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A model of peasant household behavior, under varying degrees of household-specific food and labor market failures, is constructed to show that these structural features can explain several well known patterns of peasant response which have often been attributed to peculiar motives, presumed specific to peasants. The model explains sluggish response to cash crops prices and high instability in perceived food and labor scarcities; the key role of manufactured consumer goods prices in stimulating peasants' effort in cash crops production; the effectiveness of taxation as opposed to incentives in stimulating cash crops production; and the key role of technological change in food production to enhance cash crop production. Results are obtained analytically in the case of one market failure and by numerical simulation with more than one.

Keywords: household behavior, market failure, peasants

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PEASANT HOUSEHOLD BEHAVIOR WITH MISSING MARKETS: SOME PARADOXES EXPLAINED

I. PEASANT BEHAVIOR OBSERVED: INTERNAL INSTABILITY, EXTERNAL SLUGGISHNESS

Two recurrent complaints are commonly heard in societies with large peasantries, one among peasant households and the other among governments when the economy depends on peasants for foreign exchange earnings and for the supply of food or labor. The first is that peasants invariably complain that every year is a bad year to them: it is characterized either by labor bottlenecks if the weather is good or by food scarcity if it is bad. Product and factor price changes, imposition of a monetary tax, and uneven technological progress between cash and food crops also destabilize their perceived scarcities of labor and food and make them scramble to compensate internally by adjusting their workload and food consumption levels. The second is that governments complain that peasants are not responsive to price incentives and to opportunities to adopt new technologies for cash crop production. The result is frustrated policies of incentives and modernization that lead governments to try, instead, coercive measures of tax and labor draft. These two leitmotifs together motivate this paper: Why, if peasants are always pressed by labor or food shortages, and consequently lead a life of great instability in work and consumption, do they appear to governments as sluggish and unresponsive to incentives and modernization opportunities?

In the literature on peasants, explanations of peasant behavior have often been sought in the specificity of their motives, postulating that peasants are not utility maximizers, by difference with other households, but are motivated instead by the satisfaction of needs or by the desire to insure "simple reproduction" (Vergopoulos, 1978). The "substantivist" school in economic anthropology (Polanyi, 1944; Dalton, 1961) thus rejected the use of formal economic analysis based on optimization behavior. Even when markets exist, such as in Malinowsky's celebrated analysis of the Kula exchange among Trobriand islanders in New Guinea, this was seen as a ritual process, not an economic activity (Malinowski, 1921). The

"formalist" response (Firth, 1946; Forman, 1975; Tax, 1953) rejected the "obsolete 'anti-market' mentality" (Cook, 1966) of the substantivists and proceeded to apply formal economic calculus to the analysis of peasant behavior under the postulate of existent markets. Cancian, for instance, described the pure formalist position as one saying "that most societies by now participate in active 'market' economies, and that therefore any significance the substantivist position may have for the study of 'non-market' economies is of little importance as a guide to present field research" (Cancian, 1966).

Like the formalists, we reject the motivationist interpretation of peasants that flies in the face of even casual observation of the extraordinary ingenuity and assiduity they exercise in struggling, both individually and collectively, to find ways of improving their lots. While using formal economic analysis to conceptualize peasant behavior in terms of utility maximization, we do not however follow the pure formalist approach of postulating the existence of markets for all the choice variables in the hands of the peasant household, labor and food most particularly. We consequently offer, as an alternative, a structuralist explanation according to which selective market failures for labor and/or food severely constrain peasants' abilities to respond to price incentives and other external shocks and force them to shift the burden of adjustment on the nontraded product (food) and factor (labor) which the household controls. In certain situations, the necessary internal adjustments can result in not only minimal external response but eventually apparent perverse behavior.

We proceed to first provide a general interpretation of the meaning of market failure as a feature that is household and not commodity specific. We then develop a model of peasant household behavior under various conditions of market failure for labor and food. Analytical solutions are derived for the simpler cases of a single market failure and empirical simulations are performed for the more complex cases where several markets fail. Simulations allow to predict the household's response to changes in the price and productivity of cash crops, changes in the price of manufactured consumption goods, the levying of a monetary head tax,

and availability of new technological opportunities in the production of food, all of which have been extensively used as policy instruments in attempting to mold peasant behavior.

II. THE PERVASIVENESS OF LABOR AND FOOD MARKET FAILURES FOR PEASANT HOUSEHOLDS

Strictly speaking, a market fails when the cost of a transaction through market exchange creates disutility greater than the utility gain that it produces, with the result that the market is not used for the transaction. Either a surrogate institution will emerge to allow the transaction to take place or the transaction simply does not occur. Nonexistence of a market is thus the extreme case of market failure. In a more general sense, the market exists, but the gains for a particular household may be below or above cost, with the result that some households will use the market while others will not. The definition of market failure is thus not commodity specific but household specific: In general, markets exist, but they selectively fail for particular households, making the corresponding commodity a nontradable for that household.

Typically, when commodities such as food and labor can be bought and sold by a peasant household, their sales price is a fraction of the purchase price. The widths of the price bands depend on transportation costs to and from the market, mark-ups by merchants, the opportunity cost of time involved in selling (search costs) and buying (recruitment and supervision costs), risk associated with uncertain prices and availabilities that determine perceived certainty equivalent prices that are lower than farm-gate prices for items sold and higher for items bought, and a variety of other transactions costs that are largely household specific. The poorer the infrastructure, the less competitive the marketing systems, the less information is available, and the more risky the transactions, the greater the size of this band.

Whenever the shadow price of a product or factor which the household produces and uses falls within this price band, trade will not occur: It is more advantageous to the household to neither buy nor sell and thus to be self-sufficient in this product or factor. If the shadow price is above the price band, the household should buy the commodity until the

shadow price that equates supply and residual demand for home production falls to the purchase price. If the shadow price is below the price band, the household should sell the commodity until the shadow price that equates residual supply, after sale of a marketed surplus, and demand rises to the sale price.

For a given width of the price band, the greater the price elasticity of demand of a household that tends to be a net seller, the more likely it is to stay self-sufficient as supply fluctuates. Conversely, the greater the elasticity of supply of a household that tends to be a net buyer, the more likely it is to stay self-sufficient as demand fluctuates.

There are also general equilibrium effects that tend to widen the price band as all households in a community tend to be net sellers or net buyers in the same year. Thus, when the harvest is good and the household could become a net seller, at the same time as the household's supply shifts, the lower bound of the price band falls, reducing the likelihood that the shadow price of a particular household will fall below sale price and make it a net seller. Conversely, in a bad year, as the household would become a net buyer, the upper bound of the price band tends to rise, eventually preventing the household from becoming a net buyer. The shallower local food and labor markets are, the more prices can be expected to be positively correlated with movements in shadow prices, trapping the household within the range of self-sufficiency.

There exists widespread empirical evidence on market failures for food in the literature on peasants. Examples include statements on the determinants of behavior by heads of peasant households in eastern Senegal where 99% assert that growing enough food for subsistence is preferable to relying on markets (Goetz *et al.*, 1988). They also include observations in four African countries, Guatemala, and the Philippines showing that peasant households continue to grow their own food, and more so as income rises, in spite of increasing involvement in the production of cash crops which provide higher returns to land and labor than the sale of a marketed surplus of food (von Braun *et al.*, 1989).

Labor markets are also commonly ineffective for the purchase or sale of labor by peasant households and high levels of labor self-sufficiency are observed (Fafchamps, 1985). Lack of a landless class, high homogeneity in factor endowments, and high levels of synchronicity in labor needs across households frequently leave little room for local labor markets. Many categories of household labor are also captive within the household for reasons of age and gender customs. Finally, transactions costs on local hired labor are particularly high because of the difficulty of penalizing opportunistic behavior in a context of tight village solidarity which plays the role of a collectively managed safety net. These labor market failures result in observed labor marginal productivities that are widely dispersed across farms (Collier, 1989).

Wide price bands force the peasant household to internalize the effects of all types of external shocks that displace the shadow prices of food and labor. It is the specific nature of the response to shocks such as changes in cash crops prices, changes in the price of manufactured consumption goods, imposition of a monetary head tax, and technological advances in food production that we will explore in this paper.

Behavior toward risk on market prices and availabilities affects the width of price certainty equivalent bands. However, once the peasant household's shadow price falls within this band, risk plays no significant additional role in decision making, and the model we develop here can consequently be nonstochastic. This is appropriate as long as the stochastic external shocks do not lead the household to revise its self-sufficiency decision.

III. THE HOUSEHOLD MODEL

Most household models developed to date have postulated the existence of perfect markets for the goods that are both produced and consumed by the household, thus implying recursiveness between production and consumption decisions (Lau *et al.*, 1981; Ahn *et al.*, 1981). Exceptions are cases where there are missing markets for risk (Roe and Graham-Tomasi, 1986) and where there are price bands for labor (commuting time in the

Lopez model (1986)). Strauss (1986) formally derived the shadow price for labor when the labor market is absent but did not use it to derive the impact that this has on the supply and demand of the commodities and factors for which markets exist, the subject which interests us here as this is what we use to characterize the external view of peasant responsiveness.

Consider a household producing two crops, a cash crop (q_c) and a food crop (q_f) with two inputs, labor (q_l) and other inputs such as fertilizers (q_x). The production technology is represented by $G(q, z) = 0$, where q is the vector of outputs (with positive values; $q_c, q_f > 0$) and inputs (with negative values; $q_l, q_x < 0$), and z is a vector of structural characteristics of the farm household. On the consumption side, this household consumes food (c_f), a manufactured good (c_m), and leisure (c_l) which is the complement in total time of its labor supply. The household has an initial endowment of time T_l as well as an endowment T_i of any commodity i. It may also have a cash endowment or receive a transfer S. The cash crop is solely sold on the market, and the other inputs and the manufactured goods are only provided by the market. For these commodities, the household is a price taker.

Food and labor are both provided by the household and eventually traded on the market. When markets exist for these commodities, they are considered homogenous, with perfect substitutability between domestic and market supply and with an exogenous price ($p_i = \bar{p}_i$). Situations of market failure, however, will be considered for food and/or for labor. In these cases, the household faces the constraint of balancing supply ($q_i + T_i$) and demand (c_i) of these commodities, called nontradables (NT) by analogy to the trade literature.

The household is assumed to maximize a utility function subject to a cash income constraint for the commodities tradable on the market (T), a technology constraint, and the equilibrium conditions for tradables and nontradables:

$$\max_{c,q} U(c, z) \tag{1}$$

$$\text{s.t.} \quad \sum_{i \in T} p_i c_i \le \sum_{i \in T} p_i (q_i + T_i) + S, \qquad \text{cash income constraint,}$$

$$G(q, z) = 0, \qquad \text{production technology,}$$

$$p_i = \bar{p}_i, \quad i \in T, \qquad \text{exogenous market price for tradables,}$$

$$q_i + T_i \ge c_i, \quad i \in NT, \qquad \text{equilibrium for nontradables.}$$

The Lagrangean associated with the constrained maximization problem is written:

$$L = U(c, z) + \lambda \left[\sum_{i \in T} \bar{p}_i (q_i + T_i - c_i) + S \right] + \phi\, G(q, z) + \sum_{i \in NT} \mu_i (q_i + T_i - c_i).$$

Tradable and nontradable commodities can be treated symmetrically in the writing of the first-order conditions of this constrained maximization problem by defining, for each nontradable commodity, an endogenous price $p_i = \mu_i/\lambda$. Assuming the existence of an interior solution, the optimal set of quantities (q_i, c_i) and the endogenous prices (p_i; $i \in NT$) are given by the solution of the system:

$$\begin{aligned}
&\text{(a)}\ U_i' = \lambda p_i, \quad i \in C = \{f, m, l\}, \quad \text{consumer goods,} \\
&\text{(b)}\ \phi\, G_i' = -\lambda p_i, \quad i \in P = \{c, f, l, x\}, \quad \text{producer goods,} \\
&\text{(c)}\ \sum_i p_i c_i = \sum_i p_i (q_i + T_i) + S, \quad \text{full income,} \\
&\text{(d)}\ G(q, z) = 0, \\
&\text{(e)}\ q_i + T_i = c_i, \quad i \in NT, \\
&\text{(f)}\ p_i = \bar{p}_i, \quad i \in T,
\end{aligned} \tag{2}$$

where U_i' and G_i' represent the partial derivatives of U and G with respect to c_i and q_i, respectively.

This household behavior can be decomposed into production and consumption decisions. As a producer, the household chooses the levels of inputs and outputs that satisfy (2b) and (2d), which is equivalent to maximizing a generalized profit function defined over all tradable and nontradable commodities. This leads to a system of input demand and output supply:

$$q_i = q_i(p, z), \quad i \in P, \tag{3a}$$

and to a maximum generalized profit equal to

$$\Pi = \sum_i p_i q_i, \quad i \in P. \tag{3b}$$

As a consumer, the household chooses the levels of consumption which maximize its utility under the full income constraint. This leads to a consumption system,

$$c_i = c_i(p, Y), \quad i \in C, \tag{3c}$$

where

$$\sum_{i \in C} p_i c_i = Y = \Pi + \sum_i p_i T_i + S. \tag{3d}$$

** If all markets exist and there is no nontradable commodity, all prices are exogenous and these decisions can be taken sequentially, as consumption decisions depend on the outcome of the production decisions but not conversely. This is the standard case of a separable household model. If some commodity or labor market does not exist, however, these two sets of decisions are linked through the endogenous "price" p_i that satisfies the equilibrium condition (2e) between supply and demand.

Although there is no explicit transaction between the producer and the consumer sides of the household, and endogenous prices cannot be observed, these nontradables' prices play a similar role to tradables' prices in the decision process of the household. When they apply, these shadow prices are equal to the marginal utility of the consumption of food and leisure and to the marginal productivity of labor. As such, they indicate the price that the peasant would be willing to pay to have the corresponding constraint relaxed by one unit. They can, therefore, serve as indicators of the *internal* perception of the severity of the constraint imposed on the peasant household, i.e., of the level of stress that he must endure. The *external* view of peasant household behavior is based on its supply and demand responses on the markets that exist.

We will see in the following empirical simulations how these two sets of variables—the internal prices of the nontradables and the marketed quantities of tradables—respond to different changes in the external environment such as market prices, taxes, and technology. But, before presenting these results, analytical derivation of the model in the simplified case where there is only one missing market sheds light on the mechanisms of internal and external adjustment. We consequently analyze, in the following section, the impact of a change in an exogenous market price when one market is missing.

IV. CASE OF ONE MISSING MARKET

IV.1. *Internal Adjustment: Shadow Price on the Missing Market*

Suppose now that there is only one absent market, for food or for labor, marked by the subscript "a", and that one market price p_j changes. Total differentiation of the relation (2e), which determines the endogenous price p_a, and substitution of the quantity of supply and consumption derived from the other equations (3a to 3d) gives:

$$\frac{\partial q_a}{\partial p_a} dp_a + \frac{\partial q_a}{\partial p_j} dp_j = \frac{\partial c_a}{\partial p_a} dp_a + \frac{\partial c_a}{\partial p_j} dp_j + \frac{\partial c_a}{\partial Y}\left[\left(\frac{\partial \Pi}{\partial p_a} + T_a\right) dp_a + \left(\frac{\partial \Pi}{\partial p_j} + T_j\right) dp_j\right].$$

In elasticity form, this can be written as

$$\left[E_a - \theta_a r_a - \eta_a r_a (s_{\Pi Y} s_{a\Pi} + s_{aY})\right] \frac{dp_a}{p_a} = -\left[E_{aj} - \theta_{aj} r_a - \eta_a r_a (s_{\Pi Y} s_{j\Pi} + s_{jY})\right] \frac{dp_j}{p_j},$$

where

E_a, E_{aj} are the direct and cross-price elasticities of supply,

$E(q_a/p_a)$ and $E(q_a/p_j)$ from (3a);

θ_a, θ_{aj} are the direct and cross-price elasticities of consumption,

$E(c_a/p_a)$ and $E(c_a/p_j)$ from (3c);

η_a is the full income elasticity, $E(c_a/Y)$;

r_a is the ratio c_a/q_a, equal to 1 if "a" is food and a negative number if "a" is labor;

and

$s_{\Pi Y} = \frac{\Pi}{Y}$, $s_{i\Pi} = \frac{p_i q_i}{\Pi}$, and $s_{iY} = \frac{p_i T_i}{Y}$ are different share parameters in profit and income. This gives the elasticity of the internal price p_a with respect to the exogenous market price p_j:

$$E(p_a / p_j) = -\frac{E_{aj} - \theta_{aj} r_a - \eta_a r_a (s_{\Pi Y} s_{j\Pi} + s_{jY})}{E_a - \theta_a r_a - \eta_a r_a (s_{\Pi Y} s_{a\Pi} + s_{aY})}. \tag{4}$$

In this expression (which generalizes the case given by Newbery, 1990), the numerator shows the direct disequilibrium created on the missing market "a" by a change in the price p_j. The first term E_{aj} is the supply change while the two other terms show the change in demand coming from the cross-price effect θ_{aj} and the income effect η_a. The change in income itself contains two terms, the profit term and the value of the initial endowment when it applies. Similarly, in the denominator, the expression shows the disequilibrium created by the change in the endogenous price p_a. The overall expression shows that the endogenous price p_a will change in response to an exogenous change of p_j in order for these two disequilibria to compensate each other and for the missing market to be in equilibrium.

IV.2. *External Response: Supply and Demand of Marketed Commodities*

The output supply and factor demand elasticities of the household model with a missing market are directly derived by differentiation of (3a):

$$E^G(q_j/p_i) = E(q_j/p_i) + E(q_j/p_a)\, E(p_a/p_i), \tag{5}$$

where E^G is the global elasticity, $E(q_j/p_i)$ and $E(q_j/p_a)$ are the elasticities of the model with markets for all commodities, and $E(p_a/p_i)$ is the elasticity of the endogenous price derived above.

Similarly, the consumption elasticities can be derived by differentiation of (3c):

$$\left(\frac{dc_j}{dp_i}\right)^G = \frac{\partial c_j}{\partial p_i} + \frac{\partial c_j}{\partial Y}\left(\frac{\partial \Pi}{\partial p_i} + T_i\right) + \left[\frac{\partial c_j}{\partial p_a} + \frac{\partial c_j}{\partial Y}\left(\frac{\partial \Pi}{\partial p_a} + T_a\right)\right]\frac{dp_a}{dp_j}.$$

In elasticity form, this is written

$$E^G(c_j/p_i) = E^H(c_j/p_i) + E^H(c_j/p_a) \cdot E(p_a/p_i),$$

where

$$E^H(c_j/p_i) = \theta_{ji} + \eta_j\,(s_{\Pi Y}\, s_{j\Pi} + s_{jY})$$

is the elasticity of consumption in a separable household model with all markets, which includes the standard consumer price elasticity θ_{ji} and the income term specific to the household model.

IV.3. *Expected Signs and Magnitudes of External and Internal Responses*

The signs of the elasticity $E(p_a/p_j)$ and of the global supply and demand elasticities $E^G(q_j/p_i)$ and $E^G(c_j/p_i)$ cannot be derived unambiguously, in particular because the simple supply and demand elaticities do not have unambiguous signs either. For the sake of brevity, we only discuss here the response to a change in the price of cash crops on the shadow price of food and the elasticity of supply response of cash crops when the missing market is that for food. Similar reasonings can be made for the other products and factors as well as when the missing market is that for labor.

We need first agree on the expected signs of the simple elasticities of supply and demand. In general, we can expect that output supply responds positively to its own price and negatively to an increase in the price of a competitive crop; and that consumption has a negative direct price elasticity, a positive cross-price elasticity with respect to other goods, and a positive income elasticity.

When the missing market is that for food and the exogenous price that changes is that of cash crops, expression (4) reduces to:

$$E(p_a / p_j) = -\frac{E_{aj} - \eta_a \frac{p_j q_j}{Y}}{E_a - \left(\theta_a + \eta_a \frac{p_a q_a}{Y}\right)}.$$

At the denominator, the term in parentheses represents the elasticity of demand for food which will be negative if the direct substitutability effect $|\theta_a|$ is greater than the indirect full income effect due to the price increase. Production and consumption effects are thus cumulative and the denominator is positive. The numerator is unambiguously negative with the result that $E(p_a/p_j)$ is positive: An increase in the price of cash crops raises the shadow value of food and destabilizes the household internally through perceived food scarcity.

Similarly, an increase in the price of manufacturing products induces an increase in the shadow price of food. If the exogenous shock is an increase in the price of labor, the effects of the numerator in equation (4) are more complex than in the two previous cases. On the production side, an increase in the market price of labor induces a downward shift in food production. On the consumption side there are two effects: (a) a substitution effect toward food and away from leisure which becomes more expensive and (b) an income effect. The latter is positive if employment in production is smaller than the total time available to the household (and not only if the household is a net seller of labor, since we are considering full income). Demand for food will therefore most likely increase, except for the very large farms on which labor costs are so important that income may dramatically decrease. Both supply and demand effects combine to put pressure on the internal food supply, and the shadow price of food increases. In response to an increase in the price of fertilizer, the two terms in the numerator have opposite signs, as the supply of food will tend to respond negatively to an increase in this input price, while the negative income effect contributes to a decrease in demand. The outcome is ambiguous. With a small effect of the price of fertilizer on food supply, the negative income effect will dominate and the shadow price of food will decrease.

With a low income elasticity of food, on the other hand, demand will not decrease while production becomes more costly and the internal price of food increases.

The case of a missing market for labor is very analogous. An increase in price of the cash crop, food, or the manufactured good generally induces an increase in the internal price of labor, while the impact of a price increase in fertilizer is ambiguous.

In equation (5), which gives the supply response for cash crops, $E(q_j/p_a)$ is negative. The indirect effect of the external price via the internal price change (the second term on the right in equation (5)) thus has a sign which is opposite to that of the direct effect (the first term on the right in equation (5)). The global elasticity with market failure is thus unambiguously inferior to the elasticity when a food market exists. The external supply response of peasants makes them appear as sluggish. This result will be confirmed in the following numerical simulations for most external price changes: The sum of both direct and indirect effects is most of the time smaller than the direct effect itself, reflecting the fact that market failures reduce flexibility in the household's behavior, eventually to the point of perversity.

By contrast, if the price of the manufactured good or of labor increases (and of food in the case of a missing market for labor), the indirect effect via the internal price increase reinforces the direct negative effect. This gives a very asymmetric behavior to the peasant household whose movement out of cash crop production in response to a price increase of the competitive crop or of an input is thus exaggerated by missing markets.

At the same time, some of the adjustment to the cash crop price increase that cannot be accomplished on the missing market spills over to the other markets. With positive cross-price elasticities of fertilizer use with respect to the prices of both products, the internal food price increase reinforces the increase in fertilizer use that would have occurred in response to a cash crop price increase. As for the consumption of manufactured goods, the positive direct income effect is reinforced by the positive substituability effect of food price.

V. THE SETUP FOR EMPIRICAL ANALYSIS

Simulation with an empirical model allows investigation of the peasant household's behavior beyond the results that could be derived analytically. For that purpose, a generalized Leontief profit function and a translog indirect utility function are specified:

$$\Pi = \sum_{i,j} b_{ij}\sqrt{p_i p_j} + \sum_{i,m} b_{im} p_i z_m, \tag{1}$$

$$U = \sum_{k} \alpha_k \ln p_k / Y + \tfrac{1}{2}\sum_{k,l} \beta_{kl} (\ln p_k / Y)(\ln p_l / Y), \tag{2}$$

with

$$Y = \Pi + p_l T + S, \quad \text{full income.}$$

Their derived systems of output supply, factor demand, and consumption demand are:

$$q_i = \sum_{j} b_{ij}\sqrt{p_j / p_i} + \sum_{m} b_{im} z_m$$

on the production side, and

$$\frac{p_k c_k}{Y} = \frac{\left[\alpha_k + \sum_l \beta_{kl} \ln p_l / Y\right]}{\left[\alpha_Y + \sum_l \beta_{Yl} \ln p_l / Y\right]},$$

with $\alpha_Y = \sum_k \alpha_k$ and $\beta_{YL} = \sum_k \beta_{kl}$ on the consumption side.

The base values for the structure of production and consumption of the household are reported in Table I. To clearly identify the role of the missing markets in household behavior, we need to consider the same household under different market structures. This household, therefore, is set to be originally self-sufficient in both food and labor, and this corresponds to an equilibrium point at market prices when markets for these commodities exist. The simulations that are performed will show how the introduction of markets for food and labor, which breaks this self-sufficiency, affects the household's response to a changing environment. They do not, however, replicate the impact of the opening of a market for a

household which would have been previously constrained and where internal equilibrium would have been at odds with market prices.

The full income of the household is composed of profit from farm production (36.2%) and the valuation of total time which is the sum of labor income (25.5%) and the value of leisure time (38.3%). There are no initial cash endowments. Profit results from the production of cash crops and food crops (41.2% and 58.8% of gross output value, respectively) with two variable factors, fertilizer and labor (29.4% and 70.6% of the variable costs, respectively). On the consumption side, full income is used in leisure (38.3%), the consumption of food (42.6%) equal to home production, and the consumption of manufactured goods (19.1%). In this original state, the household is exactly self-sufficient in labor and food, and the monetarized transactions represent less than 30% of its full income. The cash income constraint states that revenues from the sale of cash crops (29.8%) are spent on buying fertilizer for production (10.6%) and manufactured goods for consumption (19.1%).

The parameters of the supply and demand system were determined in a two-step procedure: Most likely values for all the supply and demand elasticities were taken from the literature on peasant households and the constraints derived from utility maximization and profit maximization (i.e., homogeneity, symmetry, and satisfaction of the budget constraint) were imposed on the elasticities. The resulting parameters, used in the following simulations, are reported in Table I.

VI. SIMULATION RESULTS

While there are many experiments that can be run with the numerical model, four capture the essence of peasant behavior under market failures. They are the responses to a rise in the price of cash crops, a rise in the price of manufactured consumption goods, the levying of a head tax, and a technological change in the production of food. We explore each of these in the following experiments.

VI.1. *Impact of a 10 percent Increase in the Price of Cash Crops* (Table II.1)

Market failures increase the *external stability* of the peasant household as judged by the low elasticity of supply response to price incentives. This is due to food and labor rigidities: Land allocated to food crops can only be minimally reduced (the production and consumption of food crops falls by 0.5%) and labor allocated to production falls slightly as income effects raise the consumption of leisure. The positive supply response in cash crops thus only comes from a small substitution in production between food and cash crops and from increased use of fertilizers, both of which more than compensate the reduced labor input. Market failures thus reduce (1) the elasticity of cash crop supply from 0.99 with no market failures to 0.18 when both markets fail; and (2) the cross-price elasticity of food crop with respect to cash crop from -0.54 to -0.05. The chronic inelasticity of supply response by peasant households, which is of so much concern to African governments, may thus be explained as a structural feature associated with missing markets and not as an inherent behavioral trait of peasants.

While market failures rigidify the production side of the household's insertion in the market, they destabilize the demand side for both final consumer goods and factors of production. The demand for the manufactured consumption good increases by 15.8% instead of 5.6% when there are no market failures. This is due to the fact that the income effect created by a rising cash crop price cannot translate in any significant increase in leisure or food consumption. As a result, it is rejected on the purchase of manufactures.

The demand for fertilizers increases by 4.7% instead of 2.2% when there are no market failures. This is due to the fact that a labor market failure limits responding to higher prices with an increased labor input and thus rejects the adjustment on fertilizers.

Opening of a food market, with continuing labor market failure, allows to substitute cash crops (9.3% increase) for food crops (-6.4%) in production. The elasticity of supply response in cash crops thus increases significantly to 0.93 by substitution in land use. Income effects permit to increase food consumption (3%) even though food production declines by 6.4% and the food deficit rises to 10.1% of food production. Lack of a labor market

does not, however, allow to increase leisure significantly. Labor in production declines a little due to the rising shadow wage.

With opening of a labor market, but continuing food market failure, hired labor can be substituted for family labor and the consumption of leisure can thus be increased (by 4%) even though more labor is used in production. The household hires a quantity of external labor equal to 10.6% of the household's labor effort. Because of food market failure, the production of food can only decline marginally which keeps the elasticity of supply response for cash crops at a medium level (0.55). Income effects lead to a rising consumption of leisure and manufactured goods and to a small decline in food consumption as the shadow price of food increases (5.8%).

Simultaneous performance of the food and labor markets allows to both substitute cash crops for food crops in production (and yet to increase food consumption by 2.1% even though the production of food declines by 5.4%) and to substitute family for hired labor in factor use (and thus to increase the consumption of leisure by 2.7% even though total labor use increases by 1.7%). Cumulation of these two sources of supply response raises the elasticity for cash crops to its highest level among structural alternatives.

Internal instability with market failures is shown by the large swings in the shadow prices of labor and food. Because there can only be small changes in labor use (-0.6%) and food production (-0.5%), the shadow price of labor increases by 9.3% and that of food by 8.8%. These reflect the internal pressures to increase the work effort and the perceived rising scarcity of food, both of which are not directly observable. The peasant leitmotif of chronic destabilization materializing in recurrent labor and food scarcities is thus explained.

Empirical evidence on the low elasticity of supply response to cash crops prices among African peasant households is widespread. A survey by Bond (1983) shows short-run price responses to be generally significant but not large. This response can be enhanced by perfecting the integration of peasant households into markets to reduce the

burden of nontradables and increasing the mobility of both private and public fixed factors (Schiff, 1987).

VI.2. *Impact of a 10 percent Increase in the Price of Manufactured Consumption Goods* (Table II.2)

When all markets perform, there is separability between production and consumption decisions, with the result that a change in the price of a consumer good does not affect production decisions (Singh *et al.*, 1986). In consumption, demand for the manufactured good falls (-14.8%) as its price rises and there is substitution by a rising demand for food and leisure. These latter effects are permitted by buying food (1.5% in addition to the consumption of home production) and hiring external labor (0.8% in addition to the household's own labor effort).

With both market failures, a rising price of manufactures devalorizes cash income and hence the incentive to produce cash crops. Land is reallocated to food crops and labor allocated to production falls. The result is a fall in the production of cash crops by 1.7% while the consumption of food and leisure increases, although by small amounts since neither food nor labor can be bought, raising their perceived scarcity values. This result shows that a low cost supply of manufactured consumption goods is the key bribe to induce peasants to produce cash crops when food and labor markets fail.

Opening of a food market allows to substitute purchased food for manufactures in consumption, and thus to reduce the production of food crops and maintain resources in cash crops production. The negative effect on cash crops supply is thus lessened even though the labor effort falls and the consumption of leisure rises.

Finally, opening of a labor market, with food market failure, allows to hire outside labor, increase labor in production, while sharply increasing the consumption of leisure to substitute for a falling consumption of manufactures. The result is that the production of cash crops falls as the demand for manufactures falls. The hiring of labor is thus to allow

substitution in consumption between manufactures and leisure and to increase the production of food, not to increase that of cash crops.

A number of recent studies have stressed the detrimental effect that consumer goods shortages have on African peasants' production of cash crops since their motivation to produce is the goods that cash income allows them to purchase (Mollett, 1984). Shortages of manufactured consumption goods induce a return to a subsistence economy and the development of black markets and clandestine trade. In countries with manufactured goods shortages such as Ghana, the production of cash crops developed most successfully in the border areas where smuggled imported industrial consumer goods were available. A correlation can also be established between the availability of manufactured consumption goods and better cash crops performance by contrasting successful growth of cash crop production in Cameroon, Ivory Coast, Kenya, and Malawi as opposed to Uganda and Ghana where manufactured goods were in short supply (Berthelemy and Morrisson, 1987).

VI.3. *Impact of a Monetary Head Tax* (Table II.3)

Here again, when there are perfect markets for food and labor, production and consumption decisions are separable so that a lump sum tax does not affect production. It creates, however, a severe negative effect on disposable income leading to a decline in the consumption of food, leisure, and manufactured goods and to an increase in the sale of food and of family labor on the wage market.

With market failures, the interesting result, classic in public finance, is that a tax is the more effective in inducing an increase in tradables production the more markets fail, while, by contrast, price incentives were the more ineffective the more markets were failing. With no labor market, the only way in which the monetary tax can be paid is by increasing the production of cash crops and by reducing cash outlays on the consumption of manufactured goods and the use of fertilizers. The labor effort needs to be increased and the consumption of leisure correspondingly decreased. Allocation of land to food needs to be reduced and the

consumption of food correspondingly decreased. As food and leisure consumption fall, the shadow values of food and labor collapse. We thus observe the opposite effect of the government leitmotif observed with price incentives: While, under price incentives, the peasant household appeared externally unresponsive but was internally destabilized, under the coercion of a monetary tax the household is destabilized both in its external response and in its internal tensions.

Introduction of a food market allows to shift part of the burden of tax to the production of a marketed surplus of food: The production of food increases and, as the consumption of food simultaneously decreases, the marketed surplus increases sharply, allowing to relax the need to increase the production of cash crops to pay the tax. The bulk of the tax is paid through the marketed surplus of food, allowing to increase less the production of cash crops and to reduce less the consumption of manufactured goods and fertilizers.

A labor market also allows to diversify the sources of cash income. The tax is partially paid by increasing wage earnings by family labor while family labor applied to agricultural production is reduced and food production falls sharply. The main cost is on the consumption of leisure that also falls sharply.

Lower wages and lower food prices would limit both the use of the labor market and the sale of a marketed surplus of food to pay the monetary tax. As a result, the production of cash crops would increase in response to both lower wages and lower food prices, making the coercive effect of a tax on the supply of cash crops more effective, the limit being the situation where both markets fail completely.

Imposition of a monetary head tax on African peasant households has been extensively used by the French colonial administration in West Africa. In a first period, between the two world wars, forced mobilization of labor and deportation for work on plantations was attempted, but it led to depopulation and to a collapse of food production. This was replaced, after the Second World War, by the monetary tax system where peasant households could pay the tax through the sale of cash crops produced in the village economy

or the sale of labor. While effective to increase cash crop production and the participation of peasants on the labor market, it led to increasing stress on food production which, as we have seen, falls in response to the tax when there is no food market, whether or not there is a labor market: with no labor market, cash crops displace labor from food production; with a labor market, labor is taken away from food production for sale on the labor market. The result was the rising incidence of famines reported by colonial administrators.

VI.4. *Impact of Productivity Gains in Food Production* (Table II.4)

Technological change in food production, such as the Green Revolution, creates the perverse effect, under market failure, of inducing peasants to produce more cash crops while it would induce a commercial farm, or a peasant household with no market failures, to produce less cash crops. With no market failures, a productivity gain in food leads to substitution in production away from cash crops to the production of food crops. A higher labor productivity in food crops induces the use of more labor in production, and hence the hiring of labor, while income effects lead to increased consumption of food and leisure. Sale of a larger marketed surplus of food more than compensates for lower revenues from the production of cash crops and the consumption of manufactured goods increases.

With market failures, technological change in food allows to produce and consume more food, but it also allows to release resources for the production of cash crops. This result is important as it indicates that low productivity in the production of food crops, under food market failure, is a key bottleneck to the production of cash crops. Increasing the production of the latter thus requires paying greater attention to the technological conditions under which food is produced. This is a very powerful argument in favor of the Green Revolution which is still largely failing in Africa. One of the main conclusions of the von Braun *et al.* (1989) study of the impact of cash crop production on food production by peasant households in six countries was thus that the promotion of technological change in the production of food crops

is essential to allow smallholders to capture greater gains from market integration in cash crops.

It is only with opening of a food market that the switch out of cash crops into food crops can be intense, leading to a decline in cash crop production and an increased marketed surplus of food. When, additionally, a labor market is available, this switch can be intensified on the basis of hired labor.

VII. CONCLUSION

Since the elasticity of peasant household response to price incentives is an important condition for the successful economic development of agrarian societies, the results we have obtained indicate several elements of policy interventions that can be used to increase this elasticity. One is the role of programs directed at reducing the incidence of market failures for specific households. This includes interventions that have the capacity of narrowing the width of price bands for food and labor such as infrastructure investments, increased competitiveness among local merchants, and the better circulation of information on prices. Indirect sources of market failure also need to be eliminated such as access for peasants to credit markets which is key for the hiring in of labor at planting and weeding, and to markets for insurance, which is needed to reduce food risks associated with uncertain cash crop and food crop prices as well as employment opportunities. Rising heterogeneity in production systems across households that comes with greater commercialization of production can also increase the elasticity of labor supply on local labor markets and hence reduce the width of price bands and the incidence of market failures.

We have also seen that the elasticity of peasant response depends crucially on the availability of a reward in their use of cash income. Thus, an elastic and low priced supply of manufactured consumption goods such as textiles and shoe wear, processed foods and beverages, building materials, and means of transportation is needed to induce peasants to produce cash crops. While agriculture is key for the emergence of industry, the availability of

industrial consumption goods is also essential to motivate peasant effort. An excessive squeeze on the production and import of manufactured consumption goods can thus throw a country on a downward spiral of falling export earnings and further constraints on the availability of manufactured consumer goods.

Finally, green revolution technology to improve total factor productivity in the production of food is essential to free resources for cash crops production. Technological efforts should consequently not necessarily be directed at the cash crops, the traditional thrust of colonial research, but equally importantly and as a precondition for success, at the production of food crops.

We did not study here how market failures eventually give rise to institutional arrangements that act as complete or partial surrogates for what markets do not provide. The extended family system, labor exchange, payments in kind delayed until harvest, share contracts, and village solidarity schemes provide alternatives to food, labor, credit, and insurance markets. Frequently, however, lack of clear definition of property rights and imperfect information imply that these institutional arrangements have high efficiency costs. This implies the need to carefully balance the relative merits of improved market performance and of improved institutions' performance to achieve greater efficiency and welfare.

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Table I

Parameters for the Household Model

	Share in full income (percent)	Full income elasticity	Elasticity with respect to the price of				
			Food crop	Cash crop	Fertilizer	Labor	Manufacture
Profit	36.2						
Total time	63.8						
Production							
Food crop	42.6		.80	-.54	-.04	-.22	
Cash crop	29.8		-.77	1.00	-.08	-.15	
Fertilizer use	-10.6		.15	.22	-.50	.13	
Labor use	-25.5		.37	.17	.05	-.60	
Consumption							
Food crop	42.6	.70	-.80			-.07	.17
Leisure	38.3	.90	-.16			-.80	.06
Manufacture	19.1	1.87	-.12			-.25	-1.50

Table II

Simulation Results

	II.1. Impact of a 10 percent increase in the price of cash crops				II.2. Impact of a 10 percent increase in the price of manufactured goods				II.3. Impact of a monetary head tax				II.4. Impact of a 10 percent increase in productivity of food production			
	Market failures				Market failures				Market failures				Market failures			
	Food and labor	Labor	Food	None	Food and labor	Labor	Food	None	Food and labor	Labor	Food	None	Food and labor	Labor	Food	None
	Percentage changes over base				Percentage changes over base				Percentage changes over base				Percentage changes over base			
Consumption																
Food	-0.5	3.0	-0.8	2.1	1.1	1.8	1.0	1.7	-4.9	-9.1	-4.3	-7.0	8.8	4.5	8.8	3.0
Leisure	0.4	0.6	4.0	2.7	0.2	0.3	0.9	0.6	-3.9	-4.2	-10.2	-9.0	0.8	0.5	1.3	3.9
Manufactured good	15.8	7.7	9.5	5.6	-12.8	-14.5	-14.0	-14.8	-33.6	-23.6	-22.3	-18.7	1.0	11.4	0.2	8.0
Production																
Food crop	-0.5	-6.4	-0.8	-5.4	1.1	-0.2	-1.0		-4.9	2.3	-4.3		8.8	16.4	8.8	18.0
Cash crop	1.8	9.3	5.5	9.9	-1.7	-0.1	-1.0		10.7	1.7	4.1		0.7	-8.8	1.2	-7.7
Fertilizer	4.7	2.8	3.1	2.2	0.5	0.1	0.2		-3.7	-1.4	-0.8		0.0	2.4	-0.2	1.5
Labor	-0.6	-1.0	3.9	1.7	-0.4	-0.4	0.5		5.8	6.3	-2.0		-1.2	-0.7	-0.6	3.7
Prices																
Food crop	8.8	--[a]	5.8		1.9	--	1.3		-10.7	--	-5.4		-11.0	--	-11.4	
Cash crop	10.0	10.0	10.0	10.0												
Fertilizer																
Labor	9.3	4.5			1.7	0.7			-16.4	-10.5			1.3	7.4		
Manufactured good					10.0	10.0	10.0	10.0								
Net labor supply[b]			-10.6	-6.1			-1.7	-0.8			15.2	11.7			-1.7	-9.7
Marketed surplus of food[b]		-10.1		-7.9		-2.0		-1.5		11.2		7.0		10.3		12.7

[a]Blanks indicate no change relative to base value.
[b]Net labor supply in percent of household labor effort, and marketed surplus in percent of food production.