On the Size and the Evolution of the Informal Sector in Developing Countries: The Case of Turkey

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Paper prepared for presentation at the International Conference on Policy Modeling,

EcoMod2003, Istanbul, Turkey, July 3-5, 2003

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May, 2003

Abstract

This paper studies a three sector Ramsey-type growth model with different groups of households. Groups of households are differentiated in terms of their access to the markets of productive assets, capital and land. This variation in access to asset markets implies differences in factor endowments, and results in asset and income inequality among households. Production occurs in agricultural, formal, and informal sectors. In particular, household preferences display Engel effects in two of the goods: agricultural and informally produced goods. Income elasticity of demand for formally produced goods, on the other hand, is equal to one. The model is calibrated to Turkish National data for the year 1997, and the simulation results indicate that as the economy transitions into the long-run equilibrium with the process of growth, the importance of agricultural and informal sectors diminish, and that of the formal sector increases, given any degree of asset and income inequality. However, with higher degrees of asset inequality, the results show that in the long run, the economy ends up with a larger informal sector output and a smaller formal sector output. Furthermore, it is shown that lowering the labor taxes in the formal sector yields favorable results in terms of capital stock, income, and formal sector ouput and employment in both transition and in the long-run.

JEL Classification Codes: *C61, D33, O17, O41*

Keywords: *Informal Sector, Economic Growth, Asset and Income Inequality, Engel Effects.*

[1] Ph.D. Candidate, Department of Applied Economics, University of Minnesota. I would like to thank my advisor Professor Terry L. Roe for encouragement and invaluable comments, and to Professors V.V. Chari, Rodney Smith and Laura Kalambokidis for helpful discussions and guidance. Correspondance can be directed to sara0016@umn.edu, and all comments will be greatly appreciated.

1 Introduction

Until the early 1970's, the less developed countries were often characterized by dual economies, with a traditional agricultural sector and a more modern, urban sector. The dichotomy within the urban sector (traditional urban versus modern urban) in these countries was considered to be a temporary phenomenon by most authors, that is, the traditional urban employment was considered to be a temporary mode of employment for the unskilled agricultural labor en route to a permanent modern urban employment (Lewis, 1954; Ranis and Fei, 1961; Todaro, 1969). However, studies first by Hart (1973) on urban employment in Ghana and later by International Labour Office (1973) redefined the traditional urban sector as the "informal" sector, and argued that in less developed countries, informal sector employment was a permanent rather than a temporary source of employment, and should be examined separately from employment in the "formal" sector. Following these studies, the analysis of the dualism between formal and informal sectors, particularly analyzing the informal sector in less developed countries, has gained much momentum, and created a sizeable literature[2].

In the literature, several terms have been used to describe informal economic activity around the world: unofficial, shadow, hidden, underground, illegal, unrecorded, unreported, parallel, black. Although there may be nuances in these terms, they all have a common denominator: "those engaged in (such) activities circumvent, escape, or are excluded from the institutional system of rules, rights, regulations and enforcement penalties that governs those agents engaged in formal production and exchange" (Feige, 1990). Particularly in less developed and developing countries, informal economic activity, or the term "informal sector" has additional connotations: this term usually describes a small scale, traditional industry sector, characterized by ease of entry, reliance on indigenous resources, family ownership of enterprises, labor intensive technologies, skills acquired outside the formal school system, and unregulated and competitive markets (Bromley, 1978). Several empirical studies (including Schneider and Enste, 2000; Loayza, 1996; Friedman, et al., 2000; World Bank World Development Report, 2002) have found a large informal sector to be an important characteristic of less developed and developing economies: Schneider and Enste compare the size of the informal economy in 76 countries between 1989 and 1993, and find that on average, in developing countries (Africa, Central and South America, Asia), the size of the informal economy is between 35% and 44% of official GDP, in transition countries (former Soviet Union and

[2] Please see Danesh (1991) as a comprehensive research guide on the informal economy.

Eastern Europe), between 21% and 35% of official GDP, whereas in OECD countries, it is about 15%. Loayza estimates the size of the informal sector in Latin America to be 39% of official GDP, on average for the early 1990's, ranging from 18% in Chile, to 66% in Bolivia. In his famous study on Lima, Peru, de Soto (1989) estimates the size of the informal sector to be 39% of official GDP in the early 1980's, and to grow to 61% in year 2000. He has also reported that some 61% of total work hours have been devoted to informal economic activity during the early 1980's in Lima. These findings, among others, imply a strong negative relationship between the level of economic development and the size of the informal sector. Furthermore, a negative relationship can be observed between GDP per capita (US$, PPP adjusted) and the share of informal urban employment in total urban employment (as an indicator of informal activity) amongst developing countries, as depicted by Figure 1.1 for the 1995-1999 average (World Development Indicators, 2002):

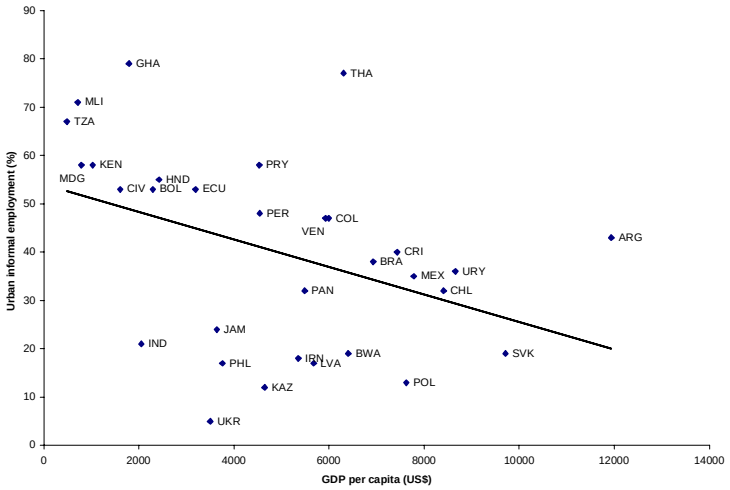

Figure 1.1: GDP per capita vs. informal employment

In addition to these findings, Friedman, et al. (2000) report that controlling for per capita income, "poor institutions" lead to a large informal sector in an economy. Institutions, as North (1990) puts it, are "the rules of the game in a society". They are "...the humanly devised constraints that shape human interactions", and "...they structure incentives in human exchange, whether political, social, or economic." North recognizes that institutions in a society can be classified as informal (conventions and codes of behavior that evolve over generations, they are subjective in nature) and formal (those rules devised by human beings).

In the strand of economic literature that focuses on the relationship between institutions and economic performance, the term "institutions" implies formal, or government institutions such as the rule of law, bureaucratic and regulatory competence, security of property and contractual rights, and the like. Numerous studies link better institutions to better economic performance measured as economic growth: Knack and Keefer (1995, 1997), Knack (1996), Easterly and Levine (1997), Goldsmith (1998), Gang and Chunying (1998), Colombatto (1998), Brunetti, et al. (1997), Parente and Prescott (1999), Henisz (2000), Grigorian and Martinez (2000) to list a few. Another strand of economic literature establishes the link between the quality of institutions and the size of informal economic activity in a country: heavy bureaucratic and regulatory burden, tolerance of corruption, lack of legal competence and enforcement, unsecure or non-existent property and contractual rights, and higher than optimal tax rates drive agents to engage in production and exchange activities in the informal sector (Friedman, et al. 2000; Johnson, et al. 1998; Djankov, et al. 2001; Loayza, 1996; World Bank World Development Report, 2002; Neck, et al. 1989; de Soto, 1989; Ihrig, et al., 2000; Lackó, 2000). From these studies, one can deduce that factors that promote informal economic activity also hinder better overall economic performance.

The objective of the present paper is twofold: the general purpose is to argue that institutional factors that may lead to permanent asset and income inequality are important for both the income level and income growth, as well as the relative size of the informal sector. The more specific objectives are to detect the behavior of the informal sector during the structural transition process of an economy, and to explain the transition process in part by the preference and income structure of heterogenous agents. To achieve these objectives, a multi-sector Ramsey-type growth model with agents differentiated by their ownership of factors of production (land, labor and capital) is introduced; there are asset-rich households who control ownership of capital and land, and asset-poor households who own only labor. With this distinction in factor ownership, institutional rigidities that may lead to permanent asset and income inequality are emphasized. Effectively, there are two asset market failures, one in capital, and the other in land. These are the two factor markets that are said to be "relatively institutionally intensive"[3]. Production occurs in three sectors, agricultural,

[3]That is, agent behavior in capital and land markets are dependent on institutional structures (property rights, contract enforceability, etc.) more than in any other market. In this study, agent behavior and incentives are not explicitly modeled, but it is assumed that one group of agents enjoy access to capital and land markets, whereas another group does not.

formal and informal[4]. Agriculture uses capital, labor and fixed land, whereas the formal and informal sectors use only capital and labor. In particular, one of the distinctive features of the formal sector is that the firms in this sector face regulatory measures in the form of labor taxes, whereas the informal sector firms evade such regulatory measures.

In addition to the supply-side effects implied by the relative factor intensities, the demand side of the economy is also expected to have a significant effect on the transition path to long run equilibrium, depending on the severity of income inequality[5]: asset-poor agents will continue to devote an important portion of their incomes on buying informally manufactured goods and agricultural goods, this expenditure pattern will prevail even though the economy transitions into long run equilibrium as it accumulates capital, benefiting the asset-rich households, who already devote a larger portion of their total expenditures on purchasing formally produced goods, and a relatively smaller portion on informal and agricultural goods, to begin with. If income inequality is severe, i.e. only a small fraction of the population own capital and land, a relatively slow change in demand patterns away from agricultural and informal goods is expected as the economy transitions into the long run; if the income inequality is less severe, i.e. assets are more evenly distributed, then a relatively faster change in overall demand patterns may occur.

The next section describes the model and its basic properties. In Section 3, the equilibrium for this economy is defined and characterized. In Section 4, the model is calibrated to Turkish National data for the year 1997, and the results from model simulations are presented. Especially, the long-run effects of varying the degree of asset and income inequality, as well as the effects of varying the labor taxes levied on formal sector firms are examined. Section 5 concludes this study.

[4] In their article, Gang and Gangopadhyay (1990) have a similar structure in the supply side of the economy, however, they do not present demand-side relationships in their model economy.

[5] Persson and Tabellini (1994) link income inequality and economic growth via (regulatory) institutions such as patent legislation, or property rights that allow the agent to privately appropriate returns on his investment. Gangopadhyay (1998) also links low economic growth to income inequality, but offers a different point of view: with non-homothetic preferences, and inequality in capital ownership, capital accumulation without any change in ownership pattern generates enclaves of prosperity, leaving large sections of the society unaffected. Murphy, et al. (1989) show that the composition of demand, as determined by the market size for manufactures, and income distribution, play an important role in industrialization. Rosser, et al. (2000) empirically show that for transition economies, income inequality is positively related with the share of output produced in the informal economy.

2 The Basic Model

In this section, the environment, the assumptions about the production technologies, household preferences, and the asset distribution are introduced.

The model is a simple multi-sector Ramsey-type growth model with two households differentiated by their holdings of factors of production. There is no technological change, or population growth in the present model.

A small open economy with three production sectors is described. These three sectors capture the two types of dualism in developing countries: the dualism between traditional agricultural and modern sectors, and the dualism within the modern sector, formal versus informal production. In each period, the production of formal and informal sector goods requires the use of capital and labor inputs, and the production of agricultural goods requires labor, capital, and a fixed, sector-specific factor of production, land. Labor and capital are perfectly mobile between sectors; and land can be rented in or out only within the agricultural sector. There is no mobility of the factors of production between nations.

2.1 Production

The production in agriculture is represented by a constant returns to scale Cobb-Douglas production function[6]:

$$Y_1 = b_1 B_1 L_1^{\alpha_1} K_1^{\alpha_2} T^{\alpha_3} \tag{1}$$

where Y_1 is the aggregate agricultural output[7], K_1, L_1 and T are the capital, labor and fixed land inputs, respectively, $b_1 > 0$, $B_1 > 0$, $\alpha_1, \alpha_2, \alpha_3 \in (0,1)$ and $\alpha_1 + \alpha_2 + \alpha_3 = 1$. Agricultural sector firms are perfectly competitive in both input and output markets, and the output of the sector is a pure consumption good that can be internationally traded.

Agricultural firms take the price of the labor input, wages ω and the rental price of capital, r as given, and choose $L_1$and K_1 to minimize costs for all t, i.e.

$$\begin{aligned} & \min \ \omega L_1 + r K_1 \\ \text{subject to } Y_1 \ &\leq \ b_1 B_1 L_1^{\alpha_1} K_1^{\alpha_2} T^{\alpha_3} \\ L_1, K_1 \ &> \ 0 \end{aligned} \tag{2}$$

[6] Time subscripts, t, are suppressed since the producers solve the same (cost minimization and profit maximization) problems in every period.

[7] For simplification, the scaling parameter B_1 is set at $B_1 \equiv \alpha_1^{-\alpha_1} \alpha_2^{-\alpha_2} \alpha_3^{-\alpha_3}$.

Given the cost-minimizing values of L_1, K_1 and the market price of the agricultural good, p_1, agricultural firms choose Y_1 to maximize profits, for all t,

$$\max \ \{p_1 Y_1 - \omega L_1(\omega, r, Y_1, T) - r K_1(\omega, r, Y_1, T)\} \tag{3}$$

The maximum profits generated by the agricultural sector are

$$\Pi_1(p_1, \omega, r) = (b_1 p_1)^{\frac{1}{\alpha_3}} \omega^{-\frac{\alpha_1}{\alpha_3}} r^{-\frac{\alpha_2}{\alpha_3}} T \tag{4}$$

in which

$$s(p_1, \omega, r) = \frac{\partial \Pi_1}{\partial T} = (b_1 p_1)^{\frac{1}{\alpha_3}} \omega^{-\frac{\alpha_1}{\alpha_3}} r^{-\frac{\alpha_2}{\alpha_3}} \tag{5}$$

represents the rents to land[8]. The profits in agriculture are immediate rents to the landowner households.

The constant returns to scale Cobb-Douglas production functions in formal and informal sectors are

$$Y_2 = b_2 B_2 L_2^{\beta} K_2^{1-\beta} \tag{6}$$

$$Y_3 = b_3 B_3 L_3^{\delta} K_3^{1-\delta} \tag{7}$$

where Y_j, L_j, K_j, $j = 2,3$ are the aggregate output, labor input, and capital input in formal and informal manufacturing, respectively[9]. Finally, $b_j > 0$, $B_j > 0$, $j = 2,3$, β and $\delta \in (0,1)$. Firms in both of the manufacturing sectors are competitive in input and output markets, and earn normal profits. The formal sector firms, however, pay labor taxes, i.e. they have to make contributions towards the social security premiums of their employees, at the rate τ_f of wages earned. The informal sector firms are out of the realm of government regulations, therefore have no such extra labor costs. The output of informal sector is a pure consumption good that is not internationally traded, whereas the output of the formal sector is both an investment and a consumption good, that can be internationally traded.

2.2 Households

The economy is populated by two types of households: households of Type-1 ("asset-rich", or only "rich") has the ownership of all land, and capital, along with some of the labor; households of Type-2 ("asset-poor", or only "poor") own some of the labor, only. Consequently,

[8] Land market clears at s.

[9] For simplification, scaling parameters B_2 and B_3 are set at $B_2 \equiv \beta^{-\beta}(1-\beta)^{\beta-1}$ and $B_3 \equiv \delta^{-\delta}(1-\delta)^{\delta-1}$.

only the rich have the ability to save intertemporally and contribute to capital accumulation, whereas the poor exhaust all of their wage income on consumption, every period.

The representative rich household[10] wishes to maximize intertemporal utility, U, as given by the function

$$U = \int_0^\infty \frac{c^1(t)^{1-\theta} - 1}{1-\theta} e^{-\rho t} dt \tag{8}$$

subject to her flow budget constraint

$$\left(\frac{\dot{K}}{L^1}\right)(t) = \omega(t) + r(t)\frac{K}{L^1}(t) + s(t)\frac{T}{L^1} + \Upsilon(t) - E^1(c^1(t), p(t)) \tag{9}$$

initial level of aggregate capital

$$K(0) = K_0 \tag{10}$$

and the transversality condition

$$\lim_{t\to\infty} K(t) e^{-\int_0^t r(\nu)d\nu} = 0 \tag{11}$$

where $c^1(t)$ is an index of aggregate consumption by the rich household. The remaining variables are defined as follows: $K(t)$ is the aggregate capital, $L^1 \in (0, 1]$ is the population of the rich households, $\omega(t)$ is the wage per unit of labor, $r(t)$ is the return on per unit of capital, $s(t)$ is the return on land, $\Upsilon(t)$ is the per capita transfers, equal to the per capita social security premium contributions made by formal sector firms, $E^1(c^1(t), p(t))$ is the aggregate expenditure by rich household, $p(t)$ is the vector of output prices $(p_1, p_2, p_3)(t)$, $1/\theta$ is the elasticity of intertemporal substitution, and ρ is the discount factor. Evidently, the rich household faces a two-stage consumption choice problem: intra-temporal and inter-temporal.

The representative poor household[11], on the other hand, simply chooses consumption bundles in every period, subject to her instantaneous budget constraint

$$E^2(c^2, p)(t) = \omega(t) + \Upsilon(t) \tag{12}$$

[10] Consumption variable is represented in terms of "per household" rather than "group of rich households". Expressing rich households as a group: let aggregate consumption be C^1, then consumption "per" rich household is $c^1 = \frac{C^1}{L^1}$, and consumption per capita with respect to group of rich households is $\frac{C^1}{L^1}\frac{L^1}{L} = c^1\ell^1$.

[11] Let aggregate consumption of group of poor households be C^2, then consumption "per" poor household is $c^2 = \frac{C^2}{L^2}$, and consumption per capita with respect to group of poor households is $\frac{C^2}{L^2}\frac{L^2}{L} = c^2\ell^2$. Here, $L^2 = L - L^1$ and $\ell^2 = 1 - \ell^1$.

where c^2 is an index of aggregate consumption and $E^2(c^2, p)$ is the aggregate expenditure of the of the poor household.

The instantaneous consumption composite of household Type-i, $i = 1, 2$, is of the Stone-Geary form:

$$\begin{aligned} c^i &= B(c_1^i - \gamma_1^i)^{\lambda_1}(c_2^i)^{\lambda_2}(c_3^i - \gamma_3^i)^{\lambda_3} \qquad (13) \\ c_1^i &> \gamma_1^i \\ c_2^i &> 0 \\ c_3^i &> \gamma_3^i \end{aligned}$$

where c_j^i is the consumption of good j, $j = 1, 2, 3$ per household Type-i, $B > 0$ is a constant[12], and $\lambda_1 + \lambda_2 + \lambda_3 = 1$. In this study, the non-homotheticity of the Stone-Geary preferences are meant to capture the Engel effects, i.e. households devote a smaller portion of their incomes on agricultural and informal sector goods as their incomes increase[13]. Furthermore, these preferences imply that the income elasticities of the demand for agricultural and informal sector goods are less than one, and that for the formal sector goods is equal to one. Here, γ_1^i of agricultural good for household Type-i can be interpreted as the level of subsistence food consumption, while γ_3^i of informal good for household Type-i may be interpreted as the purchases of the household from informal goods markets before any substantial purchases are made in the formal goods markets.

3 Competitive Equilibrium

In the definition below and in what follows in the rest of the study, all variables are in per capita terms:

[12] For algebraic simplicity, the scale parameter B is set at $B \equiv \lambda_1^{-\lambda_1}\lambda_2^{-\lambda_2}\lambda_3^{-\lambda_3}$.

[13] Similar Engel effects are briefly mentioned in Tybout (2000) for those goods produced using "cottage technologies", implying small scale informal production, and studied in Irz and Roe (2001) for agricultural goods, and Echevarria (1997, 2000) for all types of goods.

Table 3.1: Variables, in per capita terms

Variable	*Per capita*	*Symbol*
Fraction of Type-i households	$\frac{L^i}{L}$	ℓ^i
Consumption, good j, Household Type-i	$\frac{C_j^i}{L^i} \times \frac{L^i}{L}$	$c_j^i \ell^i$
Output, Sector j	$\frac{Y_j}{L}$	y_j
Aggregate Capital	$\frac{K}{L}$	k
Sectoral Capital, Sector j	$\frac{K_j}{L}$	k_j
Sectoral Labor, Sector j	$\frac{L_j}{L}$	l_j
Land	$\frac{T}{L}$	τ
Trade in good j	$\frac{X_j}{L}$	x_j

Definition 1 *A competitive equilibrium for this economy is a list of sequences of output prices* $\{(p_1, p_2, \hat{p}_3(t))\}_{t=0}^{\infty}$, *consumption levels* $\{(\hat{c}_j^i(t))_{j=1,2,3}\}_{t=0}^{\infty}$ *for each household Type-i,* $i = 1, 2$, *wage rates* $\{\hat{\omega}(t)\}_{t=0}^{\infty}$, *capital rental rates* $\{\hat{r}(t)\}_{t=0}^{\infty}$, *land rental rates* $\{\hat{s}(t)\}_{t=0}^{\infty}$, *production plans* $\{\hat{y}_j(t), \hat{k}_j(t), \hat{l}_j(t)\}_{t=0}^{\infty}$ *for each sector* j, $j = 1, 2, 3$ *such that*

i) given output and input prices, for each representative household $i = 1, 2$, *the sequence* $\{(\hat{c}_j^i(t))_{j=1,2,3}\}_{t=0}^{\infty}$ *solves the utility maximization problem;*

every period t, $t = 0, ..., \infty$,

ii) given output and input prices, representative firms in each sector $j, j = 1, 2, 3$, *maximize profits;*

iii) market clears in the non-tradable (informal) goods market;

iv) labor market clears;

v) capital market clears;

vi) Walras' Law holds: $p_1\widehat{x}_1 + p_2\widehat{x}_2 = 0$, *where* $\widehat{x}_1$ *is the per capita exports (imports, if a negative value) of agricultural good,* $\widehat{x}_1 = \widehat{y}_1 - \sum_{i=1}^{2} \widehat{c}_1^i \ell^i$, *and* $\widehat{x}_2$ *is the per capita exports (imports, if a negative value) of formal manufacturing good,* $\widehat{x}_2 = \widehat{y}_2 - \sum_{i=1}^{2} \widehat{c}_2^i \ell^i - \dot{\widehat{k}}$.

vii) No-arbitrage condition holds between capital and land assets:

$$r = \frac{s(p_1, \omega, r)}{p_{land}} + \frac{\dot{p}_{land}}{p_{land}}$$

viii) Total taxes (contributions towards social security premiums) paid by formal sector firms equal total transfer payments to households.

3.1 Characterization of Competitive Equilibrium

In equilibrium, profit maximization in formal and informal sectors imply[14]

$$MC_2(\tilde{\omega}, r) = 1 \tag{14}$$
$$MC_3(\omega, r) = p_3 \tag{15}$$

where $MC_2(\tilde{\omega}, r)$ and $MC_3(\omega, r)$ denote the marginal cost in each sector, and p_3 the relative price of informal good. Per unit labor cost of the formal sector firm is $\tilde{\omega} \equiv \omega(1+\tau_f)$. Using (14) and (15), wages and informal good prices are expressed as functions of capital rental rate,

$$\omega = \mathbf{w}(r) \tag{16}$$
$$p_3 = \mathbf{p}(r) \tag{17}$$

Factor market clearing conditions allow us to solve for functions for per capita output levels in formal and informal sectors in terms of capital rental rate and capital:

$$-\frac{\partial s(p_1, \omega, r)}{\partial \omega} + \frac{\partial MC_2(\tilde{\omega}, r)}{\partial \tilde{\omega}} y_2 + \frac{\partial MC_3(\omega, r)}{\partial \omega} y_3 = 1 \quad \text{(Labor Market)}$$
$$-\frac{\partial s(p_1, \omega, r)}{\partial r} + \frac{\partial MC_2(\tilde{\omega}, r)}{\partial r} y_2 + \frac{\partial MC_3(\omega, r)}{\partial r} y_3 = k \text{ (Capital Market)}$$

After substituting $\mathbf{w}(r)$ for ω above, these two market clearing conditions can be easily solved for y_2 and y_3 :

$$y_2 = \mathbf{y}_2(r, k) \tag{18}$$
$$y_3 = \mathbf{y}_3(r, k) \tag{19}$$

Using the informal goods (home-good) market clearing condition,

$$c_3^1 \ell^1 + c_3^2 \ell^2 = y_3 \tag{20}$$

we obtain the expenditure function for rich household as a function of r and k,

$$E^1(r, k) = \frac{\mathbf{p}(r)}{\lambda_3}\left(\frac{\mathbf{y}_3(r, k)}{\ell^1} - \gamma_3^1 - c_3^2(r)\frac{\ell^2}{\ell^1}\right) + p_1\gamma_1^1 + \mathbf{p}(r)\gamma_3^1 \tag{21}$$

[14] Formal manufacturing sector output is assumed to be the numeraire, and we set $p_2 \equiv 1$.

where

$$c_3^2(r) = \frac{\lambda_3}{\mathbf{p}(r)}(\mathbf{w}(r) + \Upsilon(r,k) - p_1\gamma_1^2 - \mathbf{p}(r)\gamma_3^2) + \gamma_3^2 \tag{22}$$

After substituting equation (21) for rich household expenditures, the intertemporal budget constraint of the rich household[15] can be written as:

$$\begin{aligned} \dot{k} &= \mathbf{w}(r)\ell^1 + rk + s\tau + \Upsilon(r,k)\ell^1 - E^1(r,k)\ell^1 \\ &= f_1(r,k) \end{aligned} \tag{23}$$

Next, total time-differentiating the informal goods market clearing condition (20) yields

$$\begin{aligned} & \lambda_3 c^1 \ell^1 p_1^{\lambda_1} \mathbf{p}(r)^{\lambda_3} (\frac{\dot{c^1}}{c^1} + \lambda_3 \frac{\partial \mathbf{p}(r)}{\partial r} \frac{r}{\mathbf{p}(r)} \frac{\dot{r}}{r}) \\ & + \lambda_3 (\frac{\partial \mathbf{w}(r)}{\partial r}\dot{r} + \frac{\partial \Upsilon(r,k)}{\partial r}\dot{r} + \frac{\partial \Upsilon(r,k)}{\partial r}\dot{k} - \frac{\partial \mathbf{p}(r)}{\partial r}\dot{r}\gamma_3^2)\ell^2 \\ = \quad & \frac{\partial \mathbf{p}(r)}{\partial r}\dot{r}(\mathbf{y}_3(r,k) - \gamma_3^1\ell^1 - c_3^2(r)\ell^2) + \mathbf{p}(r)(\frac{\partial \mathbf{y}_3(r,k)}{\partial r}\dot{r} + \frac{\partial \mathbf{y}_3(r,k)}{\partial k}\dot{k}) \end{aligned} \tag{24}$$

in which

$$\lambda_3 c^1 \ell^1 p_1^{\lambda_1} \mathbf{p}(r)^{\lambda_3} = \mathbf{p}(r)(\mathbf{y}_3(r,k) - \gamma_3^1\ell^1 - c_3^2(r)\ell^2) \tag{25}$$

and

$$\frac{\dot{c^1}}{c^1} = \frac{1}{\theta}(r - \rho - \lambda_3 \frac{\partial \mathbf{p}(r)}{\partial r} \frac{r}{\mathbf{p}(r)} \frac{\dot{r}}{r}) \tag{26}$$

Finally, after substituting for (25) and (26) in (24), the resulting differential equation $\dot{r}$ is obtained:

$$\dot{r} = f_2(r,k) \tag{27}$$

[15] Note that in rewriting the budget constraint, we simply multiply and divide the original budget constraint (9) by L and then manipulate the terms as follows:

$$\begin{aligned} \frac{\dot{K}}{L^1}\frac{L}{L} &= \frac{\dot{K}}{L}\frac{L}{L^1} \\ &= \dot{k}\frac{1}{\ell^1} \\ &= \mathbf{w}(r) + rk\frac{1}{\ell^1} + s\tau\frac{1}{\ell^1} + \Upsilon - E(c^1,p) \\ \Longrightarrow \quad \dot{k} &= \mathbf{w}(r)\ell^1 + rk + s\tau + \Upsilon\ell^1 - E(c^1,p)\ell^1 \end{aligned}$$

The reduced system of 2 differential equations (23) and (27), together with an initial condition for capital, k_0 and the transversality condition completely characterize the dynamic competitive equilibrium.

3.2 Steady State Equilibrium and the Transition path

In the long-run equilibrium in this economy, all endogenous variables are constant for all t, under the assumption that $\dot{k} = 0$, in particular. Such an equilibrium is called the steady state equilibrium.

Definition 2 *A steady state is an equilibrium such that it satisfies all equilibrium conditions above, and given p_1, p_2 and k_0, all endogenous variables $p_3(t), (c_1^i(t), c_2^i(t), c_3^i(t))^{i=1,2}$, $\omega(t)$, $r(t)$, $(y_j(t), l_j(t), k_j(t))_{j=1,2,3}$ are constant for all periods of time, t.*

By definition, at the steady state, it must be the case that

$$\dot{k} = 0 \tag{28}$$

$$\dot{r} = 0 \tag{29}$$

$$\dot{c}^1 = 0 \tag{30}$$

Then, from the Euler condition (26),

$$r_{ss} = \rho \tag{31}$$

must be true at the steady state, where r_{ss} denotes the steady state value of the capital rental rate. Knowing r_{ss} and that $\dot{k} = 0$, the intertemporal budget constraint of the rich household can be rewritten as

$$0 = \mathbf{w}(r_{ss})\ell^1 + r_{ss}k_{ss} + s(p_1, r_{ss})\tau + \Upsilon(r_{ss}, k_{ss})\ell^1 - E^1(c_{ss}^1, \mathbf{p}(r_{ss}))\ell^1 \tag{32}$$

where k_{ss} and c_{ss}^1 are the steady state values of aggregate capital and rich household's consumption, respectively. However, (32) still leaves us with two unknowns at the steady state, namely k_{ss} and c_{ss}^1. We know that for every point in time, including the steady state, the informal goods market clearing condition must hold:

$$c_{3,ss}^1\ell^1 + c_{3,ss}^2\ell^2 = \mathbf{y}_3(r_{ss}, k_{ss}) \tag{33}$$

$$\frac{\lambda_3 c_{ss}^1 \ell^1 p_1^{\lambda_1} \mathbf{p}(r_{ss})^{\lambda_3}}{\mathbf{p}(r_{ss})} + \gamma_3^1\ell^1 + \frac{\lambda_3 c_{ss}^2 \ell^2 p_1^{\lambda_1} \mathbf{p}(r_{ss})^{\lambda_3}}{\mathbf{p}(r_{ss})} + \gamma_3^2\ell^2 = \mathbf{y}_3(r_{ss}, k_{ss}) \tag{34}$$

From (34),

$$c_{ss}^1 \ell^1 p_1^{\lambda_1} \mathbf{p}(r_{ss})^{\lambda_3} = \frac{\mathbf{p}(r_{ss})}{\lambda_3}(\mathbf{y}_3(r_{ss}, k_{ss}) - \gamma_3^1 \ell^1 - \frac{\lambda_3 c_{ss}^2 \ell^2 p_1^{\lambda_1} \mathbf{p}(r_{ss})^{\lambda_3}}{\mathbf{p}(r_{ss})} - \gamma_3^2 \ell^2) \tag{35}$$

In equilibrium, poor household's expenditures equal her wages income and transfers received,

$$E^2(c_{ss}^2, \mathbf{p}(r_{ss})) = \mathbf{w}(r_{ss}) + \Upsilon(r_{ss}, k_{ss}) \tag{36}$$

$$c_{ss}^2 \ell^2 p_1^{\lambda_1} \mathbf{p}(r_{ss})^{\lambda_3} + p_1 \gamma_1^2 \ell^2 + \mathbf{p}(r_{ss}) \gamma_3^2 \ell^2 = \mathbf{w}(r_{ss}) \ell^2 + \Upsilon(r_{ss}, k_{ss}) \ell^2 \tag{37}$$

Hence,

$$\frac{\lambda_3 c_{ss}^2 \ell^2 p_1^{\lambda_1} \mathbf{p}(r_{ss})^{\lambda_3}}{\mathbf{p}(r_{ss})} = \frac{\lambda_3}{\mathbf{p}(r_{ss})}(\mathbf{w}(r_{ss}) \ell^2 + \Upsilon(r_{ss}, k_{ss}) \ell^2 - p_1 \gamma_1^2 \ell^2 - \mathbf{p}(r_{ss}) \gamma_3^2 \ell^2) \tag{38}$$

Finally, we know that

$$E^1(c_{ss}^1, \mathbf{p}(r_{ss})) \ell^1 = c_{ss}^1 \ell^1 p_1^{\lambda_1} \mathbf{p}(r_{ss})^{\lambda_3} + p_1 \gamma_1^1 \ell^1 + \mathbf{p}(r_{ss}) \gamma_3^1 \ell^1 \tag{39}$$

Then, the expenditures of the rich household at the steady state can be represented by the function

$$\begin{aligned} E^1(r_{ss}, k_{ss}) \ell^1 = & \frac{\mathbf{p}(r_{ss})}{\lambda_3}(\mathbf{y}_3(r_{ss}, k_{ss}) - \gamma_3^1 \ell^1 - \gamma_3^2 \ell^2) \\ & -(\mathbf{w}(r_{ss}) \ell^2 + \Upsilon(r_{ss}, k_{ss}) \ell^2 - p_1 \gamma_1^2 \ell^2 - \mathbf{p}(r_{ss}) \gamma_3^2 \ell^2) \\ & + p_1 \gamma_1^1 \ell^1 + \mathbf{p}(r_{ss}) \gamma_3^1 \ell^1 \end{aligned} \tag{40}$$

After plugging (40) in (32), one can solve (32) for the only unknown k_{ss}. By substituting r_{ss} and k_{ss} for r and k, the steady state values of the other endogenous variables can be found.

Finally, given the steady state values and initial conditions, the Time-Elimination Method is adopted to numerically solve for the transition path equilibrium. Time Elimination Method has been first applied by Mulligan and Sala-i Martin (1991) for economies with two production sectors and homogenous households, and is further discussed in Barro and Sala-i Martin (1995). Here, the method is applied to the model economy with three sectors and two households.

4 Numerical Analysis

4.1 Data and calibration

Informal sector activity, as in other developing economies, has remained significant in Turkey over the years. According to a report by the Tax Inspectors Board[16], the factors that promote informal activity in Turkey include low per capita income, low institutionalization rate in the private sector, underdeveloped capital and money markets, an inefficient tax system, and high tax rates, as well as high social security premiums. The following chart depicts the counter-movement of GDP per capita and informal employment, as a percentage of non-agricultural employment, over the last decade in Turkey[17]:

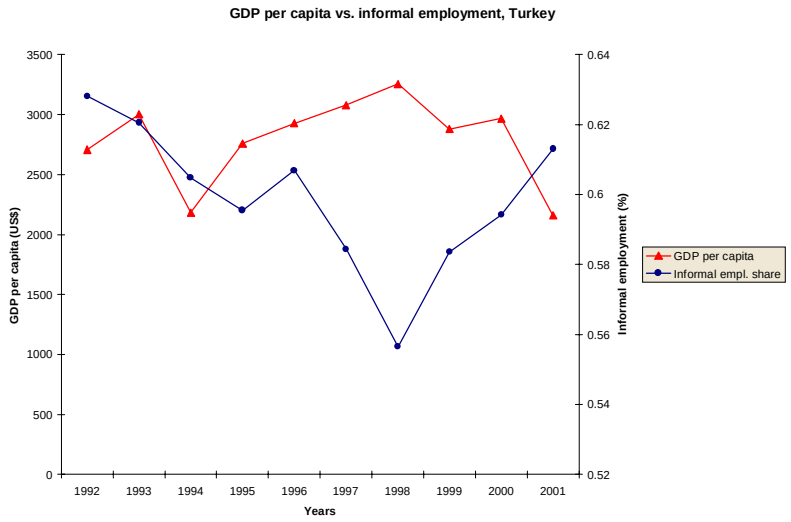

Figure 4.1: GDP per capita vs. informal employment

The model is calibrated to the Turkish economy for the year 1997. A simple SAM (Social Accouting Matrix) with three production sectors, three consumption goods, and two households has been constructed based on 1997 National Accounts, employment and consumption statistics (SIS, 1998). To estimate the size of informal sector output, the procedure intro-

[16] Hurriyet News (11.03.2003), Internet Source: www.hurriyetim.com.tr/haber/0,,nvid~241170,00.asp

[17] Internet sources: State Institute of Statistics, www.die.gov.tr/ieyd/milhes/page15.html and Social Security Institution, www.ssk.gov.tr/wps/sskroot/istatistikk/istatistik2001

duced in Kelley (1994) was followed. However unlike Kelley, instead of unpaid employment as a proxy for informal employment, in this study, uninsured non-agricultural employment is taken as a proxy[18]. It is found that in 1997, about 45.4% of the paid workforce in Turkey consists of uninsured, informal workforce, and this informal workforce produces about 31% of the total output in the economy. Insured formal workforce, which is 31% of total paid workforce, produces about 54% of the total GDP. The remaining 24.5% is the agricultural workforce[19], and the agricultural output is 15.8% of the total GDP. The following table summarizes production share parameters in each sector[20]:

Table 4.1: Factor Elasticities in each sector

	Agriculture	Formal Sector	Informal Sector
Labor	0.47	0.21	0.45
Capital	0.38	0.79	0.55
Land	0.15	-	-

These factor elasticities are such that relatively, agriculture has the highest labor intensity, and formal sector has the highest capital intensity. Informal sector production, on the other hand, is relatively more labor intensive than formal sector production, and relatively more capital intensive than agricultural production. In the formal sector, the labor cost to the firm includes the contributions of the employer towards social security premiums and unemployment insurance of the employee. In Turkey, as per the Article 73 of the Social Insurance Act, this contribution ranges from 21.5% to 27% of the employee's earnings[21]. In this study, the average 24.25% is chosen.

The table below summarizes the parameters that characterize consumer behavior:

[18] In fact, in developing countries in the 1990's (selected years), the correlation between the share of urban informal sector employment (in total urban employment) and the share of uninsured workforce is quite high (The World Bank, World Development Indicators, 2002).

[19] In agriculture, only 0.82% of the workforce is insured, hence insured agricultural workers are ignored in calculations.

[20] Share of payments to land in agriculture, 0.15, is taken exogenously.

[21] Social Security Institution Internet source: www.ssk.gov.tr/wps/sskroot/bilgibankasi/mevzuat /506eng/chapter8.jsp

Table 4.2: Consumption Parameter Values

Parameter	*Symbol*	*Value*
Fraction of Supernumerary Expenditures spent on Good-1	λ_1	0.15
Fraction of Supernumerary Expenditures spent on Good-2	λ_2	0.7
Fraction of Supernumerary Expenditures spent on Good-3	λ_3	0.15
Discount factor	ρ	0.042
Elasticity of intertemporal substitution	$1/\theta$	1

Here, supernumerary expenditures of the household Type-i refer to the expenditures made after setting aside budget for the purchases of goods j in accordance with the parameters γ_j^i at their respective prices. Essentially, the fraction parameters above reflect the consumption choices of the households when the economy is in the long-run, in other words, when the expenditures on subsistence consumption are insignificant enough in total expenditures[22]. Accordingly, the γ_j^i values are such that in the initial period[23], the rich households are closer to their long-run behavior whereas the poor take a longer time to approach to the long run.

[22] When $\gamma_j^i = 0$, the preferences are of the Cobb-Douglas form.

[23] These values are obtained from calibration of the base model for Turkey, for the year 1997 ($\ell^2 = 0.8$). For Household-1 (Asset-rich), at $t = 0$:

$$\frac{\lambda_1(E_{1,0} - p_1\gamma_1^1\ell^1 - p_{3,0}\gamma_3^1\ell^1) + \gamma_1^1\ell^1}{E_{1,0}} = \frac{p_1 c_{1,0}^1}{E_{1,0}} = 0.3195 \tag{41}$$

$$\frac{\lambda_2(E_{1,0} - p_1\gamma_1^1\ell^1 - p_{3,0}\gamma_3^1\ell^1)}{E_{1,0}} = \frac{p_2 c_{2,0}^1}{E_{1,0}} = 0.2979 \tag{42}$$

$$\frac{\lambda_3(E_{1,0} - p_1\gamma_1^1\ell^1 - p_{3,0}\gamma_3^1\ell^1) + \gamma_3^1\ell^1}{E_{1,0}} = \frac{p_{3,0} c_{3,0}^1}{E_{1,0}} = 0.3825 \tag{43}$$

and for Household-2 (asset-poor), at $t = 0$:

$$\frac{\lambda_1(E_{2,0} - p_1\gamma_1^2\ell^2 - p_{3,0}\gamma_3^2\ell^2) + \gamma_1^2\ell^2}{E_{2,0}} = \frac{p_1 c_{1,0}^2}{E_{2,0}} = 0.45 \tag{44}$$

$$\frac{\lambda_2(E_{2,0} - p_1\gamma_1^2\ell^2 - p_{3,0}\gamma_3^2\ell^2)}{E_{2,0}} = \frac{p_2 c_{2,0}^2}{E_{2,0}} = 0.05 \tag{45}$$

$$\frac{\lambda_3(E_{2,0} - p_1\gamma_1^2\ell^2 - p_{3,0}\gamma_3^2\ell^2) + \gamma_3^2\ell^2}{E_{2,0}} = \frac{p_{3,0} c_{3,0}^2}{E_{2,0}} = 0.50 \tag{46}$$

The values on the RHS are the initial share of expenditure on the consumption of each good by each household. Since the values of $E_{i,0}$ are obtained from the data, γ_j^i can be easily calculated.

4.2 Simulation Results

In Table 4.3, the simulation results from the baseline economy with a large pure wage earner population ($\ell^2 = 0.8$) are presented. According to the model, development implies that the share of the agricultural sector in GDP falls from 15.8% to an insignificant amount, that of the informal manufacturing falls from 30.8% to 16.4%, and that of the formal manufacturing rises from 53.5% to 83.6% (see Figure 4.2). As capital accumulates, agricultural sector loses labor to the formal sector which uses labor most efficiently among all sectors. Furthermore, agriculture also loses capital to both formal and informal sectors, thus agricultural output declines substantially. Even though it has a lower degree of capital intensity than the formal sector, informal sector is capable of competing for capital since the price of its product relative to the price of the formal product rises during the transition process.

As capital accumulates over time, the increase in the productivity of labor causes the wages to increase. Hence, capital accumulation benefits the poor as well as the rich households. As incomes of all types of households increase, they continue increasing their consumption in all goods, however, they decrease the share of expenditures spent on agricultural goods and on informally produced goods, and increase the share of formal sector goods due to their non-homothetic preferences (see Figures 4.3 and 4.4). Thus, the drop in the share of agricultural output and in the informal sector output, and the rise in the share of formal sector output in GDP are reinforced by the non-homotheticity of preferences.

As a source of income, as agriculture loses its importance, land rents earned by the rich households also diminish, and become insignificant in overall income. The share of labor income diminishes as labor moves into the formal sector, which is the least labor intensive sector, and the importance of capital in income rises over time (Figure 4.5). This has the implication that even though the income level of the pure wage earners increases over time, they contribute progressively less to the GDP, and the gap in the income level of the rich assets holders and the pure wage earners widens, as the income of rich asset holders increases faster than the income of the pure wage-earners.

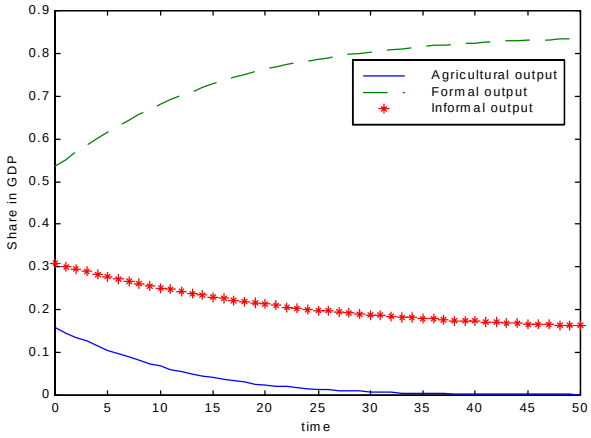

Figure 4.2: Sectoral Shares in GDP

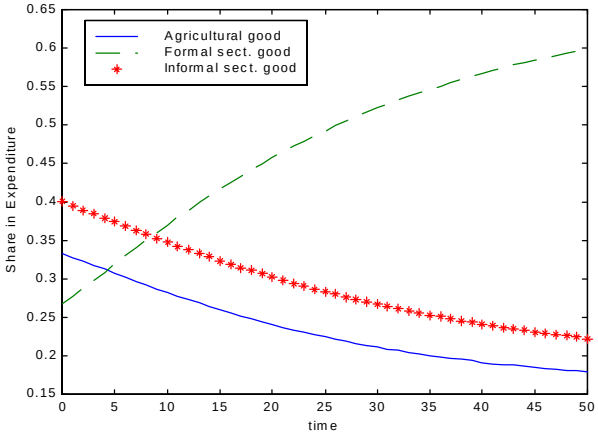

Figure 4.3: Cons. Shares in Expend., Asset-rich HH

Table 4.3: Baseline Model, $\ell^2 = 0.8$; $\tau_f = 24.25\%$

	$t = 0$	*Steady State*
Shares in GDP (%)		
Agricultural output	15.8	-
Formal ouput	53.5	83.6
Informal output	30.8	16.4
Consumption shares in Expenditures (%)		
Household Type-1 (Rich)		
Agricultural good	33	15.1
Formal sector good	26.7	69
Informal sector good	40	15.9
Household Type-2 (Poor)		
Agricultural good	43	15.4
Formal sector good	9.3	66.7
Informal sector good	47.7	18
Sectoral Allocation of Inputs (%)		
Labor		
Agriculture	24.4	-
Formal Sector	30	65.9
Informal Sector	45.6	34
Capital		
Agriculture	9.1	-
Formal Sector	64.8	87.8
Informal Sector	26	12
Share of Informal labor in non-agri. labor (%)	60.3	34

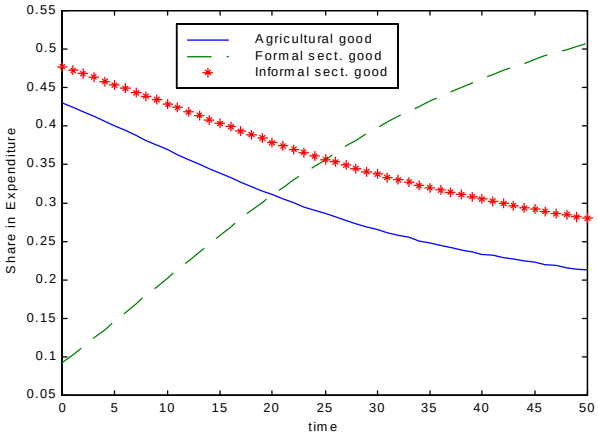

Figure 4.4: Cons. Shares in Exp., Asset-poor HH

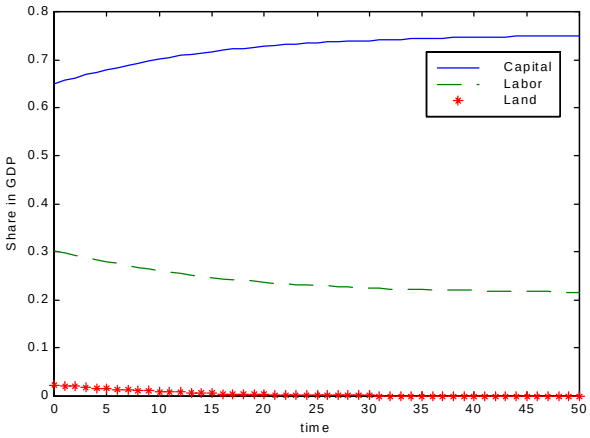

Figure 4.5: Factor Shares in GDP

Figures 4.6 and 4.7 depict the use of labor (as a percentage of total labor) and the use of capital (as a percentage of aggregate capital) in each sector. Not surprisingly, these shares of labor and capital evolve in the same pattern as their respective sectors' output evolves over time, that is, the uses of labor and capital in agricultural and informal sectors diminish as a share in total labor and capital, whereas the uses of labor and capital in formal sector increase. In particular, as the economy transitions into the long-run equilibrium with the

process of growth, the share of informal sector employment in non-agricultural employment (sum of informal and formal sectors' employment) diminishes. Recall that one could detect a clear negative relationship between per capita income and informal employment in the Turkish economy in the mid-1990's to early 2000's, as depicted in Figure 4.1.

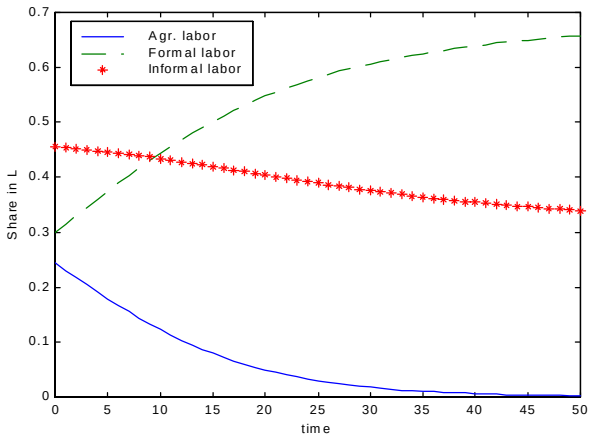

Figure 4.6: Sectoral Allocation of Labor

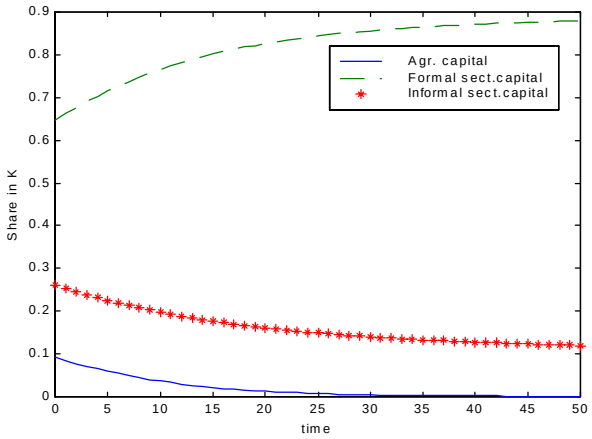

Figure 4.7: Sectoral Allocation of Capital

In Table 4.5, the steady state effects of lowering the inequality parameter in the same economy are presented:

Table 4.5: Steady State Effects of Decreasing the Inequality parameter, ℓ^2

Shares in GDP (%)	
Agriculture	(insig.)
Formal Sector Output	(+)
Informal Sector Output	(-)
Levels, per capita	
GDP	(+)
Aggregate Capital stock	(+)
Sectoral Allocation of Inputs (%)	
Labor	
Agriculture	(insig.)
Formal Sector	(+)
Informal Sector	(-)
Capital	
Agriculture	none
Formal Sector	(+)
Informal Sector	(-)
Share of informal labor in non-agri. labor (%)	(-)

The same economy with a smaller fraction of pure wage-earners, thus a more even asset and income distribution, starts with a smaller informal sector than the economy with a large pure wage-earner population, and reaches the long run with a smaller informal sector, and a larger formal sector. Since now there are more households with access to capital and land markets and with higher earnings beyond wages, collectively, the demand for the informal sector good will be lowered. Since the informal good is a home-good, in equilibrium its market must clear, then, the supply of the informal good will diminish, as well. The factors of production released from the informal sector will be absorbed by the formal sector, increasing the ouput of this sector, and meeting the increased demand. However one must realize that since the population of the asset-rich households is now higher than before, capital and land per household is lower than the case where only a small fraction of the population had ownership of capital and land (these assets are evenly distributed among the rich), thus

income per asset-rich household is lower. Therefore, the drop in the demand and supply of informal goods and the increase in the demand and supply of formal goods are not as pronounced as one would expect.

Finally, Table 4.6 reports the long run effects of lowering the rate of formal employer's contributions towards employee's social security premiums. When this rate is lowered from 24.25% in the baseline model, we see significant increases in capital stock and the GDP, both in transition and in the long run. For example, when the rate is lowered to 20%, long-run value of the capital stock increases by 22.6%, and that of the GDP increases by 21.6% from the base. When the labor costs are lower, as one would expect, the output of the formal sector increases by 21.7% from the long-run base value. On the other hand, the output of the informal sector also increases, by 10.5%. We can attribute this increase in informal sector output only to the increased availability of capital in the economy, and to increased use of capital in the informal sector, since employment in the informal sector drops. Moreover, the share of informal output in GDP, as well as the share of informal employment in total non-agricultural employment decreases with lower labor taxes levied on formal sector firms. These results suggest that lower social security premium contribution rates promote employment in the formal sector, which in turn, may have the effect to increase the taxes collected from the formal sector, and hence increase transfer payments to the households.

Table 4.6: Steady State Effects of Decreasing τ_f

Shares in GDP (%)	
Agriculture	(insig.)
Formal Sector Output	(+)
Informal Sector Output	(-)
Levels, per capita	
GDP	(+)
Aggregate Capital Stock	(+)
Sectoral Allocation of Inputs (%)	
Labor	
Agriculture	(insig.)
Formal Sector	(+)
Informal Sector	(-)
Capital	
Agriculture	(insig.)
Formal Sector	(+)
Informal Sector	(-)
Share of informal labor in non-agri. labor (%)	(-)

5 Summary and Concluding Remarks

In developing countries, informal sector is a large and a significant part of the economic life. The importance of the informal sector in terms of quality of institutions, employment, and also the effectiveness of economic policies has recently attracted many economists to conduct both empirical and theoretical research on the subject. However, what have been lacking in the literature are the study of the informal sector with the inclusion of the household demand perspective, and the study of the evolution of the informal sector vis-à-vis other sectors of the economy, in the process of economic growth, and as capital accumulates. In this paper, we attempted to address these issues, and also tried to answer other relevant questions: do "poor" institutions affect the size of the informal sector in a country? In particular, are poor institutions that lead to asset and income inequality significant in determining the relative size of the informal sector?

To tackle these issues, a three-sector growth model is developed with production in agricultural, formal and informal sectors, and with households differentiated by their endowments of factors of production. Especially, the group of rich households own all productive assets in addition to some of the labor, whereas the group of poor households only own some of the labor. Within this framework, it is assumed that the poor households do not contribute to the capital formation in the economy, i.e. they have a saving propensity of zero. Another assumption about the households concerns their preferences: households prefer to devote more of their expenditures on formal goods, and less on agricultural and informal goods as their incomes increase. This structure of the preferences perfectly summarizes the behavior of the various groups of consumers in developing countries: for example we are more likely to encounter low-income and poorer households in street bazaars and outdoor markets, and higher-income households in modern supermarkets and shopping-malls.

Within the framework of the model, we are able to trace the evolution of the three production sectors over time, as an economy accumulates capital and grows. In addition to tracing the evolution in each of the sectors, the model allowed us to explain the evolution by studying the effects of factor movements between the sectors and the demand patterns of the households. The model also provides an affirmative answer to the questions posed in the first paragraph: it is that the size of the informal sector would be slightly larger, both in transition and in the long run, if a large fraction of the population lacks access to productive assets (i.e. poor). As an additional result, it is also determined that the rate of growth of output and the rate of capital accumulation would be slightly slower than otherwise, under these circumstances. Finally, it is shown that lower labor taxes in the formal sector promote employment and production in this sector, reducing employment in the informal sector as a result. These outcomes agree with the empirical findings by numerous other researchers: "poor" institutions, in our case specifically those leading to high asset and income inequality, are negatively related to economic performance.

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