A Three-Sector, Time-Series Model of the Labor Market in India

Raj Krishna
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Raj Krishna is professor of economics at the Delhi School of Economics, University of Delhi, India, and a consultant to the World Bank.

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Summary and Conclusions

This paper presents a three-sector time-series (1959-1979) model of the labour market in India. The paper estimates a rural labor absorption equation, a rural wage rate determination equation, and a rural-urban migration equation, for three sectors, as interdependent parts of a seven-equation system. (The growth of the aggregate labor force is assumed to be exogenous.) The three sectors are: the agricultural (or "farm") sector, the "organised" nonagricultural (or "formal") sector, and the "unorganised" nonagricultural (or "informal") sector. The estimated model generates time series estimates which are within the range of available cross-section estimates.

There are many hypotheses in the field about the factors which influence the determination of employment and wages in the farm, formal and informal sectors of developing countries. The estimated model shows that in India the determination of both farm employment and formal employment conforms to neo-classical optimization. But the behaviour of real wages in the two main sectors is consistent with the dualist/institutionalist hypothesis of wages being determined by the average product, though the relevant average products and the institutional mechanics which produce this outcome differ as between the two main sectors.

The behaviour of earnings in the informal sector, which absorbs the whole labor force not employed in the main sectors (and thus includes unemployment and underemployment), confirms the "disequilibrium" hypothesis that average earnings are passively, negatively related to the size of the labor force unabsorbed in the main sectors, and positively to informal output.

In the last section of the paper the reduced form of the estimated model is used to project sectoral employment and wages and rural-urban migration over the next two decades—assuming three alternative sets of growth rates of industrial output. The first simulation shows that with growth rates of sectoral output remaining at average levels in the past, demographic pressure will allow only a modest rate of increase in average informal earnings (1.2 percent a year) for a long time. Implicitly, positive growth of measured unemployment (and underemployment) will persist, for in the past (1959-1979) even a higher increase in informal earnings (1.7 percent a year) has been associated with measured unemployment also growing 1.7 percent a year. A second simulation with a lower industrial growth rate (4 percent) suggests an even worse outlook, with average informal earnings growing only 0.5 percent a year. The third scenario shows, however, that a high industrial growth rate (7 percent a year) can allow average informal earnings to rise at a rate much higher (2.4 percent) than in the past, and, by implication, cause unemployment to decline.
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Résumé et conclusions

Cette étude présente un modèle du marché du travail en Inde fondé sur des séries chronologiques (1959-79) et portant sur trois secteurs. On y estime une équation de l'absorption de la main-d'œuvre rurale, une équation de la détermination du taux des salaires ruraux et une équation de l'exode rural, dans trois secteurs, comme parties interdépendantes d'un système à sept équations. (On a utilisé l'hypothèse d'une croissance exogène de la main-d'œuvre globale.) Les trois secteurs sont : le secteur agricole, le secteur non agricole structuré et le secteur non agricole non structuré. Le modèle obtenu donne des séries chronologiques estimatives qui sont dans la fourchette des estimations représentatives disponibles.

Il existe de nombreuses hypothèses quant aux facteurs qui influencent la détermination de l'emploi et des salaires dans les secteurs agricole, structuré et non structuré des pays en développement. Le modèle obtenu montre qu'en Inde la détermination de l'emploi tant dans le secteur agricole que dans le secteur structuré est conforme au principe de l'optimisation néoclassique. Mais le comportement des salaires réels de ces deux grands secteurs concorde avec l'hypothèse dualiste/institutionnaliste selon laquelle les salaires sont déterminés par le produit moyen, encore que les produits moyens pertinents et les mécanismes institutionnels qui produisent ce résultat diffèrent dans les deux secteurs.

Dans le secteur non structuré, qui absorbe toute la main-d'œuvre qui n'est pas employée dans les deux autres (et qui donc inclut le chômage et le sous-emploi), le comportement des revenus confirme l'hypothèse du "déséquilibre", selon laquelle les gains moyens sont passivement et négativement liés à la quantité de main-d'œuvre qui n'est pas absorbée dans les deux autres secteurs, et positivement liés à la production du secteur non structuré.

Dans la dernière partie de cette étude, on a utilisé la forme réduite du modèle obtenu pour préparer des projections de l'emploi et des salaires sectoriels et des migrations rurales pour les deux prochaines décennies, en fonction de trois hypothèses de taux de croissance de la production industrielle. La première simulation montre que si les taux d'augmentation de la production sectorielle restent aux niveaux moyens antérieurs, l'accroissement de la population ne permettra qu'une progression modeste (1,2 % par an) des gains moyens du secteur non structuré pendant de nombreuses années. Implicitement, les taux de chômage (et de sous-emploi) mesurés continueront à augmenter, car dans le passé (1959-79) on a pu noter qu'un taux plus élevé d'augmentation des revenus du secteur non structuré (1,7 % par an) correspondait à un taux de chômage mesuré augmentant également au rythme de 1,7 % par an. Une deuxième simulation, prenant comme point de départ un taux de croissance industrielle plus faible (4 %), donne des résultats encore pires, les gains moyens du secteur non structuré n'augmentant que de 0,5 % par an. Par contre, le troisième scénario montre qu'un taux de croissance industrielle élevé (7 % par an) permet aux gains moyens du secteur non structuré de progresser beaucoup plus rapidement que par le passé (2,4 %) et, par implication, de réduire le chômage.
Resumen y conclusiones

En este trabajo se presenta un modelo de series cronológicas (1959-79) de datos de tres sectores del mercado laboral de la India. Se calculan una ecuación de la absorción de la mano de obra rural, una ecuación de la determinación del nivel de salarios en las zonas rurales y una ecuación de la migración rural-urbana para los tres sectores, como partes interdependientes de un sistema de siete ecuaciones. (Se parte del supuesto de que el crecimiento de la fuerza de trabajo global es exógeno.) Los tres sectores son los siguientes: el sector agrícola, el sector agropecuario, el sector no agropecuario "organizado" (o estructurado) y el sector no agropecuario "no organizado" (o no estructurado). El modelo elaborado genera estimaciones de series cronológicas que están dentro de la gama de estimaciones disponibles de secciones transversales.

Abundan las hipótesis acerca de los factores que influyen en la determinación del empleo y los salarios en los sectores agropecuario, estructurado y no estructurado de los países en desarrollo. El modelo elaborado muestra que en la India la determinación del empleo tanto en el sector agropecuario como en el sector estructurado concuerda con la optimización neoclásica. Empero, el comportamiento de los salarios reales en los dos sectores principales está en consonancia con la hipótesis dualista/institucionalista de que los salarios los determina el producto medio, aunque los productos medios y la mecánica institucional pertinentes que producen ese resultado difieren en la misma forma que los dos sectores principales.

El comportamiento de los ingresos en el sector no estructurado, que absorbe la totalidad de la fuerza de trabajo no empleada en los sectores principales (y, por lo tanto, incluye el desempleo y el subempleo), confirma la hipótesis del "desequilibrio", es decir, que los ingresos medios están relacionados pasiva y negativamente con la magnitud de la fuerza de trabajo no absorbida por los sectores principales, y positivamente con la producción del sector no estructurado.

En la última sección del trabajo se usa la forma reducida del modelo elaborado para preparar proyecciones del empleo y los salarios sectoriales y de la migración rural-urbana durante los dos próximos decenios, basándose en tres diferentes series hipotéticas de tasas de crecimiento de la producción industrial. La primera simulación muestra que si las tasas de crecimiento de la producción sectorial se mantienen en los mismos niveles medios registrados en el pasado, la presión demográfica permitiría sólo una tasa moderada de aumento del ingreso medio en el sector no estructurado (1,2% al año) durante mucho tiempo. Implícitamente, persistiría el crecimiento positivo del desempleo (y del subempleo) medido, ya que en el pasado (1959-79) un aumento aún mayor de los ingresos del sector no estructurado (1,7% al año) se ha relacionado con un crecimiento también de 1,7% del desempleo medio. La segunda simulación, con una tasa menor de crecimiento industrial (4%) indica unas perspectivas aún peores, ya que los ingresos medios del sector no estructurado sólo aumentarían 0,5% al año. Sin embargo, la tercera hipótesis muestra que una tasa de crecimiento industrial elevada (7% al año) puede permitir que los ingresos del sector no estructurado aumenten a un ritmo mucho mayor (2,4%) que en el pasado, lo que supondría una disminución del desempleo.
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1. **Introduction**

This paper presents a three-sector, time-series (1959-1979) model of the labor market in India. Many recent studies of labor market relationships using cross-section data from India have appeared recently (Bardhan 1981, Papola and Misra 1980, Rosenzweig 1981, Evenson and Binswanger 1981.) But these studies focus on one or two relationships for a single sector: a rural labor supply equation, a rural labor absorption equation, a rural wage rate determination equation, and/or a rural-urban migration equation. This paper estimates all these relations, except a labor supply equation, for three sectors, as interdependent parts of a seven-equation system. (The growth of the aggregate labor force is assumed to be exogenous.) The three sectors are: the agricultural (or "farm") sector, the "organized" nonagricultural (or "formal") sector, and the "unorganized" nonagricultural (or informal) sector.

Theoretically, time series and cross-section estimates of the wage-elasticities of sectoral employment need not be similar, because the specifications and the levels of aggregation of time-series and cross-section equations are basically different. However, the model estimated here generates time-series estimates which are within the range of available cross-section estimates.
There are many hypotheses in the field about the factors which influence the determination of employment and wages in the farm, formal and informal sectors of developing countries.

The estimated model shows that in India the determination of both farm employment and formal employment conforms to neo-classical optimization. But the behaviour of real wages in the two main sectors is consistent with the dualist/institutionalist hypothesis of wages being determined by the average product, though the relevant average product and the institutional mechanics which produces this outcome differs as between the two main sectors.

The behaviour of earnings in the informal sector, which absorbs the whole labor force not employed in the main sectors ¹/ (and thus includes unemployment and underemployment ²/), confirms the "disequilibrium" hypothesis: average earnings are passively, negatively related to the size of the labor force unabsorbed in the main sectors, and positively to informal output.

In the last Section of the paper the reduced form of the estimated model is used to project sectoral employment and wages and rural-urban migration over the next two decades--assuming three alternative sets of growth rates of industrial output. The first simulation shows that with growth rates of sectoral output remaining at average levels in the past, demographic pressure will allow only a modest rate of increase in average informal earnings (1.2% a year) for a long time. Implicitly, positive growth of measured unemployment (and underemployment) will persist, for in the past (1959-1979) an even higher increase in informal earnings (1.7% a year) has been associated with measured unemployment also growing 1.7% a year. A second
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The paper is organised as follows. The next Section (2) presents the model and the rationale for its specifications. Section 3 discusses the estimated equations and compares the various elasticities given by the model with those yielded by earlier studies. Finally, Section 4 reviews three alternative sets of projections of all the endogenous variables.

2. The Model

The following symbols (arranged in an alphabetical order) are used in the model developed below.

- **EAG**: employment in the agricultural ("farm") sector,
- **ENN**: employment in the unorganised nonagricultural ("informal") sector,
- **ENN'**: ENN + measured unemployment,
- **ENO**: employment in the organised nonagricultural ("formal") sector,
- **LT**: total labor force,
- **MIG**: annual rural-urban migration,
- **MIG1**: MIG lagged one year,
- **PR**: rural population,
- **PT**: total population,
- **PU**: urban population,
- **PU**: urban population estimated on the assumption of equal urban and total population growth rates,
- **QF**: net output of foodgrains (available in the fiscal year),
- **QIND**: index of industrial production,
\text{T} = \text{time-trend,}

\text{UT} = \text{total measured unemployment,}

\text{VAG} = \text{net value added in the farm sector,}

\text{VNN} = \text{net value added in the informal sector,}

\text{VNO} = \text{net value added in the formal sector,}

\text{WAGI} = \text{index of daily farm wages deflated by the cost of living index of agricultural labourers,}

\text{WAGI2} = \text{index of daily farm wages deflated by the implicit price deflator of farm output,}

\text{WNN'} = \text{deflated annual labor income plus self-employment income in the informal sector, per worker unemployed and informally employed,}

\text{WNO} = \text{deflated annual wages in the formal sector, and}

\text{WRT3} = \text{ratio of the index of wages in the formal sector, to the index of farm wages (both undeflated).}

The 7 equations of the model are:

\begin{align*}
(1) \quad \ln \text{EAG} &= \text{EAG}(\ln \text{VAG}, \ln \text{WAGI2}), \\
(2) \quad \ln \text{ENO} &= \text{ENO}(\ln \text{VNO}, \ln \text{WNO}, \text{T}), \\
(3) \quad \ln \text{WAGI} &= \text{WAGI}(\ln \text{QF/PR}), \\
(4) \quad \ln \text{WNO} &= \text{WNO}(\ln \text{VNO/ENO}), \\
(5) \quad \ln \text{WNN'} &= \text{WNN'}(\ln \text{VNN}, \ln \text{ENN'}) \\
(6) \quad \ln \text{VNN} &= \text{VNN}(\ln \text{QIND}) \\
(7) \quad \ln \text{MIG} &= \text{MIG}(\ln \text{WRT3}, \text{MIG 1}).
\end{align*}

The model consists of 2 employment equations for the farm and formal sectors, 3 wage equations for the 3 sectors (AG, NO and NN), one equation for the net output of the informal sector, and one rural-urban migration equation. The reduced form of the model in growth rates and elasticities is presented in Appendix A.
The total labor force determined by population growth is treated as exogenous to the model. Labour "supply" measured in working days or working hours would be wage-responsive, as in developed-country labour market models. But the total stock of persons in the labor force can be reasonably regarded as a function of exogenous population growth.

The total labour force (LT) divides into farm employment (EAG), formal employment (ENO), informal employment (ENN) and unemployment (UT). But since the UT series is not available for 21 years, variable ENN' is defined as the sum of informal employment and unemployment. Thus

\[
(8a) \quad LT = EAG + ENO + ENN + UT = EAG + ENO + ENN',
\]

(8b) \quad ENN' = ENN + UT.

Annual migration is defined as the excess of the urban population in any year over the expected urban population (\(PU\)) for that year. \(PU\) is the urban population estimated on the assumption that the growth of the urban population in the year is the same as the growth of the aggregate population. Given the official series of the total, rural and urban population, we thus have

\[
(9a) \quad PT_t = PR_t + PU_t, \text{ and}
\]

\[
(9b) \quad MIG_t = PU_t - PU'_t,
\]

where

\[
(9c) \quad PU'_t = \frac{PT_t}{PT_{t-1}} \cdot PU_{t-1}.
\]
The sectoral employment equations for the farm and formal sectors are derived by eliminating the capital stock (K) from the production function and the first-order condition for optimum employment (see Intriligator 1971, Rosen and Quandt 1978). If the production function is

\[ V = V(E, K, T) \]

where \( V \) is value added, \( E \) is employment and \( T \) is time-trend, the deflated wage is

\[ \frac{w}{p} = \frac{\delta V}{\delta E} \]

and optimal employment is

\[ E = E(V, \frac{w}{p}, T) . \]

(10c) is the form adopted in model equations (1) and (2) with the coefficients of \( V \) and \( \frac{w}{p} \) expected to be positive and negative respectively. The price deflators for wages here are indices of the prices of farm and formal output. Time-trend is omitted in the farm employment equation because it was non-significant.

Output is treated as exogenous in this study, as in other labor market studies, because the focus is on labor flows and labor earnings. (See, for example, Rosen and Quandt 1978.)
The trend variable (T) in the employment equation is the counterpart of the trend variable (the proxy for "technical change") in the production function.

For the informal sector an employment equation is not specified; only an average earnings function is included, on the basis of the following argument. ENN' is a composite variable, including employment (ENN) as well as unemployment (UT). The employment segment could be treated like farm and formal employment so that

\[ \text{(11)} \quad \text{ENN} = \text{ENN}(\text{WNN}', \text{VNN}). \]

The expected signs of the coefficients of WNN' and VNN in (11) would be negative and positive respectively. As for the unemployment segment (UT) in ENN', an increase (decrease) in it would depress (improve) the average earnings in the ENN sector (WNN'). Thus WNN' should be a negative function of UT:

\[ \text{(12)} \quad \text{WNN}' = \text{WNN}'(\text{UT}). \]

Since earnings in the informal (NN) sector are not actively influenced by trade-union or government action they can be supposed to be passively, negatively related not only to unemployment but to the whole labor force not absorbed by the farm and formal sectors. It is therefore better to write the ENN function (11) above as an earnings determination function than as an employment function.

\[ \text{(13)} \quad \text{WNN}' = \text{WNN}'(\text{ENN}, \text{VNN}), \]
with the signs of ENN and VNN negative and positive respectively. WNN' being also negatively related to UT in (12) we can re-write (13) with ENN' (ENN + UT) instead of ENN:

\[ (14) \quad WNN' = WNN'(ENN', VNN). \]

This equation appears as equation (5) in the model.

It would be obviously unrealistic to assume year-to-year clearing of every labour market in the presence of persistent measured unemployment. Therefore the informal earnings function (14) above reflects a "disequilibrium" or "an adjustment towards equilibrium" hypothesis: the greater (less) the volume of unemployment and labor unabsorbed in the two main sectors, the lower (higher) would be average informal earnings.

Available evidence suggests that in the two main sectors, while employment is determined by the neoclassical rule of the equality of the deflated wage and the marginal product of labour, wages are institutionally determined. The segmentation of the labour market is reflected in the fact that during the estimation period the average annual deflated wage for manual employees in the formal sector was 3.6 times, and deflated informal earnings 1.3 times the deflated wage in the farm sector.

In the farm sector the real wage appears to be determined simply by food (grain) output per capita because of the institutional fact of food sharing in the extended family in the early stages of development. 6/ In a recent review of the literature on rural labour markets Binswanger and Rosenzweig (1981) have noted that in the neoclassical framework the existence
of rural unemployment can be rationalized only if there is downward wage rigidity. In extreme low-income situations, the employers themselves may pay a minimum "efficiency wage," considering the link between effort and nutrition (as suggested by Stiglitz 1976) or between "morale" and the absolute level of wages. In either case the employed have to support the unemployed both in the small farm and landless households. The macro implication of food sharing in the rural family is that grain output per rural person should be related to the real wages for hired labour. Also, a rise (fall) in grain output per person would raise (lower) the real rural wage by raising (reducing) the demand for labour, and reducing (raising) the rural cost of living dominated by the price of grain. Strong support for this relation is found in the time series of real farm wages and grain output per person depicted in Chart 1. Both have recorded much fluctuation and a mild trend. In all but four of the twenty-one years, the two series move in harmony even though the sources of data underlying them are independent. Thus for the determination of real farm wages we have equation (3) of the model

\[ WAGI = WAGI(QF/PR) \]

where \( QF/PR \) is grain output per rural person.

For the formal sector, as for the farm sector, a causal link between the wage rate and the average product of labor has been hypothesized, though the institutional reasons for it (trade unionism and labor legislation) are different from those which apply in the agricultural sector. Lyn Squire has reviewed evidence from many developing countries showing that trade union pressure becomes effective mainly through government intervention in wage determination (1979, pp. 75-76). For India, Dutta (1980) concludes from a
CHART 1
Agricultural Wage Rate and Grain Output
per Rural Person, India, 1959-1979

Grain output (QF/PR)\(^a/\)

Wage index (WAG)\(^b/\)

Fiscal year ending March

\(^a/\) Grain output per rural person in kilograms per year.

\(^b/\) Real agricultural wages (1956/57 = 100).
review of the literature that trade unions have succeeded in getting wage increases by "forcing the government to take a hand in the wage determination process" (p. 29). The wage boards assess an industry's "capacity to pay" higher wages in terms of "profitability" or "the surplus available for distribution between labour and capital" (p. 34). The bargaining equilibrium is "implicitly defined in terms of proportionate shares of the surplus" (p. 34). In other words, effective intervention either maintains or increases the share of wages in value added. Actually, the wage share in the organised (NO) sector in India increased 0.4 percent a year during 1959-1979. The wage determination system thus enabled organised workers to secure real wage increases even in excess of average productivity growth. 7/ In any case, the system clearly established a strong positive relationship between real wages and average productivity in the organised sector. This can be seen in the time series of these variables plotted in Chart 2.

Researchers have found the hypothesis of average product determining the real wage in the organised sector to be true also in studies of the interstate (cross-section) variation of the wage rate in this sector (Dutta 1980).

Equation (4) of the model reflects these considerations:

\[(4) \quad W_{NO} = W_{NO} (V_{NO}/E_{NO})\].

In addition to the employment and wage-determination equations, the model has an equation for the net output of the informal sector (NN). This is the only sector whose output is kept endogenous in the model because this output is postulated to be dependent on the gross output of the formal sector. Dipak Mazumdar stressed the dependence of informal output on formal output in
CHART 2

Real Wages and Real Net Output per Worker in the Organized Sector, India, 1959-1979

Fiscal year ending March
his (1975) model of the urban labor market. Acharya (1983) has brought together concrete evidence on the many backward and forward linkages between formal and informal sectors in specific fields of production in many countries. The formal sector obtains a considerable part of its material and service input requirements from the informal sector, and a substantial part of the income earned by the relatively well-paid employees of the formal sector is spent on consumer goods and services produced in the informal sector. The formal sector also contracts out some parts of the production process (assembly, fabrication, repairs etc.) to informal units. Therefore, the greater the volume of formal sector activity, the greater is the derivative activity in the informal sector. Accordingly, equation (6) of the model postulates

\[ V_{NN} = V_{NN}(Q_{IND}) \]

The last of the 7 equations of the model pertains to rural-urban migration. The main explanatory variable in the equation should be the differential between urban and rural wages. The relevant urban wage is the weighted average of earnings in the urban formal and informal sectors, the weights being the probabilities (approximated by the proportions) of employment in the two sectors (Harris and Todaro 1970). But the wage variable actually specified here in the migration equation (7) is simply the ratio of (undeflated) formal wages and farm wages. The reason for using the ratio of sectoral wages rather than the ratio of weighted urban wages to rural wages is that sectoral wages enter the rest of the model; and the ratio of undeflated formal wages to farm wages explained a greater part of the variance of migration than the ratio of the deflated wages or the ratio of the weighted
sum of formal and informal nonfarm wages to farm wages. The latter result is perhaps due to the fact that informal earnings, instead of actively influencing migration, are passively influenced by migration (and the size of other segments of the labor force.)

Lagged migration is introduced as an additional variable to allow for lags in adjustment to changes in the wage ratio.

Thus the form of the migration function in the model is

\[ MIG = MIG(WRT3, MIG 1). \]

3. Estimated Equations

The OLS and 3SLS coefficients of the loglinear equations of the model are given in Table 1. The 3SLS procedure is necessitated by the interdependence of sectoral employment and wage equations; of the net output and wage equations of the informal sector; and of the wage and migration equations.

The Table shows that all 3SLS coefficients (elasticities) have the expected signs and are significant at better than the 5 percent level \( (t > 1.74) \) with the sole exception of the coefficient of lagged migration.

The 3SLS coefficients of the formal employment equation are noticeably different from the corresponding OLS coefficients. The (absolute) wage elasticity of formal employment rises from \( .39 \) to \( .69 \). The 3SLS elasticity of formal employment with respect to value added is also higher \( (.74) \) than the corresponding OLS elasticity \( (.51) \). But the residual trend rate of growth of formal employment decreases. The elasticity of migration with respect to the wage-ratio increases from \( (1.9) \) to \( (3.3) \), and
### Table 1

**THREE-SECTOR LABOR MARKET EQUATIONS, INDIA, 1959-1979**  
(OLS and 3SLS Estimates)

<table>
<thead>
<tr>
<th>Equation No.</th>
<th>Dependent Variable</th>
<th>Explanatory Variable</th>
<th>Coefficient/Elasticity (OLS)</th>
<th>t</th>
<th>$R^2$</th>
<th>Coefficient/Elasticity (3SLS)</th>
<th>t</th>
</tr>
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<tbody>
<tr>
<td>(1)</td>
<td>EAG</td>
<td>VAG</td>
<td>0.77***</td>
<td>9.48</td>
<td>0.87</td>
<td>0.75***</td>
<td>10.99</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WAGI2</td>
<td>-0.21**</td>
<td>-1.73</td>
<td>-0.21**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2)</td>
<td>ENO</td>
<td>VNO</td>
<td>0.51***</td>
<td>3.80</td>
<td>0.99</td>
<td>0.74***</td>
<td>10.40</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WNO</td>
<td>-0.39*</td>
<td>-1.60</td>
<td>-0.69***</td>
<td>-4.47</td>
<td></td>
</tr>
<tr>
<td></td>
<td>T</td>
<td>0.015**</td>
<td>2.05</td>
<td>0.010***</td>
<td>2.64</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3)</td>
<td>WAGI</td>
<td>QF/PR</td>
<td>0.98***</td>
<td>5.18</td>
<td>0.59</td>
<td>0.95***</td>
<td>6.11</td>
</tr>
<tr>
<td>(4)</td>
<td>WNO</td>
<td>VNO/ENO</td>
<td>1.19***</td>
<td>15.11</td>
<td>0.92</td>
<td>1.24***</td>
<td>19.22</td>
</tr>
<tr>
<td>(5)</td>
<td>WNN'</td>
<td>VNN</td>
<td>1.26***</td>
<td>10.85</td>
<td>0.96</td>
<td>1.29***</td>
<td>16.76</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ENN'</td>
<td>-1.59***</td>
<td>7.44</td>
<td>-1.64***</td>
<td>-11.37</td>
<td></td>
</tr>
<tr>
<td>(6)</td>
<td>VNN</td>
<td>QIND</td>
<td>0.84***</td>
<td>41.08</td>
<td>0.99</td>
<td>0.85***</td>
<td>44.89</td>
</tr>
<tr>
<td>(7)</td>
<td>MIG</td>
<td>WRT3</td>
<td>1.92*</td>
<td>1.55</td>
<td>0.48</td>
<td>3.31***</td>
<td>3.07</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MIGI</td>
<td>0.45**</td>
<td>2.04</td>
<td>0.25*</td>
<td>1.51</td>
<td></td>
</tr>
</tbody>
</table>

**Sources:** Printouts 2 April, 19 April, 21 April and 28 April, 1983 for OLS equations. Printout 28 April 1983 for 3SLS equations.

Constants of the estimated equations are omitted.

All variables are in natural logarithms except T. All coefficients are elasticities except the coefficient of T.  

(***), (**) and (*) denote that the coefficients are significant at 1%, 5% and 10% levels respectively.
the elasticity with respect to lagged migration decreases from (.45) to (.25). Other elasticities of the system are not affected.

Although elasticities estimated in different studies are not strictly comparable because of the diversity of specifications and estimation procedures, it is still useful to make rough comparisons of the orders of their magnitude. The following discussion compares the 3SLS estimates derived here with a few other recent cross-section estimates.

The wage elasticity of agricultural employment estimated here (-0.21) is below the lower limit of the range (-0.3 to -0.6) of the cross-section elasticities estimated by Evenson and Binswanger (1981) with a simultaneous equation model fitted to Farm Management data for various regions of India for the years 1954-55 to 1971-72. But it is higher than Bardhan's (1981) cross-section estimates of this elasticity based on NSS data for rural West Bengal in 1972-73 (-0.09.). The time-series estimate obtained here should be expected to differ from cross-section estimates, particularly because farm employment is defined here as the number of workers engaged in agriculture (on a weekly status basis), whereas it is defined as the input of person-days in the other studies.

The estimate of the wage elasticity of formal employment in India (-0.7) is less (in absolute value) than the unitary wage-elasticity of all private hours worked (-0.98) estimated for the U.S. by Rosen and Quandt (1978). But it is close to the range of estimates (-0.7 to -0.9) made with a similar equation for 4 Latin American countries (Brazil, Colombia, Costa Rica and Mexico) by Eriksson (1970) (Table 2).

It should be noted, however, that the wage-elasticity of employment in the "factory" part of the formal sector is much lower than the wage-
elasticity of total formal employment. The estimate for the manufacturing (factory) sector is only \((-0.25)\) (Table 3) whereas estimates for the formal sector are \((-0.39)\) (OLS) and \((-0.7)\) (3SLS). The factory sector is a segment of the organised sector, employing only 4.1 million workers on the average (during 1960-1976) out of 15.1 million in the whole formal sector. Besides manufacturing factories, the formal sector includes private and public units in the construction, electricity and service sectors. The two largest components of organised nonfactory employment are government employment in administration and transport.

If the underlying production function for the formal sector has the CES form, the negative of the wage-elasticity of employment (0.69) is an estimate of the elasticity of substitution (\(\sigma\)) (Rosen and Quandt 1978, Brown 1966). It is commonly recognised that in the organised sector of developing countries, using imported technology, \(\sigma\) should be less than unity and lower than in the developed countries. For 16 two-digit industry groups Kelley, Williamson and Cheetham (1972) have cited elasticities of substitution, estimated with data from 3 developing countries, ranging between 0.41 to 0.86, and those estimated with data from 9 developed countries ranging between 0.74 to 0.99. (Kelley, Williamson and Cheetham 1972, p. 228.)

The \(\sigma\) for the organised sector estimated here (0.69) is thus within the range of estimates for other developing countries.

The implicit elasticity of substitution for the manufacturing factory sector alone is however much lower (0.25).

The estimates of the elasticity of employment with respect to output are: 0.75 for agriculture and 0.74 for the organised sector. The latter is, again, within the range of Latin American estimates cited in Table 2 (0.71 to 0.97). For manufacturing proper the elasticity for India is 0.34 (Table 3).
TABLE 2
ELASTICITIES OF INDUSTRIAL EMPLOYMENT

<table>
<thead>
<tr>
<th>Country</th>
<th>Period/ Cross-Section (CS)</th>
<th>Wage Elasticity (a)</th>
<th>Output Elasticity (a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>CS, 75 Industries 1953-63</td>
<td>-0.36</td>
<td>0.71</td>
</tr>
<tr>
<td>Brazil</td>
<td>CS, 75 Industries 1949-59</td>
<td>-0.72</td>
<td>0.84</td>
</tr>
<tr>
<td>Colombia</td>
<td>CS, 60 Industries 1953-63</td>
<td>-0.99</td>
<td>0.73</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>CS, 60 Industries 1957-63</td>
<td>-0.67</td>
<td>0.97</td>
</tr>
<tr>
<td>Mexico</td>
<td>CS, 75 Industries 1960-65</td>
<td>-0.87</td>
<td>0.82</td>
</tr>
</tbody>
</table>


a/ Variables are rates of change over the period indicated. The equation used is \(\ln E = f(\ln W, \ln V)\), where \(E\) is employment, \(W\) wages and \(V\) value added.

TABLE 3
FACTORY EMPLOYMENT EQUATION, INDIA, 1960-76

\[
\ln EFAC = 7.03^{***} + 0.34^{***} \ln VFAC - 0.25^{**} WFAC + 0.012^{***} T \\
\text{t} = (15.70) (3.85) (-1.83) (2.98)
\]

\(R^2 = 0.99\)


EFAC is employment in the factory sector (workers only); VFAC is value added, and WFAC the earnings per worker, both deflated by the implicit price deflator for the manufacturing sector, and \(T\) is time-trend.
This is close to the time-series (1951-1965) estimates of the output elasticity of employment made by Gupta (1975) for nine 2-digit industry groups: these varied within the narrow band 0.31 to 0.37 (Table 4).

The hypothesis that the real farm wage is institutionally linked to grain output per rural person, and the real formal wages to average net product, is supported by the highly significant coefficients of equations (3) and (4) in Table 1. The elasticity of the real farm wage with respect to the grain output per head is a little less than, but not significantly different from, unity (0.95) and that of the real formal wage with respect to average product (1.24) significantly exceeds unity. It is shown in Appendix B that if (in agriculture) the institutionally determined wage grows h times output per capita the wage share should remain constant. Actually, the wage share in agriculture recorded a low, nonsignificant trend 0.05 percent a year. (Table 5.)

Appendix B also shows that if, in the formal sector, the real wage grows h times the average product, the growth of the wage share should be

\[ \alpha' = \frac{\lambda \Theta(h-1)}{1+\lambda-h} \]

where \( \lambda \) is the substitution parameter and \( \Theta \) the residual technical change parameter in the CES production function. Using the values of the parameters estimated in equations (2) and (4) (\( h = 1.24, \ \Theta = 0.0104, \ \text{and} \ \lambda = 0.45 \) because the elasticity of substitution \( \sigma = 1/(1+\lambda) = 0.69 \)) the expected rate of growth of the wage share is 0.0053. Actually, it grew 0.40 percent a year. (Table 5).

<table>
<thead>
<tr>
<th>Elasticity</th>
<th>Industry</th>
<th>Elasticity</th>
<th>Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>.31</td>
<td>Food</td>
<td>.21</td>
<td>Chemicals</td>
</tr>
<tr>
<td>.37</td>
<td>Textiles</td>
<td>.09</td>
<td>Petroleum</td>
</tr>
<tr>
<td>.37</td>
<td>Wood</td>
<td>.19</td>
<td>Metal</td>
</tr>
<tr>
<td>.36</td>
<td>Paper</td>
<td>.17</td>
<td>Machinery</td>
</tr>
<tr>
<td>.33</td>
<td>Leather</td>
<td>.07</td>
<td>Transport Machinery</td>
</tr>
<tr>
<td>.35</td>
<td>Rubber</td>
<td></td>
<td></td>
</tr>
<tr>
<td>.31</td>
<td>Mineral</td>
<td></td>
<td></td>
</tr>
<tr>
<td>.35</td>
<td>Basic Metal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>.30</td>
<td>Electrical Machinery</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Gupta 1975, p. 763. The elasticities are net of the effects of other variables in the employment functions.
TABLE 5
WAGE SHARES, INDIA, 1958-59/1978-79

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Agriculture*</th>
<th>Nonagriculture Organised</th>
<th>Nonagriculture Unorganised*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average (%)</td>
<td>91.46</td>
<td>67.39</td>
<td>89.39</td>
</tr>
<tr>
<td>Coefficient of variation (%)</td>
<td>1.26</td>
<td>4.32</td>
<td>2.95</td>
</tr>
<tr>
<td>Growth rate (% per year)</td>
<td>0.05</td>
<td>0.40***</td>
<td>-0.23***</td>
</tr>
<tr>
<td>t (of growth rate)</td>
<td>1.27</td>
<td>3.44</td>
<td>-2.54</td>
</tr>
<tr>
<td>r² (of growth rate equation)</td>
<td>0.07</td>
<td>0.37</td>
<td>0.24</td>
</tr>
</tbody>
</table>

*Includes self-employment income.

Thus for both the major sectors the observed wage-share behaviour is consistent with the maintained hypothesis about "institutional" wage determination.

The coefficient of the informal earnings equation (5) in Table 1 have the signs expected on the basis of the reasoning in Section 2. The growing size of the labor force remaining unabsorbed in the farm and formal sectors (ENN') exerted a downward push on the competitively determined earnings in the informal sector; while the growth of productive activity in this sector (VNN) tended to keep earnings up. The two elasticities of earnings (-1.6 and 1.3) with respect to ENN' and VNN are significantly above unity. The first elasticity implies that, given the demand for informal output, a given percentage increase in the labor force unabsorbed elsewhere (ENN') will depress informal earnings by more than one-and-a-half times that percentage. The second elasticity suggests that earnings per informal worker rise faster than value added in the sector, given the informal work force.
The informal activity level itself clearly grows with gross industrial output, as hypothesized in equation (6) (Table 1) but at a slower rate: a 10\% growth in gross industrial output induces, on the average, a little more than 8 percent growth in net informal output.

Finally, the migration equation (7) (Table 1) reveals an upward trend in annual migration and a high elasticity of migration (3.3) with respect to the ratio of nominal wages in the formal sector to nominal agricultural wages. In a very recent study of the Argentinian economy Cavallo and Mundlak (1982) have also obtained high income differential elasticities of migration (ranging from 3.4 to 4.1) from a time series equation with a different specification. 9/ (Cavallo and Mundlak 1982, p. 133.)

Viewed together, the seven equations (Table 1) reveal the working of the Indian labor market to be consistent with a mixed neo-classical-cum-institutionalist view that (farm and formal) employment and migration are systematically wage-sensitive; but wages themselves are institutionally linked to the relevant average product. Net informal output is linked to gross formal output and, given the level of informal activity, the larger the proportion of the labor force which the main sectors cannot absorb, the lower is the level of average informal earnings.

4. Some Projections

Writing the estimated 3SLS system as

\[(16) \quad AY = BX\]

where Y and X are vectors of endogenous and exogenous variables respectively, and A and B are coefficient matrices, we get the reduced form
(17) \[ Y = CX \]

where

\[ C = A^{-1}B. \]

Equation \( Y = CX \) can be used to generate predicted time-series of the endogenous variables \( Y \) both for the estimation period, with the actual time series of the exogenous variables \( X \), and for the future with time series of exogenous variables \( X \) projected with alternative assumptions.

Table 6 shows the coefficients of correlation between the actual series of the endogenous variables and the series predicted with the 3SLS model for the estimation period (1958-59/1978-79). The 3SLS model tracks net informal output and employment in the farm and formal sectors with the least error. It also predicts wages/earnings in the three sectors fairly well. The tracking of migration is, however, adequate but less satisfactory (mainly because of abrupt changes in the annual growth rates of population in the Registrar General's annual population series in one or two years.) Charts 3 and 4 show the actual and predicted series of the real farm and formal wages for the estimation period. These two series are selected because the equations for them are designed to test the "average product" hypotheses and both have recorded fluctuations. The farm wage series has been particularly volatile. The charts show that in the case of both series, 16 out of 20 movements of the predicted series are in the same direction as the movements of the actual series.

The results of three simulation runs [Medium (M), Low (L) and High (H)] for the period 1979-80/1999-2000 are summarised in Table 7. In
simulation (M) it is assumed that the predetermined variables will continue to grow at rates recorded in the past (1959/1979.) The simulated series show farm employment growing 1.49% a year and farm wages 0.57% a year over the next two decades. Formal and informal wages grow somewhat slower than in the past. The formal-farm wage differential diminishes; hence the growth of migration too is a shade slower. The key indicator of pressure in the labour market in the model is the rate of growth of average informal earnings.

TABLE 6

COEFFICIENTS OF CORRELATION BETWEEN ACTUAL AND PREDICTED SERIES OF ENDOGENOUS VARIABLES:
1958-59/1978-79

<table>
<thead>
<tr>
<th>Endogenous Variable</th>
<th>r</th>
</tr>
</thead>
<tbody>
<tr>
<td>EAC</td>
<td>.935</td>
</tr>
<tr>
<td>ENO</td>
<td>.956</td>
</tr>
<tr>
<td>WAGI</td>
<td>.770</td>
</tr>
<tr>
<td>WNO</td>
<td>.808</td>
</tr>
<tr>
<td>WNN</td>
<td>.899</td>
</tr>
<tr>
<td>VNN</td>
<td>.994</td>
</tr>
<tr>
<td>MIG</td>
<td>.526</td>
</tr>
</tbody>
</table>

Source:  Printout 1 May 1983.
CHART 3

Actual and Predicted Values
of the Real Farm Wage Index, 1958/59 to 1978/79

Fiscal year ending March
CHART 4

Actual and Predicted Values of the Formal Sector Wages

Fiscal year ending March
### TABLE 7


<table>
<thead>
<tr>
<th>Variables</th>
<th>Predicted</th>
<th>Actual</th>
<th>Medium</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predetermined</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>QF/PR</td>
<td>0.60</td>
<td>0.60</td>
<td>0.60</td>
<td>0.60</td>
<td></td>
</tr>
<tr>
<td>QIND</td>
<td>5.24</td>
<td>5.24</td>
<td>4.00</td>
<td>7.00</td>
<td></td>
</tr>
<tr>
<td>VAG (a)</td>
<td>2.16</td>
<td>2.16</td>
<td>2.16</td>
<td>2.16</td>
<td></td>
</tr>
<tr>
<td>VNO</td>
<td>4.89</td>
<td>4.89</td>
<td>3.73</td>
<td>6.53</td>
<td></td>
</tr>
<tr>
<td>LT</td>
<td>2.02</td>
<td>2.02</td>
<td>2.02</td>
<td>2.02</td>
<td></td>
</tr>
<tr>
<td>Endogenous</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EAG</td>
<td>1.74</td>
<td>1.49</td>
<td>1.49</td>
<td>1.49</td>
<td></td>
</tr>
<tr>
<td>ENO</td>
<td>3.16</td>
<td>3.21</td>
<td>4.26</td>
<td>1.74</td>
<td></td>
</tr>
<tr>
<td>WAGI</td>
<td>0.76</td>
<td>0.57</td>
<td>0.57</td>
<td>0.57</td>
<td></td>
</tr>
<tr>
<td>WNO</td>
<td>2.20</td>
<td>1.94</td>
<td>-0.75</td>
<td>5.71</td>
<td></td>
</tr>
<tr>
<td>WNN'</td>
<td>1.73</td>
<td>1.18</td>
<td>0.50</td>
<td>2.34</td>
<td></td>
</tr>
<tr>
<td>VNN</td>
<td>4.41</td>
<td>4.32</td>
<td>3.32</td>
<td>5.73</td>
<td></td>
</tr>
<tr>
<td>MIG</td>
<td>6.20</td>
<td>6.18</td>
<td>-5.67</td>
<td>22.73</td>
<td></td>
</tr>
<tr>
<td>ENN'</td>
<td>2.42</td>
<td>2.68</td>
<td>2.30</td>
<td>3.05</td>
<td></td>
</tr>
</tbody>
</table>

**Sources:** Printouts 12 April 1983, 28 April 1983, and 1 May 1983.
This growth is lower (1.2% a year) in the Medium scenario than in the past (1.73%). Since the past growth of informal earnings was associated with a positive growth of measured unemployed (1.7% a year) the lower growth of earnings in case (M) implies a worsening of the unemployment situation.

In the scenario (L) of low industrial growth (4%) the outlook is even worse, for informal earnings grow only 0.5% a year or at a rate less than one-third of the rate in the past. Formal employment grows very fast because real formal wages decline; but the weight of formal employment in the total is small (7.3%). The growth of the labor force unabsorbed in the main sectors is less; but the reduction in the growth of informal output depresses the growth of informal earnings.

Simulation (H) explores the likely behaviour of endogenous variables when industrial output grows at a higher rate (7% a year) and value added in the formal sector therefore grows 6.53% a year. (Other exogenous growth rates are kept unchanged.) The system-determined growth of formal productivity \((VNO'-ENO')\) is now 2.8 times the growth in simulation (M). This is associated with a very high rate of growth of the formal wage (5.7% as compared to 1.94% in simulation (M).) But this drastically reduces formal employment growth to only 1.7% from 3.2% in the Medium case. The higher rate of formal industrial growth induces a higher rate of growth of informal activity (5.7% a year). This growth allows informal earnings to grow at a high rate in spite of slower growth of formal employment. Informal earnings in fact increase 2.3 percent a year. Since formal wages rise at a rapid rate (5.7% a year) and farm wages only 0.57% a year, the formal-farm wage differential grows and the growth of annual migration escalates to 22% a year.

All the simulations reflect and quantify the interaction of the predetermined and exogenous variables as captured by the estimated structure.
The upshot seems to be that a sustained industrial growth rate of the order of 7% a year (which India achieved in the 1950s and many newly industrialised countries have realised in the 1960s and early 1970s) can enable the Indian economy to absorb labor force growth with rapidly rising average informal earnings associated with declining unemployment. But with the industrial growth rate remaining at the past or lower levels, informal earnings will rise slowly, and the volume of measured unemployment should be expected to keep growing. Whether India can again attain and maintain the high rate of industrial growth of the 1950s (7.4%) remains problematic, because structural bottlenecks caused its deceleration to 6.4% in the 1960s and 4.3% in the 1970s.
FOOTNOTES

1/ The farm and formal sectors are referred to as the two main sectors in the following text. The average combined employment in these two sectors was 73.6% of the total labour force during 1959-1979.

2/ An annual time series of unemployment in India is not available. (The coverage of the employment exchange series is known to be limited.) But a discontinuous time series of "weekly status" unemployment (UWS) has been constructed on the basis of data collected in 8 nationwide labour force surveys during 1958-59/1977-78. All workers in a large sample of rural and urban households were interviewed four times a year. UWS is the average number of workers who did not get even one hour of work in the week preceding every round, and were searching or available for work.

WEEKLY STATUS UNEMPLOYMENT, INDIA, SELECTED YEARS, 1958-59/1977-78

<table>
<thead>
<tr>
<th>Year</th>
<th>Aggregate (Million)</th>
<th>Rate (Percent of Labour Force)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1958-59</td>
<td>8.98</td>
<td>5.28</td>
</tr>
<tr>
<td>1959-60</td>
<td>8.09</td>
<td>4.70</td>
</tr>
<tr>
<td>1960-61</td>
<td>6.47</td>
<td>3.64</td>
</tr>
<tr>
<td>1961-62</td>
<td>7.87</td>
<td>4.80</td>
</tr>
<tr>
<td>1964-65</td>
<td>6.56</td>
<td>3.64</td>
</tr>
<tr>
<td>1966-67</td>
<td>4.95</td>
<td>2.50</td>
</tr>
<tr>
<td>1972-73</td>
<td>10.10</td>
<td>4.34</td>
</tr>
<tr>
<td>1977-78</td>
<td>11.15</td>
<td>4.56</td>
</tr>
</tbody>
</table>

The trend rate of growth of aggregate unemployment computed with this series was 1.67% a year.

A more comprehensive measure of unemployment, including underemployed time during the survey week, based on national sample survey data, is also available for 2 years:

<table>
<thead>
<tr>
<th>Year</th>
<th>Aggregate (Million Personyears)</th>
<th>Rate (Percent of Labour Force)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1972-73</td>
<td>18.63</td>
<td>8.35</td>
</tr>
<tr>
<td>1977-78</td>
<td>19.17</td>
<td>8.23</td>
</tr>
</tbody>
</table>

3/ Cross-section equations estimated by Bardhan (1981) with data from the state of West Bengal, India, show hired labor supply of landless and small farm households, in days per week, to be positively wage-responsive. The wage elasticity was 0.2 and 0.26. But the wage-elasticity of the total labor supply of all rural households was found to be zero.
Population growth is treated as exogenous for, in spite of the growth of per capita income (about 1.3 percent a year) over the 30 years 1950-51/1980-81, and family planning programmes, the population growth rate accelerated from 1.98% a year in the 1950s to 2.20% in the 1960s and 2.23% in the 1970s (Visaria 1981).

In interstate regressions estimated with sample survey data for 1970-71, in which rural unemployment was directly measured in persondays, the elasticity of rural wages with respect to unemployment turns out to be -0.2 (t = -5.36; r² = 0.67).

As Lyn Squire has noted: "The supply price of labor in traditional sector dualism is usually determined by the average product of labor in income-sharing rural households (Lewis 1954) or by subsistence wage payments established by landlords. (Fei and Ranis 1961)" (Squire 1979, p. 42). Harris and Todaro have also observed that: "Much of the literature has stressed that in peasant economies producers receive their average product which is higher than their marginal product. Indeed, this is at the heart of the well-known Lewis and Fei-Ranis models." (Harris and Todaro 1970, p. 129.)

Since the relation between the wage share (a), the wage rate (W), and the average product (v), is \( a = \frac{W}{v} \), we have, in growth rates, \( a' = \frac{W' - v'}{v'} \). Thus, a positive growth of the wage share implies wage rate increases in excess of average productivity growth.

A formal test of the equality of OLS and 3SLS coefficients of equations with the same variables is not available.

In the Cavallo-Mundlak study the migration series is generated as in this paper (vide equation 9c) but the dependent variable is the ratio of migration to the agricultural labor force. The income differential is approximated by the ratio of average labor productivity in the farm and nonfarm sectors measured in current prices. Other aspects of the specification also differ. (Cavallo and Mundlak 1982, pp. 131-134.)

Only the growth rates of simulated series are shown in Table 7. The full series are available with the author.
APPENDIX A
THE REDUCED FORM OF THE MODEL IN GROWTH RATES

Using (') to denote growth rates, $e_{ij}$ to denote the elasticity of dependent variable $i$ with respect to the predetermined variable $j$, and shorter symbols: 1, 2, 3 for sectors AG, NO and NN', respectively.

$E$ = employment,
$L$ = labor force,
$M$ = migration,
$M_{1}$ = lagged migration,
$P$ = rural population,
$q_{1}$ = grain output, per rural person,
$Q_{2}$ = industrial output,
$R$ = ratio $W_{2}/W_{1}$
$r$ = initial share of sectoral employment in total labour force,
$V$ = value added,
$v$ = value added per worker, and
$W$ = wages.

The reduced form of the model is

1. $E_{1}' = e_{11}V_{1} + e_{12}W_{1} + e_{13}q_{1}$

2. $E_{2}' = a_{2} + e_{21}V_{2} + e_{22}W_{2} + (e_{23}V_{2} - e_{24}W_{2})$

   $a_{2} + (e_{21}V_{2} + e_{22}W_{2} + e_{23}V_{2})$

   $= \frac{1 + e_{24}W_{2}}{1 + e_{24}W_{2} + e_{23}V_{2}}$
(3) \[ W'_1 = e_{W_1} q_1 q'_1. \]

(4) \[ W'_2 = e_{W_2} v_2 (v'_2 - \bar{E}'_2) \]

(5) \[ W'_3 = e_{W_3} v_3 v'_3 + e_{W_3} E_3 \frac{L' - r_1 \bar{E}'_1 - r_2 \bar{E}'_2}{1 - r_1 - r_2} \]

(6) \[ V'_3 = e_{V_3} Q_2 Q'_2 \]

(7) \[ M' = e_{M_1} (\bar{W}'_2 - \bar{W}'_1) + e_{M_1} M_1' \].

\bar{E}'_1 and \bar{E}'_2 in equations (5) and (6) are the values given by equations (1) and (2). \bar{W}'_1 and \bar{W}'_2 in equation (7) are values given by (3) and (4). \( a_2 \) is the coefficient of \( T \) in the equation for ENO. \( e_{W_1} q_1 \) in equation (1) and \( W'_1 \) in (3) and (7) are adjusted for differences in deflators. Values of \( W'_2 \) in equations (4) and (7) are also adjusted for deflation differences.
For cases in which wages are institutionally determined, but employers equate the marginal product to the given wages, expressions for the growth rates of employment (E), net output (V), wages (w), average product (V/E) and the wage share (\( \alpha_E \)) can be derived as follows.

Let the farm production function, with labor as the only variable, and output as numeraire, be

\[
V = V_0 e^{zt_E^B}
\]

where \( z \) is the residual rate of technical change.

In growth rates,

\[
(1') \quad V' = z + \beta E'.
\]

The wage rate is institutionally linked to average output per head of population (P) (not per worker):

\[
(2) \quad w = w_0 (V/P)^h
\]

so that, if \( n \) is the exogenous growth rate of population,

\[
(2') \quad w' = h(V' - P')
\]

\[= hV' - hn.\]
Employers equate wages to the marginal product:

\[ w = V_0 e^{zt} \beta^\beta e^{\beta-1} \]  

(3') \[ w' = z + (\beta-1)E' \] 

The three equations (1'), (2') and (3') can be solved to get

(4) \[ E' = \frac{z(h-1)-hn}{\beta(1-h)-1} \] 

(5) \[ V' = z + \beta\left\{ \frac{z(h-1)-hn}{\beta(1-h)-1} \right\} \] 

(6) \[ w' = z + (\beta-1) \left\{ \frac{z(h-1)-hn}{\beta(1-h)-1} \right\} \] 

The growth of the average product per worker is

(7) \[ V' = E' = z + (\beta-1) \left\{ \frac{z(h-1)-hn}{\beta(1-h)-1} \right\} \] 

And the rate of change of the labour share is zero:

(8) \[ \alpha'_E = w' - (V' - E') = 0 \]

Assuming a CES production function for the nonfarm sector (again with K given, output as numeraire, and \( \Theta \) as the residual technical change parameter).

(9) \[ V = V_0 (\beta_1 e^{-\lambda t} + \beta_2 K^{-\lambda t})^{-1/\lambda} e^{\Theta t} \]
optimum employment is given by

\begin{equation}
    w = e^{-\lambda \Theta t} \beta V / E^{1+\lambda}.
\end{equation}

If institutional wage determination is represented by

\begin{equation}
    w = w_o (V/E)^h
\end{equation}

we can use the growth rate versions of (10) and (11)

\begin{equation}
    w' = -\lambda \Theta + (1+\lambda) (V-E').
\end{equation}

and

\begin{equation}
    w' = h(V-E')
\end{equation}

to get the rate of change of the real wage

\begin{equation}
    w' = \frac{h\lambda \Theta}{1+\lambda-h}
\end{equation}

and the rate of growth of the average product

\begin{equation}
    V' - E' = \frac{\lambda \Theta}{1+\lambda-h}.
\end{equation}

The rate of change of the labor share is

\begin{equation}
    a'_E = w' - (V' - E')
\end{equation}

\[= \frac{\lambda \Theta (h-1)}{1+\lambda-h}\]
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