Agriculture and the Rest of the Economy: Macroconnections and Policy Restraints

Graciela Chichilnisky and Lance Taylor

The economic relationships between the agricultural and nonagricultural sectors have long been scrutinized, with a number of key linkages singled out—investment requirements and the macroadjustments between the two sectors that permit savings to come forth; nonagricultural demand for employment and food confronting agricultural supply response; shifts in income distribution that ensue as people move from agricultural/rural to nonagricultural/urban occupations and economic roles. In this paper, we develop diagrammatic models to illustrate short- and long-run aspects of these two-sector interactions and their implications for policy. Both models are "post-Keynesian" in their focus on Keynes-like savings-investment approaches to the macrosystem, and Ricardo-like determination of the functional income distribution via the real wage. But they also follow tradition in addressing questions under debate for decades and likely to be controversial for time to come. In that sense, we add only novel presentation and a few modern twists to strands of macrotheory that Arthur Lewis, Simon Kuznets, Richard Eckaus, Latin American structuralists, and the participants in the Soviet industrialization debate started to spin long ago.

The first two sections of the paper are devoted to a combination of the Kuznets and structuralist stories, where we ask how the agricultural/nonagricultural terms of trade and income distribution must adjust to permit both savings-investment and commodity market balance to be assured. It will be shown that inflationary processes can easily be kicked off by terms of trade movements in the short run. In the next two sections we follow Chichilnisky in working out a longer run, Lewis-style model in which economic dualism plus an elastic labor supply can lead to severe problems with realization of the marketed surplus and agricultural exports abroad. A brief final section summarizes the major implications of the models for policy choice.

Investment Demand, Savings Supply, and the Terms of Trade

The agricultural terms of trade are supposed to balance many forces—food demand, producer supply, and agricultural savings in response to investment needs. Which factors dominate movements in the terms of trade and which are relatively unimportant may vary with the conjuncture, and more generally with the institutions of the economy at hand. In this section, we present a four-quadrant diagram which helps isolate controlling forces and we identify the conditions under which each may reign.

The general equilibrium of the terms of trade appears in figure 1. The equilibrating variables are the price of agricultural (or A-sector) output, and output itself in nonagriculture (N-sector). The diagram shows how these variables are determined jointly in the market for nonagricultural goods in the upper quadrants and by aggregate demand and supply (or savings and investment) below. When both savings-investment and N-sector commodity balance are in equilibrium, then so will be the market for agriculture by Walras's Law.

To explain the diagram we discuss the relationships depicted in each quadrant, beginning with the northwest. The agricultural price is measured on the horizontal axis running left from the origin, and demand for nonagricultural products on the vertical axis [illegible]. Demand faced by the N-sector is [illegible] three components, viz. (a) [illegible]

The authors are, respectively, associate professor of economics at Columbia University and professor of economics, Massachusetts Institute of Technology.

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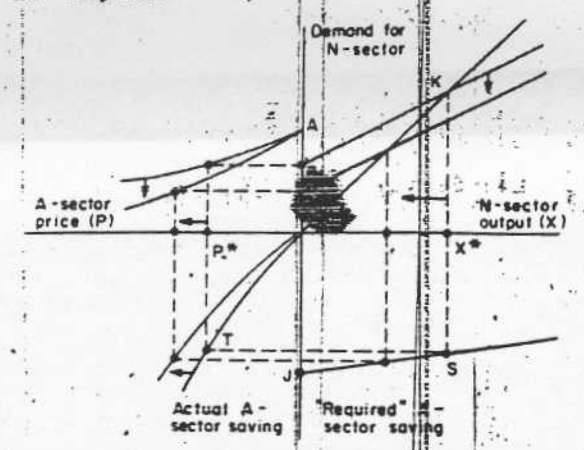

Note: A two-sector model in which the agricultural price varies to clear its market (*A*-sector) while nonagricultural output (*N*-sector) adjusts to meet effective demand. A downward shift in the agricultural supply function leads to less real saving from the *A*-sector and less demand for *N*-sector products, for a given agricultural price. The outcome is an increase in the *A*-sector price, and a fall in *N*-sector output.

Figure 1. A two-sector model

mand for government consumption, investment, and exports, at point *A*. (*b*) Demand from agricultural incomes. This increases with the agricultural price *P*, because of rising farm incomes and price-substitution responses in farmers' demand functions.[1] (*c*) Demand from nonagricultural incomes will fall as *P* rises, for a given nonagricultural output *X*. The stylized fact is that food and most raw material demands are price inelastic; thus an increase in *P* will lead to increases in money outlays for agricultural commodities, and decreases in nonagricultural real income and purchases of nonagricultural goods.

The response to price of the sum of these demands has an ambiguous sign. In the northwest quadrant of figure 1, we have shown the income effect in demand from nonagricultural incomes as dominant, so that as *P* rises, demand for nonagricultural products drops off. At price P^*, the market demand facing the *N*-sector (at zero level of output *X*) is *B*.

Consumption of nonagricultural goods also responds to incomes generated in that sector. For simplicity in the diagram, we assume that the price of *N*-goods is fixed by a constant mark-up over urban prime cost (the short-run numeraire) and also that there is excess capacity in the sector. Its consumption function takes the usual Keynesian form, a straight-line rising function of *X*, beginning for the agricultural price P^* at point *B*. The northeast quadrant is a Keynesian cross, determining equilibrium at point *K* where the consumption function meets the 45°-line. For price P^*, nonagricultural output is pegged at X^*.

Together with the market for nonagricultural goods, the savings-investment balance serves to close the model. The southeast quadrant shows the amount of savings "required" from agriculture (required savings = investment − savings from nonagriculture), a declining function of *X*. For high enough *N*-sector output all autonomous expenditure could be matched by savings from nonagriculture alone, at a point far to the right on the axis for *X*. On the other hand, if *X* fell to zero, agriculturalists could presumably manage to generate all savings required—point *J*. In practice, the economy will lie somewhere between these two extremes. However, with low marginal savings propensities from nonagricultural incomes (not improbable in LDCs), savings supplied from the *N*-sector will not be highly responsive to output *X*. Required savings from agriculture will mostly be determined by investment or, in the representation of figure 1, the trade-off relationship between the two sources of saving will be rather flat.

Savings supply from agriculture will of course rise with the sector's income, as determined by the price (via the supply function). The southwest quadrant of figure 1 sketches agricultural savings as a function of price. Savings-investment balance occurs at the price and output pair P^* and X^* where savings generated from agriculture at level *T* is just equal to the amount required at *S*. From the accounting implicit in the diagram, the agricultural savings will have to take the form of a trade surplus with respect to the nonagricultural sector. The flat curve in the southeast quadrant means that the required surplus in terms of nonagricultural goods is pegged by investment demand. The price *P* (and the terms of trade) adjust to permit the surplus to appear.

The points P^* and X^* in fact represent a full equilibrium in which the commodity market and savings-investment are both in balance. The two equilibrating processes can be summarized in one diagram, by consolidating the upper and lower quadrants of figure 1 sche-

[1] Very strong income effects in farmers' demand for their output could make their nonagricultural purchases fall as *P* goes up. In the present model we assume away this marketed surplus problem, though it is central to the model of the sections below.

rately. On the savings-investment side, the southeast quadrant shows that required agricultural savings is a declining function of X. On the other hand, savings supply from the A-sector rises with P. Thus, in equilibrium an increase in P has to be accompanied by a fall in X, to keep savings-investment in balance. This relation is drawn as the "Saving-investment" curve in figure 2.

The story in the commodity market is slightly more complicated. As figure 1 is drawn, an increase in nonagricultural output (determined by the Keynesian cross in the northeast) will have to be accompanied by a fall in P. The dominant mechanism is the income effect in nonagricultural commodity demand—a decrease in P raises nonagricultural real incomes enough to stimulate overall demand for X. Again we derive a negative relationship between P and X. For stability, the slope has to be less steep than in the savings-investment balance, as shown by the "Commodity market" line in the left-hand diagram of figure 2.

The other possibility is that increases in P will stimulate aggregate demand for X, via rising farm incomes. This case is more likely when the agricultural sector is large relative to nonagriculture and is illustrated by the rising "commodity market" line in the diagram to the right in figure 2.

Comparative Statics of Output Levels and the Terms of Trade

Changes in policy or exogenous variables can be viewed as shifting one or more of the curves appearing in figures 1 and 2—the diagrams show how agricultural price and nonagricultural output adjust to re-establish a disturbed equilibrium. We work through several examples in this section. They reveal that interactions between sectors hold enough potential surprises to keep the macropolicy team alert.

First, figure 1 itself demonstrates what happens when there is a downward shift (due to bad weather, say) in the agricultural supply function. For a given agricultural price, agricultural income will be lower because of the loss in output. There will be both less savings and less demand for N-goods originating in the A-sector, causing the curves in the northwest and southwest quadrants of figure 1 to shift toward the horizontal axis. Tracing around responses in the diagram (beginning at point S, say) shows that P must rise and X fall in the new equilibrium—the whole graphical structure is displaced to the left. The adjustment mechanism is the slide downward of the demand curve in the northeast quadrant—aggregate demand is reduced by the income loss attendant upon falling agricultural supply.

The sort of supply shock shown in figure 1 easily can set off a burst of inflation, if money wages respond to the rising agricultural price and (as discussed in more detail below) drive up N-sector costs in turn. A sequence of such shocks could keep inflation going if, for example, population growth runs ahead of the growth rate of agricultural supply. To deal with such a process formally would take us too far afield, but the reader will recognize its affinity to the Structuralist inflation model that Sunkel first proposed.[2]

A second set of implications can be drawn regarding agricultural trade. For simplicity assume that imports come in under a quota or exports go out through a marketing board; in effect, the government regulates the quantum of trade. In figure 1, the upper quadrants will not be affected by changes in trade policy because they relate internal incomes and prices to N-sector demand. In the lower quadrants, however, required saving from agricultural income will react to trade policy shifts. An increase in agricultural imports or reduction in exports, for example, will lead to an *ex ante* increase in the trade deficit or foreign saving and a reduction in A-sector saving required. As shown by the shifted "savings-investment" curves in figure 2, a lower level of X (and N-sector saving) is then consistent in equilibrium with a given P (and agricultural saving). The final outcome depends on whether N-sector demand responds positively or negatively to P. In the latter case (when N-sector income effects are important), an increase in agricultural imports will cause P to fall and generate enough demand to lead to an increase in X (left side of figure 2). Both changes would favor urban dwellers, under conditions in which their share in economic activity (and N-sector demand) is large. In the circumstances, a political coalition in favor of gaining easy access to imports could form. Examples might be the groups favoring repea

[2] See the paper by Eliana Cardoso for an elegant description of Sunkel-type inflation in an independent development of essentially the same model as in figure 1. Taylor provides additional background.

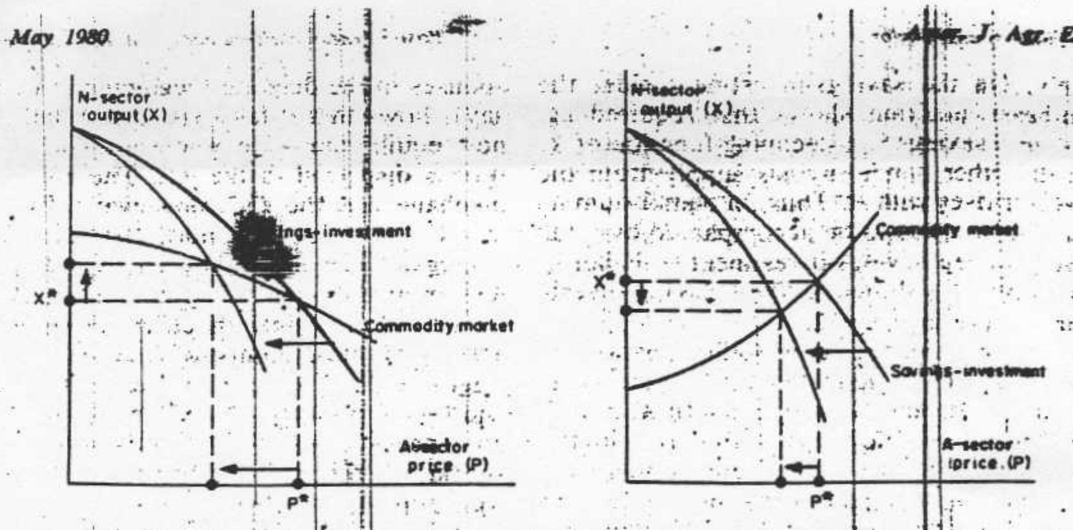

Figure 2. Model of the agricultural and nonagricultural sectors expressed in terms of equilibrium (P, X) combinations in the nonagricultural commodity market and the savings-investment balance

of the Corn Laws in England in the last century, or the domestic supporters of low-cost Japanese acquisition of rice from Taiwan and other locales before World War II. By contrast, in the large-agriculture case, shown to the right in figure 2, the increase in imports causes P and X to fall. Liberal import policies might be opposed by most domestic interests in this case, whereas only agriculturalists are penalized in the situation at figure 2's left.

Increases in exogenous demands for nonagricultural goods generate a third comparative static tale. The analysis is a bit tricky, so we take it in steps.

The initial impact of the demand increase is to shift both autonomous demand for nonagriculture (point A in figure 1) and the base level of required agricultural savings (point J) away from the origin. Assume for a moment that demand for nonagricultural products is independent of P. Then the demand increase will lead to a higher X from the Keynesian cross in the northeast. The subsequent impact on required agricultural savings in the southeast appears to have an ambiguous sign, because X rises (lower required savings) but J moves away from the origin (higher required savings for a given X). However, the problem vanishes when we recognize that the demand response in the northeast is subject to an expenditure leakage that does not matter in the southeast. The Keynesian cross shows multiplier demand stimulated by X for itself, after demand for agricultural products from nonagricultural income is netted out. The southeast quadrant shows the gap between investment and overall savings from incomes generated by X. The difference shows up in a positive response of required savings—and thus of P—to the increase in autonomous demand.

Now reintroduce the dependence of N-sector demand on P. By LeChatalier's principle, a positive relationship means that the increase in X just discussed will lead to further demand increments through the price mechanism, so the initial increase in autonomous spending will be reinforced. On the other hand, a negative relationship between P and demand (as actually shown in figure 1) will dampen the initial increase in X, and might even leave a final negative effect of autonomous spending on nonagricultural output. This extreme response is unlikely, but the analysis does show that when agricultural products are a large part of the consumption bill of a non-negligible urban population, then weak or ambiguous output responses to fiscal initiatives may be the rule. Semi-industrialized countries are particularly prone to such ills.

A fourth story is based on an increase in the marginal propensity to consume from nonagricultural incomes, for example, from an income distribution shift. For given levels of autonomous spending and the agricultural price, the demand line in the northeast quadrant of figure 1 becomes steeper, leading to an incipient increase in X. In the lower quadrants, the result would be a fall in required agricultural savings and P, if the response curves stayed put. However, the increased propensity to consume will lead to a lower propensity to save, and the required [illegible] tural savings curve in the southeast would flatten out. The flattening, in fact, would be strong enough to lead to a higher agricultural price, for the reason sketched above—part of the consumption increment in the northeast quadrant leaks to demand for agricultural commodities, while the whole effect is captured in the savings response below. In the northwest quadrant, the price increase would lead to additional demand for nonagriculture if it responds positively to P, or dampen the initial impact in the opposite case. Once again, income effects can foil the expansionary impact of an increase in the nonagricultural propensity to consume. But prices will rise regardless of the output response.

Finally, consider an increase in the urban money wage. From the assumption of mark-up pricing, the wage increase will drive up the price level, perhaps after a lag. For an unequal urban income distribution (as postulated by Kuznets and—indeed—Lewis) it also may increase the overall propensity to consume, as the wage bill rises relative to total profits and import costs.

We can decompose the effect of the wage increase, using results previously derived. The nonagricultural price increase cuts back on the purchasing power of agriculture, shifting the curves as in the left-hand quadrants of figure 1. Hence, we would expect the agricultural price to rise and nonagricultural output to fall from the wage increase.

At the same time, the nonagricultural propensity to consume goes up. As just discussed, P will be given another upward nudge, but the output response can have either sign. In sum, the wage increase will lead to higher prices in both sectors, but output can shift either way. In at least one empirical model embodying agriculture/nonagriculture interactions of the type stressed here, an urban wage increase leads output to expand (see McCarthy and Taylor). The rising wage offsets the loss in aggregate demand implicit in any downward shift in the agricultural supply function, but only at substantial inflationary cost. The dilemma posed by the structuralist inflation model sketched above begins to bite.

Economic Dualism, Marketed Surplus, and Trade

The model just described lets the agricultural price vary to clear the market, with income distribution shifts between the sectors bringing aggregate demand in line with supply. Now we take a somewhat longer term perspective, in which technological conditions, factor supply functions, and patterns of demand dictate economic response. Specifically, we consider an economy in which there is technological dualism in the sense of wide differences in technique between the sectors (with the capital-labor ratio being substantially higher in nonagriculture), surplus labor due to a highly elastic labor supply function, and heavy concentration in demand from labor incomes on agricultural (or food) commodities. Largely to avoid unilluminating mathematics, labor and capital are assumed to be freely shiftable between the sectors, and fixed coefficients for these inputs characterize technology in production. The model thus is based on assumptions stressed by Lewis and Eckaus.

Sectoral interactions are easily described using standard results from the theory of international trade. Let the nonagricultural price be the numeraire. Then by the assumption that agriculture is labor-intensive, an increase in the agricultural price P will increase the wage w and lower the profit rate r. The real wage in terms of food ($q = w/P$) is also an increasing function of P, on Stolper-Samuelson lines. However, as P rises it has an increasingly weaker positive effect on q (the second derivative is negative), due to a rising relative cost of capital inputs. (See Chichilnisky for a proof, as part of a full formal development of the model.)

By the surplus labor assumption, the increase in q in response to P will pull more workers into production according to the labor supply function.[3] But since agriculture is labor-intensive and the capital stock is fixed, total agricultural output will increase by the Rybczynski theorem. The mechanics are illustrated in figure 3. A rising agricultural price provides more labor along the curve in the southwest quadrant, which in turn stimulates an increase in agricultural output (Z) in the southeast. Reflection around the 45°-line in the northeast quadrant allows measurement of Z on the vertical axis pointing up. Reading the diagram in reverse shows that an increase in demand for Z (for export, say) would have to

[3] Figure 3 is drawn assuming an inverse supply function of the form $q = q_0 + \beta L$, where q_0 is the "subsistence" real wage at which no employment would be forthcoming, and L is total employment. In a surplus labor situation, the coefficient β will be very small.

be accompanied by more employment and a higher agricultural price.

So far, so good: agricultural supply response depends on price in a dual economy. But nothing has been said regarding how the extra labor income from more *A*-sector output gets spent. Suppose that a large share of the increment goes toward purchases of agricultural goods. Demand mirrors the increases in employment and output, so that excess agricultural supply after sales for personal consumption may not be very price responsive at all. The northwest quadrant of figure 3 illustrates a case in which around 90% of wage income is spent on "food." The example is exaggerated, but does illustrate for the two prices traced around the quadrants how *A*-sector output minus demand increases only slightly as the price P is doubled. Indeed, at higher levels of P the excess supply response may even be perverse. When restated in a plausible though simplified general equilibrium model, the traditional marketed surplus problem is far from being as trivial as it sometimes has been made out to be.

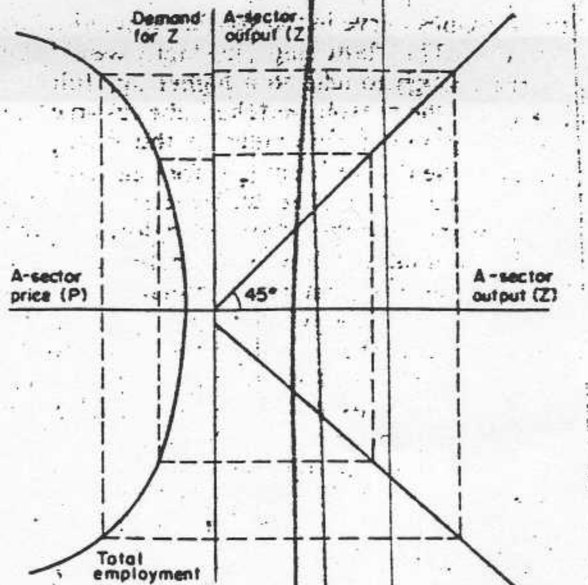

Figure 3. Impact of changes in the agricultural price on the sector's excess supply in a model with highly elastic labor supply, production dualism, and a large share of wage income devoted to food

Marketed Surplus Woes

Figure 3 illustrates an income distribution problem faced by countries in which the wage good is used for export. An increase in the price to call forth extra supply is frustrated, because the extra income resulting from increased production largely goes to wage good demand.

Policy choice under these circumstances is difficult, as experience in a number of countries suggests. When the agricultural product is exported (wheat or beef in Argentina, rice in Thailand) the government often tries to drive a wedge between the acquisition and sale price of the wage good, to cut real consumer income and demand while maintaining supply. Such policy may fail on other grounds, however. An example is increasing resistance on the part of profit-income recipients to shifting the income distribution toward agriculture via the high supply price. More generally, the economic system is Walrasian unstable (or nearly so), which makes management via the price system a delicate task.

Even in a closed economy, where the wage good is not traded and *A*-sector demand must equal supply, similar problems arise. For example, an increase in the capital stock will shift the intercept of the line in the southeast quadrant of figure 3 away from the origin.[4] For a given employment level, the diagram shows that the result would be a decrease in agricultural supply as resources move toward the capital-intensive, nonagricultural sector. With demand limited by supply the agricultural price P would have to fall to reduce labor income (northwest quadrant), leading via a lower real wage to decreased labor supply in the southwest. After subsequent rounds the process could converge at a lower (or at best slightly higher) level of employment overall.

What these results show is that internal demand conditions do not permit easy absorption of the capital-intensive good. In Eckaus's terminology, there is a "factor proportions" problem, exacerbated by patterns of demand. A bowdlerized Marxist interpretation would be that surplus from nonagricultural production cannot be realized. Confiscatory income realignments against wages by a government favoring nonagriculture would shift the demand curve in the northwest quadrant toward the horizontal axis, and permit realization to

[4] The intercept represents the level of employment when agricultural output is zero and all available capital is used to produce the nonagricultural good.

occur. An example would be state purchases of the nonagricultural good financed by a levy on labor income. The Stalinist resolution of this set of difficulties (first enunciated by participants in the Soviet industrialization debate of the 1920s) might be interpreted along these lines.

Problems with Policy Change

The problems raised by the dual economy model could be pursued further. For example, its potential Walrasian instability can be countered by the government acting as a Marshallian stable purchasing agent, as explored by Chichilnisky. Similarly, if the supply of capital is also price-sensitive, the transformation curve between agriculture and nonagriculture can cease to be concave to the origin—Chichilnisky and Heal. These difficulties ultimately arise from production dualism, factor supply functions, and demand behavior, all tending to destabilize the system in the same way.

Somewhat similar observations apply to the model discussed in the first two sections of this paper. The relative price insensitivity of food demand and the role of agricultural incomes as a savings source go together there to generate potentially perverse responses to standard policy ploys. In particular, agricultural supply shortfalls may be highly inflationary, fiscal spending may not stimulate aggregate demand, extra food imports will have strong effects on the intersectoral income distribution, and demand may react positively to an increase in the money wage.

The implications of these results for policy are sobering, insofar as the models adequately replicate sectoral interdependencies in real economies. In a two-sector framework, modest ingenuity suffices to generate difficulties of the type emphasized here. The question is whether or not the models capture slices of likely economic response. Our view is that they do, and that the problems faced by policy makers in poor countries are economically real and severe. But we would be delighted if we were wrong and would welcome demonstrations that such is the case.

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