent Variable:W
A_{t-1}	0.018 (0.182)	0.137 (0.222)
NA_{t-2}	-0.042 (0.000)	-0.423 (0.000)
y_{t-1}	-0.235 (0.003)	-2.425 (0.055)
x_t	0.305 (0.000)	5.242 (0.000)
e_{t-1}	0.706 (0.056)	2.941 (0.418)
Constant	7.336 (0.000)	7.149 (0.000)
$\overline{R}^2$	0.622	0.705

P-values are in parenthesis. Standard errors computed using Newey and West (1987).

Table 3: Estimation Results (Mauritius)

Explanatory Variable	Dependent Variable: CP	Dependent Variable: I
A_{t-1}	1.065 (0.000)	0.050 (0.023)
NA_{t-2}	-0.430 (0.017)	-0.014 (0.260)
y_{t-1}	10.047 (0.001)	0.574 (0.001)
x_t	0.772 (0.701)	0.104 (0.440)
e_{t-1}	-12.302 (0.000)	-0.382 (0.153)
Constant	0.296 (0.427)	2.764 (0.000)
$\overline{R}^2$	0.491	0.055

P-values are in parenthesis. Standard errors computed using Newey and West (1987).

Table 4: Estimation Results (Mauritius)

Explanatory Variable	Dependent Variable: E	Dependent Variable:W
A_{t-1}	-0.175 (0.015)	0.540 (0.027)
NA_{t-2}	0.058 (0.166)	-0.167 (0.219)
y_{t-1}	-2.073 (0.001)	5.653 (0.008)
x_t	-0.348 (0.428)	1.942 (0.189)
e_{t-1}	0.293 (0.699)	3.074 (0.348)
Constant	4.013 (0.000)	6.993 (0.000)
$\overline{R}^2$	0.122	0.058

P-values are in parenthesis. Standard errors computed using Newey and West (1987).

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