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ABSTRACT

Many developing countries pursue policies that treat large and small firms differently. For example, large firms may be subject to a value added tax while small firms are explicitly exempted. Moreover, governments often find it impractical to collect taxes from the smallest enterprises; this may increase the tax burden for larger firms, whose compliance can be enforced. Such policies clearly affect the size distribution of firms. But how great is the impact on macro variables? How large are the resulting inefficiencies? And what are the dynamic effects on capital accumulation and economic growth? This paper uses a dynamic general equilibrium variant of the Lucas (1978) span-of-control model to address such questions. The model is matched to data from the Ghanaian manufacturing sector. As a policy experiment, alternative tax and regulatory regimes are compared. The model shows that a policy disproportionately penalizing large firms can reduce output by nearly one-half, compared with an alternative policy regime in which all firms face the same taxes and regulatory costs.

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Introduction

Many developing countries pursue policies that treat large and small firms differently. Tax rates, labor regulations, and social security contributions — to name a few examples — may differ explicitly with firm size. In addition, selective policy implementation and enforcement may create implicit or *de facto* differences in the environment facing large and small firms. For example, governments often find it impractical to collect taxes from the smallest enterprises; instead, they are likely to set higher tax rates and to enforce compliance only among larger firms.[1]

Such policies clearly affect the size distribution of firms. But how great is the impact on firm size? How large are the resulting inefficiencies? And what are the dynamic effects on capital accumulation and economic growth?

A number of authors have argued that discrimination against large firms forms a major obstacle to economic growth. De Soto (1989) argues that policy distortions have frustrated would-be entrepreneurs in Peru, creating a huge mass of small enterprises and constraining them to the "informal" sector. By liberalizing its policies and eliminating unnecessary regulations, de Soto contends, Peru can unleash the energies of its informal entrepreneurs, allowing their businesses to grow and stimulating the whole economy.

To date, however, little analysis has attempted to model the impacts of policies discriminating against large firms. Numerous studies have sought to measure the size of the informal sector in different countries, but these studies have not attempted to quantify efficiency losses or to assess dynamic implications.

To provide more satisfying answers, it is necessary to use a richer theoretical framework. This paper draws on a dynamic general equilibrium model to assess the importance of policies that impose different tax rates on firms of different sizes. The model is based on the span-of-control framework developed by Lucas (1978) but adds a self-employment technology and explicit

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[1]Many rich countries also pursue policies that have different effects on large and small firms; however, there is seldom the pronounced dualism between large and small firms that is characteristic of poor countries.

dynamics. As a quantitative experiment, the parameters of the model are chosen based on data from Ghana, and the model's predictions are then compared with Ghana's firm size distribution and other macro variables. The current policy environment is then contrasted with an alternative scenario in which taxes and regulatory costs are the same for all business establishments. The model shows that the change in policies could lead to a large efficiency gain — nearly doubling current levels of output — as well as encouraging more rapid capital accumulation and growth. Ghana offers an interesting test of the model because its economy is characterized by extremely high levels of self-employment and small enterprise; over 85 percent of the manufacturing labor force is employed in establishments with fewer than 10 workers (Republic of Ghana 1989, 1991, 1993).

The first section of the paper summarizes de Soto's argument and briefly reviews relevant literature. Section 2 reports selected data from Ghana. Section 3 presents a model in which differential tax rates on small and large firms lead to distortions in the size distribution of firms. Section 4 describes the selection of parameters for a quantitative assessment of the model. Section 5 compares the output of the model with data from Ghana and presents the results of policy experiments. Section 6 briefly discusses implications for policy, along with directions for further research.

1. Small Enterprises and Government Policies: Alternative Views

In most poor countries, small businesses and own-account enterprises dominate economic activity.[2] Gollin (1995) builds on the work of Little, Mazumdar, and Page (1987) to show that small firms account for significantly higher percentages of employment and output in poor countries than in rich countries.

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[2]Own-account work is a term commonly used in national accounting to refer to various forms of self-employment.

In part, the relative importance of small enterprises in developing countries reflects the sectoral composition of output — chiefly the large share of family farming in total GDP. Even within the manufacturing sector, however, survey data suggest that small establishments represent a more significant feature of poor economies than of rich ones.

Why are small enterprises so prevalent in poor countries? One school of thought holds that structural factors account for the pattern. Kuznets (1966), for example, maintained that the transition from own-account enterprises to larger firms was a fundamental feature of economic development. Similar views can be found in the writings of many early development economists, including Rostow (1960), Lewis (1965), and Hirschman (1958), not to mention Marx and the classical economists.

More recently, however, researchers have suggested that in poor countries, the pervasiveness of small enterprises may owe much to a desire for entrepreneurs to avoid costly taxes and regulations. An informal sector, in this view, arises as a response to state actions that inhibit the growth and development of small enterprises.

1.1 The De Soto Hypothesis

De Soto (1989) is typical of authors who have argued that government policies and bureaucratic regulations effectively force enterprises into the informal economy. In this view, taxes, labor laws, registration fees, and similar state controls affect businesses that are visible to the state; i.e., those that enter the formal sector. Where the costs of these state controls are high, it is argued, many businesses will choose to remain small, informal, and underground. In support of this hypothesis, de Soto collected data on the costs facing Peruvian entrepreneurs who wished to start or expand their businesses in the formal sector. In many cases, the costs were substantial. Subsequent work by other researchers (e.g., Chickering and Salahdine 1991, for five countries in Asia and the Middle East) documents similar disincentives in numerous other countries.

1.2 The Labor Surplus Hypothesis

Other researchers maintain that small enterprises in poor countries function in a dualistic role. Although some small businesses are dynamic and growth-oriented, they suggest, others may serve only to absorb surplus labor. Following the tradition of Lewis (1965), Todaro (1969) and Harris and Todaro (1970), these authors subscribe to the view that under some circumstances, small enterprises "are acting as a sponge, soaking up excess workers in marginal activities" (Liedholm et al., 1994).[3] Several such studies have shown that one-person firms gain in efficiency if they are able to expand (Liedholm and Mead 1987; Parker and Torres 1994; Parker et al. 1995). The authors usually see this as evidence of limited scale economies.

From this perspective, there may be costs associated with policies that cause enterprises to remain small. In fact, some researchers have suggested that structural adjustment programs undertaken in Africa in the 1980s and 1990s may have had mixed effects on the small enterprise sector (e.g., Parker et al. 1995, for five Sub-Saharan countries; Sowa et al. 1992, for Ghana). While economic and financial liberalization have improved the overall business climate, it is argued, these policies have also driven workers out of the state sector and other previously protected industries, forcing them to accept lower earnings in self-employment.

1.3 Tax Policies for Developing Countries

In recent years, a number of scholars have examined the effects on poor countries of particular forms of taxation: e.g., taxes on financial assets and institutions (Chamley 1991); taxes on agricultural land (Skinner 1991); taxes on income earned through foreign direct investment (Shah and Slemrod 1991); value added taxation (Gillis et al. 1990). Most of these studies rely on static models:

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[3]This particular quote was used to refer to small rural enterprises, rather than to the entire population. Other studies that typify this literature are Haggblade and Liedholm (1992), Liedholm and Kilby (1989), Daniels (1994), and Mead (1994).

either partial equilibrium approaches or multi-sector applied general equilibrium models. As a result, important dynamic issues have largely been sidestepped.

In general, this literature supports the idea that tax distortions pose a consequential impediment to efficiency and economic growth. Curiously, however, little research has addressed the specific issue of tax policies that distort the firm size distribution. Recent surveys of the theory on tax policies for developing countries (Newbery and Stern 1987; Bird and Oldman 1990; Gillis 1989; and Khalilzadeh-Shirazi and Shah 1991a, 1991b) are silent on the question. For example, Newbery (1987) notes that one of the "special characteristics of developing countries" is the pervasiveness and importance of "small-scale enterprises." But he does not ask whether this size distribution results from distortionary tax policies. Similarly, several authors note that small firms are typically taxed at different rates from large firms, but they offer no discussion of the effects of such distortions.[4]

A notable exception is Rauch (1991), who specifically asks how a minimum wage policy might influence the size distribution of firms in a developing country. In Rauch's model, firms with more than a given number of employees were required to pay a minimum wage above the market-clearing wage. Rauch interpreted the larger firms as "formal" and the smaller as "informal." A number of comparative static results were obtained, including implications for differences in the sizes differences between informal sector firms and formal sector firms. Rauch also obtained comparative static results showing that a higher minimum wage would raise the employment threshold at which firms would opt to switch from the informal sector to the formal sector.

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[4]Such discussion as does occur typically is concerned with the use and implementation of presumptive or "forfait" rates of taxation for small enterprises. Under this system, small enterprises are not required to keep detailed tax records or receipts, but are simply taxed at a presumptive rate — based for example on the type of enterprise, the square footage occupied, etc. Some authors have asked whether such arrangements are administratively sensible and whether they result in adequate collection. However, the question of whether this presents a disincentive for expansion is ignored.

1.4 Contributions and Limitations

The existing literature has thus pointed out an important set of relationships between government policies and the size distribution of firms. But the literature offers little clear analysis of the issues; instead, it underscores the need for an analysis based on a coherent macro theory of establishment size that addresses dynamic issues directly. Such an approach can allow us to measure gains or losses from policies that alter the size distribution of firms.

In recent years, new work in the area of industrial organization — combined with improved ability to compute solutions to these models — has made it possible to design such a model and to use it for empirical purposes. Section 3 presents such a model. First, however, it is instructive to consider some background data from Ghana.

2. Small Enterprises in Ghana: Data and Perspectives

Ghana offers an interesting test for any theory of self-employment and small business. Household survey and census data indicate that around 80 percent of Ghanaians are either self-employed or work without pay in family business (Republic of Ghana 1987, 1989; Doss 1995). This fraction is extremely high relative to the comparable figures for other countries. In the United States, for example, only 8.2 percent of the workers are self-employed or unpaid family laborers (International Labor Organization 1993). Ghana's totals are typical, however, of the figures reported in some other West African countries. Liedholm and Mead (1986) cite studies showing that 95 percent or more of the small-scale enterprises in Nigeria and Sierra Leone employ fewer than five individuals. Self-employment in Burkina Faso accounted for 52 percent of the firms identified in one survey, and the figure for Sierra Leone was 42 percent (Chuta and Liedholm, 1985). (See Appendix 1 for cross-country comparisons.)

In part, the importance of small enterprises in these countries reflects the sectoral composition of output: the agricultural sector, which contributes 49 percent of recorded GDP in Ghana, is composed almost entirely of small family-run enterprises. Even within other sectors, however, small enterprises employ large shares of workers and generate substantial fractions of output. Table 1 shows the forms of employment by sector for Ghana. Within Ghana's manufacturing sector, Table 1 shows that 73 percent of workers are self employed; Industrial Census data indicate that under 15 percent of the workforce is employed by establishments with 10 or more workers. An observer in Ghana will note that self-employed workers produce a wide array of manufactured goods: clothing and footwear; clay pots and metal pans; furniture and housewares; farm tools and processed foods, to name a few.

2.1 Small enterprises and value added

Do these enormous numbers of small enterprises make any substantial contribution to value added? Appiah-Koranteng (1994) reports estimates from 1963-74 showing that the value added in small-scale manufacturing ranged from 22-37 percent of sectoral value added; the source of these estimates is not identified. The same report also cites data from a 1989 survey indicating that small enterprises accounted for 28 percent of industrial output. Since the industrial sector is defined to include mining and provision of electricity and water, as well as manufacturing, and since mining and utilities probably have relatively few small firms, this suggests that small enterprises might account for a proportion of manufacturing output well over 30 percent.

Table 1: Number of workers by sector and type of employment, Ghana, 1984.

Sector	Total Employed	Public Sector Employees	Private Sector Employees	Self-employed and employers	Unpaid family workers	Others
Agriculture, Hunting, Forestry, and Fishing	3,310,967	80,773	95,018	2,486,240	622,782	26,154
Mining and Quarrying	26,828	23,691	2,060	1,189	54	14
Manufacturing	588,418	27,587	65,516	451,299	18,684	25,332
Electricity, Gas & Water	15,437	14,623	595	165	18	36
Construction	64,686	25,590	16,174	21,175	407	1,340
Trade, Restaurants & Hotels	792,147	23,608	36,641	698,889	32,580	429
Transport, Storage & Communication	122,806	36,040	39,583	37,215	1,878	8,090
Finance, Insurance, Real Estate & Bus. Services	27,475	21,059	4,824	1,469	13	110
Community, Social & Personal Services	473,716	304,521	59,179	80,034	3,006	26,976
ALL SECTORS	5,422,480	557,312	319,590	3,777,675	679,422	88,481

Source: Republic of Ghana, Statistical Service, 1984 Population Census of Ghana: Demographic and Economic Characteristics, Total Country.

This conclusion is reinforced by data from household surveys, which show that small non-farm enterprises provide a large part of household income. Non-farm self-employment income was 24.3 percent of total household income in the first round of the Ghana Living Standards Survey and 31.0 percent in the second round (Republic of Ghana 1989, 1993).[5] If this holds true on the income side, it must also hold true on the production side. Although it is impossible to be precise, small enterprises and self-employment probably account for 25-30 percent of value added for the economy as a whole, excluding agriculture. Since small-scale enterprises and self-employment seem especially prevalent in manufacturing, it is reasonable to imagine that well over 30 percent of manufacturing output may originate in firms with fewer than 10 employees.

2.2 Policies affecting small enterprises

A wide range of policies affects the size distribution of firms in Ghana. No complete inventory of such policies has been undertaken. In addition to taxation, Appiah-Koranteng (1994) points out a partial listing of policies that implicitly affect firm size: provision of infrastructure; monopolistic or monopsonistic marketing boards; export and import controls; centralized registration and licensing of enterprises; regulatory procedures; and controls on financial institutions. Parker et al. (1995) cite "minimum wage laws and burdensome hiring and firing procedures" as important constraints on large formal sector firms.

Given sufficient information about such policies, it would be possible to construct and compute an "effective rate of taxation" that would measure the combined effects of these policies on firms of different sizes.[6] No such measure exists, however, and it is not possible to compute it from available data.

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[5]Total household income included the imputed value of owner-occupied housing as well as the values of in-kind wage income, food produced for home consumption, and home consumption of output produced by family businesses.

[6]Such a measure would also need to include extra-legal costs, such as bribes and kickbacks demanded by regulators.

Experience from other countries indicates that taxation may be only a small part of the burden facing large formal sector firms.

The policy environment has undergone numerous and pronounced shifts since Ghana achieved independence in 1957. Leith (1974) traces changes in macroeconomic policies and regimes through the early 1970s; Stryker (1990) and Sowa et al. (1992) offer detailed analysis of subsequent policy changes. These policies have produced marked effects on economic activity and growth, and Ghana's economy has consequently experienced sharp swings.

2.3 Macroeconomic environment

Ghana today ranks among the world's poorest countries, with 1992 GDP per capita of $956, according to the Penn World Tables (v. 5.5).[7] Agriculture accounted for 49 percent of recorded GDP, with industry 17 percent and services 33 percent (Republic of Ghana 1994). Main exports include gold, cocoa, coffee, and timber.

Between 1983 and 1989, the Ghanaian economy grew in real terms by 5.27 percent annually — although with population growth of 3.48 percent over the same period, the per capita gains were a more modest 1.78 percent annually.[8] Even with its relatively strong growth from 1983-89, Ghana remained poorer than it was in 1955. As Figure 1 illustrates, Ghana's GDP per capita in 1955 was $840 and rose to an average of $987 in the years 1970-74 before falling to current levels.[9]

In spite of economic fluctuations and policy shifts, the small-scale manufacturing sector appears to have undergone modest changes. Steel (1977)

[7]This figure is real per capita GDP in terms of 1985 U.S. dollars, with output valued at international prices (a form of purchasing power parity adjustment). Thus, it differs from commonly cited figures that use official exchange rates. The figure for 1989 is the latest available for Ghana in the Penn World Tables v. 5.6.

[8]It is important to note, however, that 1983 was an extremely poor year for Ghana.

[9]These figures are drawn from the Penn World Tables (v. 5.5). By comparison, South Korea in 1954 had a GDP per capita of $820 — essentially the same as Ghana at that date. Since then, however, South Korea's GDP per capita has grown to $6,209, while Ghana's has fallen slightly.

conducted the first detailed study of the small-scale manufacturing sector in Ghana; his findings remain remarkably current. Steel reported data from 1970 indicating that the "modern" manufacturing sector employed 13.9 percent of manufacturing workers, compared with 14.8 percent in data from 1987. Data from 1963 indicated that small-scale manufacturing establishments generated 34.2 percent of sectoral value added, compared with estimates of 28-30 percent at present.

Figure 1: Ghana's real per capita GDP ($US '000), 1955-89. Source: Penn World Tables, v. 5.5.

2.4 Previous studies in Ghana

This study draws on a number of surveys of small enterprises and related studies from Ghana that have been undertaken in recent years (e.g., Appiah-Koranteng 1994; Aryeetey et al. 1994; Dordunoo 1994; Sowa et al. 1992; Steel and Webster 1991; Stryker et al. 1990; Teal 1994 and 1995; Thomi and Yankson

1985). These provide a rich source of primary data. In addition, several rounds of the Ghana Living Standards Survey — a detailed household survey — include a great deal of indirect information about employment and income, as does the 1984 Census. Finally, the Industrial Census of 1987 reports complete data for a relative handful of large enterprises.[10]

Some of these studies have examined institutions and policies relating to small enterprises. Recent work by Aryeetey (1992) and Aryeetey and Steel (1992) argues that credit market imperfections — specifically, a dualism between formal and informal financial institutions — have impeded the growth and development of small enterprises in Ghana. Other authors (e.g., Sowa et al. 1992; Parker et al. 1995; Steel and Webster 1991) examine the effects on small enterprises of Ghana's Economic Recovery Programme, initiated in 1983, which liberalized trade and exchange rates, removed price controls, liberalized the financial sector, and reduced the size of government. Finally, a few papers (e.g., Appiah-Koranteng 1994; Thomi and Yankson 1985) propose measures to promote small-scale manufacturing. These papers are valuable sources of empirical information on particular production activities. None of these studies, however, asks to what extent the current patterns of firm size in Ghana can be explained by tax and regulatory policies. The following section presents a framework for analyzing such questions.

3. A Model of Firm Size under Distortionary Taxes

In recent years, the literature on industrial organization has made considerable advances in modeling heterogeneity of firm size. Previously, classical and neoclassical economists tended to use macroeconomic models characterized by constant returns to scale — in which case optimal firm size was not well defined.

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[10]A companion survey of smaller enterprises was not publicly available as of early 1995; it is unclear how extensive this survey was.

3.1 Previous models of firm size

Viner (1931) developed an early model in which the existence of fixed inputs forced cost-minimizing firms to seek an optimal size. Viner attempted to explain differences in firm size by assuming that capital was variable in the long run, and that firms sought (presumably by trial and error) to attain a long-run cost-minimizing position by balancing economies and diseconomies of scale. Viner's model, however, predicted that within a given industry, all firms should tend towards the same optimal size.

Another early contributor to the literature on firm size and growth was Gibrat (1931), who developed the postulate (subsequently known as Gibrat's Law) that firm size and growth rates are independent.

Lucas (1978) developed the seminal model of an economy with a size distribution of firms. This model is discussed in greater detail below. In Lucas's model, heterogeneity in managerial ability among people in the economy leads some people to manage businesses while others work for wages. Gibrat's Law is assumed to hold in order to guarantee existence and uniqueness of the equilibrium.

Lucas's model gave rise to a number of subsequent papers employing related frameworks. As a general rule, all these models depend on heterogeneity of some fixed factor of production, which is inelastically supplied. Jovanovic (1982) models firm growth using a learning framework in which firms attain an optimal size over time. This model seeks to explain patterns of firm growth that are associated with firm age, but does not necessarily correlate firm growth with firm size. Hornstein and Prescott (1990) extend the Lucas model to a general equilibrium framework, and Jovanovic (1994) generalizes the model to an environment in which people are heterogeneous in labor quality as well as in managerial ability.[11]

Evans and Jovanovic (1989) analyze a model in which (heterogeneously distributed) liquidity constraints determine the growth patterns of individual firms

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[11]The Hornstein and Prescott result also includes a number of convenient and widely-used results that demonstrate the existence and optimality of equilibrium in Lucas-type models, despite apparent non-convexities in household consumption possibility sets and production possibility sets.

and generate a distribution over firm size. Hopenhayn (1992) uses exogenous productivity shocks, which affect firm size, in a model of firm entry and exit decisions that seeks to simulate the processes of job creation and destruction. Lloyd-Ellis and Bernhardt (1994) treat inherited wealth as a source of heterogeneity in a study of inequality and entrepreneurship.

In all the models described above, the firm is taken to consist of an entrepreneur and a technology. This is clearly an abstraction from firms as they are conceived and characterized in literature on business and management. Although the Lucas framework can be modified to incorporate certain hierarchical management structures (see, for example, Proctor 1990), it remains a simplification. In particular, these models offer no motivation for the location of production inside firms. This literature is well developed and has been summarized elsewhere (see, for example, Hart and Holmström 1987, or Holmström and Tirole 1985).

3.2 A model of firm size under distortionary taxes

This paper analyzes Ghana's tax policy using a dynamic general equilibrium model in which the distribution of firm size can evolve over time and is sensitive to policy changes. The model is based on Lucas (1978), but it extends the Lucas framework to an infinite time horizon and explicitly includes consumers, self-employed people, and tax policies.

There is a single sector of the economy, producing one composite good which can be consumed or used as capital. People inhabiting this economy differ only in their entrepreneurial ability. In each period, people can choose among three alternative forms of employment: wage work, self-employment, and full-time management. Workers receive the market wage, w, while full-time entrepreneurs receive the rents from operating a firm. The self-employed divide their time between direct production activities and entrepreneurial activities; they receive some rents as well as a return to time spent in production. Individuals make their employment decision in such a way as to maximize earnings (since they are indifferent, in terms of utility, between the three uses of their time.

In equilibrium, people with high levels of entrepreneurial ability have a comparative advantage in full-time management of firms; people with low levels of entrepreneurial ability have a comparative advantage in wage work, and people with intermediate levels of entrepreneurial ability have a comparative advantage in self-employment.

This model has a number of attractive features. In addition to imitating some of the observed patterns in the size distribution of firms, it lends itself well to empirical work. It is straightforward to collect a variety of macroeconomic data on the model economy, which can be compared against data from actual economies. The following paragraphs describe the model in more detail.

3.2.1 Environment

Formally, the environment is characterized by the following features. There is a measure one of infinitely-lived people, who are indexed on the interval [0,1] by entrepreneurial ability, x. There is a distribution $\Delta(x)$ over skill types.

3.2.1.1 Preferences and endowments

People in the model economy have identical, preferences defined over their lifetime consumption streams $\{c_t(x)\}$ by:

$$U = \sum_{t=0}^{\infty} \beta^t u(c_t(x)) \tag{1}$$

In addition to skills, individuals are endowed with one unit of labor in each time period, which is supplied inelastically; and with k_0 units of initial capital, also supplied inelastically.

3.2.1.2 Technology: full-time entrepreneurs

At each date, a single good is produced; this can be consumed or saved as capital to be used in the next time period. The production process involves three factors: labor, capital, and entrepreneurial ability. Following Lucas's original notation, production can be imagined to consist of both an underlying physical technology and a managerial technology. The underlying physical technology is denoted $f(n,k)$, while the managerial technology is written as $g(v)$. Specifically, an individual of type x who is a full-time manager of a firm with n workers and k units of capital at date t produces output:

$$y = x\,g[f(n_t(x), k_t(x))] \tag{2}$$

where f is constant returns to scale, increasing, and concave in each argument; and where g is continuously twice differentiable, increasing, and strictly concave, with $g(0)=0$. For analytic purposes, I will restrict my attention to a class of functions where g is a power function in the form $g(v)=Av^{\theta}$, where $0<\theta<1$.[12]

[12]Lucas (1978) shows that this functional form is necessary and sufficient for Gibrat's Law to hold. Gibrat's Law holds that the size of a firm is not related to its growth rate. Although there is considerable debate over the empirical validity of the law, it provides a useful simplifying assumption in this framework.

3.2.1.3 Technology: self-employed people

In the model world, people may instead choose to operate single-person enterprises; i.e., to engage in self-employment.[13] In this case, they may divide their time between physical labor, n, and entrepreneurial or administrative time, $(1 - n)$.[14] Since they are using less than one unit of time for entrepreneurial responsibilities, these single-person enterprises experience a lower degree of entrepreneurial efficiency. In particular, the entrepreneurial factor x is scaled down to $(1 - n)^{\psi} x$. When time spent in production, n, is very small, then there is only a modest decline in entrepreneurial efficiency. Alternatively, when ψ approaches zero, then there is little loss in entrepreneurial efficiency from self-employment.

Formally, an individual of type x who is self-employed produces output according to the production function:

$$y = (1 - n_t(x))^{\psi} x \, g[f(n_t(x), k_t(x))] \tag{3}$$

3.2.1.4 Government and taxes

There is a government in this model, which collects taxes τ from firms and converts them into a composite government good, G_t, which enters production and consumption in a perfectly separable manner and thus has no impact on equilibrium outcomes. The tax schedule for firms has three tiers.

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[13] In the original Lucas model, self-employment is not an option; an individual's entire time endowment must be used to manage a firm, regardless of firm size. Self-employment would thus correspond to a situation with no labor input, which is never optimal.

[14] We could imagine that this time is spent forming contracts with suppliers and customers, participating in trade associations (which are ubiquitous in Ghana; even the informal moneylenders, or *susu* operators have their own trade association), making credit transactions, and performing other tasks that are important for enterprise operation but do not involve directly productive activities.

Tax rates are:

τ_0	for the self-employed
τ_1	for firms with $n \leq n^*$
τ_2	for firms with $n > n^*$

Thus, there are two thresholds in the tax code: between self-employment and small firms, and between firms with fewer than n^* workers and those with more than n^* workers.

3.2.2 Individual's problem

An individual in this economy must choose the type of employment that will maximize his or her income. The returns from working for a wage are simply w, which the individual takes as given. The individual compares this wage with the income derived from self-employment and from full-time management, and chooses the occupation that gives the highest income.

3.2.2.1 Income from self-employment

The returns from self-employment consist of entrepreneurial rents as well as the market value of time n devoted to production. Thus, a self-employed individual earns $\pi_t^{SE}(x)$, where this income includes wages as well as rents:

$$\pi_t^{SE}(x) = max_{\{n,\,k\}} \quad (1 - \tau_0)(1 - n)^{\psi}\, x\, g\, [f(n_t(x),\, k_t^m(x))] - r_t k_t^m(x) \quad \textbf{(4)}$$

$$s.t. \quad k \geq 0 \ and$$
$$0 \leq n \leq 1$$

Note that n and k depend on the individual's level of entrepreneurial ability, x. In equilibrium, individuals with sufficiently low levels of x will prefer wage work to self employment, and individuals with sufficiently high levels of x will prefer full-time management. (See PROPOSITION 1, below.)

3.2.2.2 Income from full-time management

An individual who operates a firm as a full-time manager will receive only the entrepreneurial rents. These increase with the individual's level of entrepreneurial ability, x, so that those with low values of x will not in general choose to be full-time managers.

Given x, the would-be manager chooses levels of labor and capital inputs to maximize rents. This is a straightforward problem except for the distortion created by tax policy: the tax rate that the manager will face depends on the level of labor input. Thus, the full-time manager's income is given by:

$$\pi_t^{FT}(x) = max_{\{n,\, k\}} \quad (1 - \tau)\, x\, g\, [f(n_t(x),\, k_t^m(x))] - w_t n_t(x) - r_t k_t^m(x) \qquad (5)$$

$$s.t. \quad n,\, k \geq 0 \text{ and}$$

$$\tau = \begin{cases} \tau_1 \text{ if } n \leq n^* \\ \tau_2 \text{ if } n > n^* \end{cases}$$

3.2.2.3 Consumer's problem

Having chosen an employment option to maximize income, the individual faces a straightforward problem in allocating this income to current-period consumption and to savings.

Denote the individual's maximum income from employment as:

$$\pi_t(x) = max\ \{\, w,\ \pi_t^{SE}(x),\ \pi_t^{FT}(x)\ \} \qquad (6)$$

The individual's decision rules can be represented by marker functions. Let $m_t(x) = 1$ if the individual earns maximum income from full-time management, and let $m_t(x) = 0$ otherwise. Similarly, let $s_t(x) = 1$ if the individual earns maximum income from self-employment, and let $s_t(x) = 0$ otherwise.

The problem of a consumer with entrepreneurial ability x can be written as:

$$\max_{c_t,\, k^s_{t+1},\, m_t} \sum_{t=0}^{\infty} \beta^t u(c_t(x))$$
$$\text{s.t.} \quad c_t(x) + k^s_{t+1}(x) \leq (1 + r_t - \delta) k^s_t(x) + \pi_t(x)$$
$$c_t(x),\, k^s_t(x) \geq 0 \quad \forall\, t \tag{7}$$

3.2.3 Equilibrium

An equilibrium for this economy consists of sequences of:

$\{c_t(x),\ n_t(x),\ k^s_t(x),\ k^m_t(x),\ w_t,\ r_t,\ y_t(x),\ m_t(x),\ s_t(x)\},\ t = 0,1,2,\ \ldots$ $\forall x \in [0,1]$

such that:

(i) The consumer's problem is solved for all individuals $x \in [0,1]$.

(ii) All establishments are maximizing profits, taking prices as given.

(iii) The usual feasibility conditions are satisfied, for all t; namely, The market-clearing condition for the goods market is given by:

$$\int_0^1 c_t(x)\, d\Delta(x) + \int_0^1 k^s_{t+1}(x)\, d\Delta(x) + G_t$$
$$\leq \int_0^1 m_t(x)\, x\, g[f(n_t(x), k^m_t(x))]\, d\Delta(x) + (1-\delta)\int_0^1 k^s_t(x)\, d\Delta(x) \tag{8}$$
$$+ \int_0^1 s_t(x)\, x\, (1 - n)^{\phi}\, g[f(n_t(x),\, k_t(x))]\, d\Delta(x)$$

Market-clearing in the wage labor market requires that:

$$\int_0^1 n_t(x)\, d\Delta(x) - \int_0^1 s_t(x) n_t(x)\, d\Delta(x)$$
$$\leq \int_0^1 (1 - m_t(x))\,(1 - s_t(x))\, d\Delta(x) \tag{9}$$

The market for capital services clears when:

$$\int_0^1 k^m_t(x)\, dx \leq \int_0^1 k^s_t(x)\, dx \tag{10}$$

Finally, the government budget is balanced when:

$$G_t = \int_0^1 \tau\, m_t(x)\, x g[f(n_t(x), k_t^m(x))]\; d\Delta(x) + \int_0^1 \tau_0 s_t(x) x (1 - n)^{\psi} g[f(n_t(x), k_t(x))]\, d\Delta(x) \tag{11}$$

where $\tau = \begin{cases} \tau_1 \text{ if } n \leq n^* \\ \tau_2 \text{ if } n > n^* \end{cases}$

The structure of the model immediately implies that people's work choices, $m_t(x)$ and $s_t(x)$, will be (weakly) monotonic in x; in other words, at each date, there will be two cutoff levels of entrepreneurial ability z_{1t} and $z_{2t} \in [0,1]$ such that everyone with a skill level below z_{1t} will work, and everyone with a skill level above z_{2t} will be a full-time manager, while individuals with intermediate levels of entrepreneurial ability (i.e., $x \in [z_{1t}, z_{2t}]$) will be self-employed. This can be expressed more formally as:

Proposition 1:

At each date t, if there are both self-employed people and full-time managers in equilibrium, then $\exists z_{1t}, z_{2t} \in [0,1]$ *such that:*

$m_t(x) = 1$ *for all* $x \geq z_{2t}$ *and*

$m_t(x) = 0$ *for all* $x \leq z_{2t}$, *while*

$s_t(x) = 1$ *for all* $z_{1t} \leq x \leq z_{2t}$ *and*

$s_t(x) = 0$ *elsewhere.*

The proof of this proposition follows directly from the fact that $\pi_t(x)$ is increasing in x.

It is worthwhile to note, however, that for some parameter values, there may be no self-employed people in the economy. Alternatively, for some parameterizations, there may be no full-time managers.

3.3 Computing the equilibrium

The competitive equilibrium for this problem is somewhat complex, since at any date t, individuals x earn different incomes and face different budget constraints. The solution is simplified, however, since all consumers have identical, homothetic preferences, and since they differ only in income. By standard aggregation theorems, this implies that the competitive equilibrium has the same prices and aggregate consumption as an alternative model with a representative consumer. This allows us to abstract from the consumption decisions of individuals in the economy, although on the production side, it remains important that individuals of different entrepreneurial ability choose employment and allocate their labor optimally.

A convenient way to compute the equilibrium with a representative consumer is to begin with the period-by-period problem of solving for the aggregate output obtained from any level of aggregate capital stock. Even with a government good, this is a straightforward competitive problem: capital and labor must be allocated across firms in such a way as to equalize marginal products. From each entrepreneur's perspective, the taxes simply appear as part of the technology; the entrepreneur chooses which technology to operate — the self-employment technology, the full-time technology with a tax rate of τ_1, or the full-time technology with a tax rate of τ_2. For either tax rate, the choice of capital and labor must be efficient.

As a practical matter, it is computationally intensive but not conceptually difficult to solve this single-period problem. Given a wage, w, rental rate for capital services, r, and the tax rates, it is simple to find the marginal self-employed person, z_1, and the marginal full-time manager, z_2, assuming that both exist. Thus, it remains only to search for the wage and rental rate at which markets clear. This is straightforward.

The solution to the single-period problem can be obtained for any start-of-period capital stock. This effectively defines a map from aggregate capital stock into aggregate production, which can be denoted as *F(K)*. Given this production function, the representative consumer's problem takes on a standard form; it can be written as a simple dynamic program:

$$V(K) = \max_{K'} \; u\left(F(K) + (1-\delta)K - K'\right) + \beta V(K') \qquad \text{s.t.} \;\; 0 \le K' \le F(K) + (1-\delta)K \tag{12}$$

To compute solutions for the model, functional forms must be specified. In keeping with the literature, this paper takes $u(x) = log(x)$. For the production technology, it uses $f(n, k) = [\gamma n^{\rho} + (1-\gamma) k^{\rho}]^{1/\rho}$, which is a standard CES form. As noted above, $g(v)$ is assumed to take the form αv^{θ}, where $0 < \theta < 1$. Given these functional forms, the next problem is to assign plausible parameters for the purposes of policy analysis.

4. Matching the model to data

In most of the literature on calibrated growth models (e.g., Cooley and Prescott 1995), time series data from the U.S. or other OECD countries is used to pin down the steady-state values of parameters. There are several problems in applying the same calibration approach to Ghanaian data.

First, key elements of aggregate data are not available for Ghana. In particular, no consistent time series is available for the National Income and Product Accounts (NIPA). Only selected years are available, and as noted above, the NIPA have limited value for this study. Moreover, the NIPA as collected in Ghana do not include GDP by its cost components. Thus, wage shares, rental income, and other such variables are not obtainable from the Ghanaian NIPA.

Second, most calibration exercises rely on steady-state (or balanced-growth path) conditions of the model to determine parameters from the data. As a conceptual matter, however, there is no reason to believe that the Ghanaian economy is now at a steady state or on a balanced growth path. (Note Figure 1, above, and its representation of the time series for GDP per capita.)

For both reasons, I have departed from standard calibration procedures. I have relied on survey data from the Ghanaian manufacturing sector, rather than NIPA data, to determine parameters, and I have not attempted to model the Ghanaian economy as being at a steady state.

The result should be considered less a calibration, in the sense that is usually understood, and more a quantitative assessment of the model. A full-fledged calibration would attempt to match economy-wide data in a number of dimensions; this quantitative assessment, in contrast, aims at a narrower range of targets.[15] The goal is to use parameter values taken from data and from literature and to see how well the model matches important facts about small enterprises and self-employment in Ghana's manufacturing sector. If the model reproduces important features of the actual economy, it can be used for policy experiments, such as an exploration of the effects of alternative tax regimes.

4.1 Assigning parameter values

The model has ten parameters. Of these, a number can be taken from sources such as the 1987 Ghanaian Industrial Census (Republic of Ghana 1991) or from surveys of small enterprises such as those sponsored by the World Bank Regional Programme on Enterprise Development in 1992 and 1993. The latter survey has been analyzed extensively by Teal et al. (1994, 1995), among others.

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[15] In particular, a full-fledged calibration would seek to replicate observations of output, growth, investment, factor shares, employment levels, and other variables of interest for studying business cycles or growth.

Parameters of the model are:

Parameters of the Model	
A	scaling constant
β	discount factor
γ	labor share in CES production function
δ	depreciation rate
θ	exponent on power function; corresponds to combined labor and capital share in total output
ρ	parameter indicating elasticity of substitution ($\sigma=1/(1-\rho)$)
ψ	exponent on managerial time of self-employed people
τ_0, τ_1, τ_2	tax rates on different sized firms
$\Delta(x)$	Distribution of managerial skill

The parameters ρ, γ, and θ can be taken or derived from available literature. In particular, Teal (1995) presents several alternative estimates of elasticities of substitution between K and L. Using a CES specification of the production function, he arrives at four alternative estimates of σ, ranging from 0.43 to 1.13 and averaging 0.78.[16] Allowing for firm fixed effects and using differenced equations, rather than level equations, Teal arrives at an estimate of 0.86. This appears to be the most convincing estimate of σ, although all four

[16]Interestingly, this average falls comfortably within the range of 0.5 to 0.8 that Lucas (1969) advocates. It is also worth noting that these figures are broadly consistent with the estimates obtained by Baah-Nuakoh (1981), although Baah-Nuakoh's estimates were on average slightly lower.

estimates are within the plausible range. It implies a value of $\rho = -0.1628$. Teal's estimates reflect the first-order condition of the CES model; namely, that:

$$\left(\frac{k}{l}\right)^{\rho-1} = \left(\frac{r}{w}\right)\left(\frac{\gamma}{1-\gamma}\right) \tag{13}$$

Taking logs, this gives:

$$\ln\left(\frac{k}{l}\right) = \left(\frac{1}{1-\rho}\right)\ln\left(\frac{\gamma}{1-\gamma}\right) + \left(\frac{1}{1-\rho}\right)\ln\left(\frac{r}{w}\right) \tag{14}$$

The constant term from this estimation equation thus gives the share parameter γ as well as the elasticity of substitution. The values obtained in this way from the estimations reported by Teal et al. give the labor share, γ, as between 0 and 0.6. For $\sigma = 0.86$, the corresponding value is $\gamma=0.532$.

Taking estimates of ρ and γ together, it is possible to derive the implicit entrepreneurial share θ.[17] The challenge in determining entrepreneurial share is that it is difficult, in the data, to separate these rents from capital income. But equation (13) indicates the firm-level relationship between capital income (*rk*) and labor income (*wl*). Turning from the firm-level data used by Teal to the aggregate data from the Industrial Census, it is possible to obtain aggregate figures for labor and capital shares. This aggregated data gives reasonable numbers for *L*, the number of persons engaged in manufacturing. Then *w* is the total employee compensation in manufacturing (wages plus benefits) divided by the number of persons engaged. Since *K* can be approximated as the value of fixed assets in manufacturing, and since γ is given from the literature, equation (13) can be solved for an average value of *r*. From this, *rK* can be computed; and given *wL* and *rK*, the third factor share (profits) can be determined as a

[17] Note that θ corresponds to the share of output that goes to labor and capital. Thus, $(1-\theta)$ is the share of output retained as entrepreneurial rent.

residual from sectoral value added. Using σ=0.86 and γ=0.523, we get θ=0.7817. This seems plausible for the share of value added accruing to capital and labor together; it implies that entrepreneurial rents are about 21 percent of total output.

The scaling constant A can be calibrated to match aggregate output levels. The drawback to this approach is that aggregate output and capital stock are not entirely visible in the data: for the smallest establishments (including single-person enterprises), neither capital nor output is well measured. It is also possible, however, to determine A from the data for entrepreneurs with any particular skill level x. For any given firm managed by an individual with skill level x, the model tells us that:

$$y(n,k;x) = xA[\gamma n(x)^{\rho} + (1-\gamma)k(x)^{\rho}]^{\frac{\theta}{\rho}} \tag{15}$$

Ideally, a median or average value of x would be used to determine A. In Ghana, however, data limitations militate a different choice: the use of data from the Industrial Census on the largest size class of firms. These data lead us to set A = 1.46.

The results of the model are not particularly sensitive to the choice of δ and β. A value of δ=0.072 can be obtained by using the Industrial Census figure for depreciation over the book value of fixed assets. For lack of any better figure, I take β=0.95, with a period defined as one year. In fact, it seems likely that a lower value of β would be justified in a poor country like Ghana, but preliminary tests indicate that the model results are not very sensitive to changes in β.

Two more parameters are essentially unobservable. First is the skill distribution, $\Delta(x)$. For simplicity, this is taken to be lognormal, in keeping with much of the literature on firm size distributions (e.g., Simon and Bonini 1958). The parameters of the distribution are μ=0.35 and σ^2=0.04, and with the support scaled into the [0,1] interval so that essentially all of the mass is contained in the interval. The small amount of truncated mass is added on as a constant term across the whole interval.

Another unobserved parameter is the self-employment efficiency parameter, ψ. The model is sensitive to large changes in this parameter but not to marginal changes. This parameter determines the relative entrepreneurial inefficiency of self-employed people; in other words, the degree to which they are less efficient managers or entrepreneurs because they must divide their time among several tasks. Given the high amount of self-employment in Ghana, it seems that self-employment cannot be greatly disadvantaged. This supports choosing a low value for ψ (i.e., close to zero). I have used a value of 0.025 in this quantitative assessment; small changes (say, between 0.01 and 0.10) appear to have little effect.

Finally, the tax rates τ_0, τ_1, and τ_2 are the subject of policy experiments. The choice of these rates is discussed in detail in the next section.

4.2 Tax rates for the model economy

The taxes in the model economy represent "effective rates" of tax and subsidy, in the sense that they aggregate the effects of all government policies. Since it is difficult or impossible to inventory all of Ghana's policies and to convert them into effective rates of taxation, I have initially used guesses based on my reading of the data. The Industrial Census gives indirect business taxes paid by the largest firms in the economy. But these are only formal taxes; the actual tax burden faced by large firms may be much higher. Evidence from other countries suggests that taxes are only a small fraction of total costs due to compliance with policies and regulations.

For example, in Peru, researchers at the *Instituto Libertad y Democracia* (ILD) estimated that, for a sample of small industrial firms, taxation comprised only 22 percent of the total cost of compliance with laws and regulations. Utilities represented an additional 5 percent of these costs; the remaining 73 percent was primarily due to time costs associated with regulatory compliance. (De Soto 1989, offers a detailed account of this research.)

The Peruvian example suggests that official tax rates may be a poor indicator of the total effective rate of taxation faced by firms of different sizes. Nonetheless, for Ghana, tax rates offer a useful starting point. The Industrial

Census of 1987 includes data on total indirect taxes paid by large manufacturing firms — including custom duties, excise duties, and sales taxes. These amounted to about 28 percent of value added for large firms. Assuming for simplicity that indirect taxes reflect half the indirect taxes for large firms, this suggests a value for τ_2 of 0.56.[18]

No comparable figures show the tax burden small establishments. Data from household surveys and from surveys of enterprises usually indicate that formal taxation is close to zero. Smaller firms undoubtedly pay some licensing and regulatory fees, however, along with some bribes and kickbacks, and other bureaucratic overheads. Many small establishments occupy permanent structures (79-85 percent in Accra in 1989-91, according to Appiah-Koranteng 1994), and thus can be located by agents of various government entities. The survey also showed that 37 percent of firms with 1-5 workers were registered with the government, compared with 78 percent of those with 6-49 workers (Parker et al. 1995). Moreover, many proprietors of small establishments belong to business associations which are quasi-formal entities; this may also expose them to certain taxes and fees, in exchange for the benefits gained from political lobbying power. Thus, it seems clear that the effective taxation rate on small firms is probably greater than zero but somewhat lower than the level faced by large firms. I find that an effective tax rate of 0.5 provides the best fit with the data, and this is the value used in the quantitative assessment.

Finally, it is unclear to what extent the self-employed in the manufacturing sector face tax or regulatory burdens. In many cases, these individuals may be able to avoid taxes altogether; certainly there are some regulations (e.g., social security payments and other labor laws) that are faced by firms that formally hire any employees. Thus, we should expect the self-employed to face the lowest tax rates of all. For the purposes of this quantitative assessment, I take $\tau_0 = 0$.

It should be noted that Ghana's tax structure has recently changed. In early 1995, Ghana imposed a value added tax (VAT) designed to replace previous indirect taxes. As is common for developing countries, the VAT explicitly

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[18]Marsden and Bélot (1987) report that the tax rate on corporate income in Ghana was 60 percent, but they do not provide a date or source, nor do they make it clear whether this was a marginal or an average tax rate.

exempted small firms, as measured by a sales threshold.[19] The new tax policy will alter the environment for firms of different sizes, but it will not change the basic impact of the tax system on firms of different sizes. Large establishments will continue to pay higher rates than small establishments, which in turn will face higher rates than self-employed people.

5. Results of quantitative assessment and policy experiment

The quantitative assessment is designed to test whether the model provides a useful representation of the Ghanaian economy and, if so, to explore the effects of alternative tax regimes.

5.1 How well does the model match the actual economy?

A question of particular interest for the quantitative assessment is whether the model accurately matches the actual size distribution of firms in Ghana. To answer this question, it is necessary to construct the actual distribution by assembling different sources of data. Most available surveys truncate either large firms or small firms, depending on their objectives. For example, the Industrial Census does not include firms with fewer than 10 employees;[20] in contrast, some researchers perform surveys that explicitly focus on "small-scale" enterprises.

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[19]However, given the structure of a VAT, it may still prove worthwhile for many small establishments to register for the VAT, so that they can be credited for the taxes paid to suppliers.

[20]A companion volume to the Industrial Census was designed to survey firms with fewer than 10 employees. Its coverage, however, was extremely limited and some of the data are particularly dubious.

5.1.1 Computing the actual size distribution of firms

According to the Population Census, self-employment is a major feature of the firm size distribution. Of the 451,299 entrepreneurs and self-employed people in the manufacturing sector, 430,029 reported that they had no employees, while 21,270 had some employees. Manufacturing employees in the public and private sector numbered 93,103. Together with 44,016 unpaid family workers and "others," this gives a total of 137,119 potential workers for enterprises of all size. If these workers were divided evenly among the 21,270 entrepreneurs-with-employees listed in the census data, it would give an average firm size of 6.45 workers. The Industrial Census reports, however, that the largest 1,258 firms employ 87,577 people. Thus, 49,542 people work for 20,012 employers in the remaining firms, for an average of 2.48 workers (not counting entrepreneurs) per enterprise in establishments with fewer than 10 employees.[21] As a matter of arithmetic, this implies that the vast majority of these firms employed either 1 or 2 persons, with very few employing 5-10.

A complete size distribution of firms can be obtained by combining this information with survey data from micro studies. For example, Thomi and Yankson (1985) found, in a survey of small-scale industries in small and medium-sized towns in Ghana, that a typical entrepreneur had 2.63 employees (comfortingly close to the figure obtained above). In particular, they found the following proportions of firms with small numbers of employees:

1 employee	.190
2 employees	.094
3 employees	.054
4 employees	.033

[21]Note that this assumes — admittedly unrealistically — that there is one entrepreneur for each of the firms in the Industrial Census. This is undoubtedly a simplistic assumption; some of these firms are quasi-public or parastatal and may have no "entrepreneurs" in the sense of the model; others may be partnerships or corporations with complex management and ownership structures. For simplicity, however, this seems to be a plausible way to interpret the data.

These ratios are not consistent with the Population Census. The ratios imply that self-employed people account for at most 63 percent of the firms. But if self-employment accounts for 63 percent of the firms, it must represent an even smaller proportion of the workforce, since the remaining 37 percent of the firms employ larger numbers of people. This conflicts with the Population Census data, which show that self-employed people are 73 percent of workers.

The two sets of data can be reconciled by using the ratios that Thomi and Yankson found but scaling the numbers down to fit the census data. This is equivalent to assuming that Thomi and Yankson undercounted the self-employed, which is not implausible, since the self-employed are notoriously hard to count.

From the combined data, the following size distribution of firms emerges:

Table 2: Actual size distribution of firms in Ghana, 1984 (based on author's estimates).

	Estimated number of firms	Share of total firms	Estimated number of workers (including entrepreneurs)	Share of workers
Self-employed	430,029	0.9488	430,029	0.7308
1 employee	10,290	0.0227	20,581	0.0350
2 employees	5,093	0.0112	15,278	0.0260
3 employees	2,917	0.0064	11,669	0.0198
4 employees	1,804	0.0040	9,020	0.0153
5-9 employees	1,830	0.0040	13,722	0.0233
10+ employees	1,258	0.0028	87,577	0.1488

Source: author's estimates from census data and Thomi and Yankson, 1985.

Although these figures are not exact, they provide a plausible approximation of the firm size distribution based on available data. Two features of the data are striking. First, self-employment accounts for well over 90 percent of firms, as well as almost three-quarters of total employment. Firms with 1-3 employees account for about 8 percent of employment, with very large firms (over 10 employees) accounting for 11 percent of employment. Interestingly, these largest firms average around 70 employees.

5.1.2 Size distribution of firms: model vs. actual

In several respects, the calibrated model appears to do a good job of replicating the size distribution of firms in manufacturing. Taking the present-day ratio of capital to output in Ghanaian manufacturing as 2, the model predicts a size distribution of firms that is exceptionally close to the actual distribution.[22] (See Figure 2.)

More detailed analysis reveals some disparities between the model economy and the data: the model predicts fewer firms with 0-2 employees than are shown in the data, while also predicting more firms with 3-5 workers than are shown in the data. This stems from the fact that, in the model economy, almost all the people who might otherwise operate enterprises with 0-2 employees are better off remaining self-employed and facing a lower tax rate. In the data, this gap is not so pronounced — possibly because, in reality, the higher tax rates do not bind precisely when a firm begins to hire employees. If, for example, there is an additional margin for tax evasion, then some establishments with 0-2 employees might enter the sector in spite of the putatively higher tax burden.

Nonetheless, the comparison suggests that the model does a good job of matching the size distribution of firms. This suggests that its output can offer some insights for analyzing the effects of alternative tax regimes.

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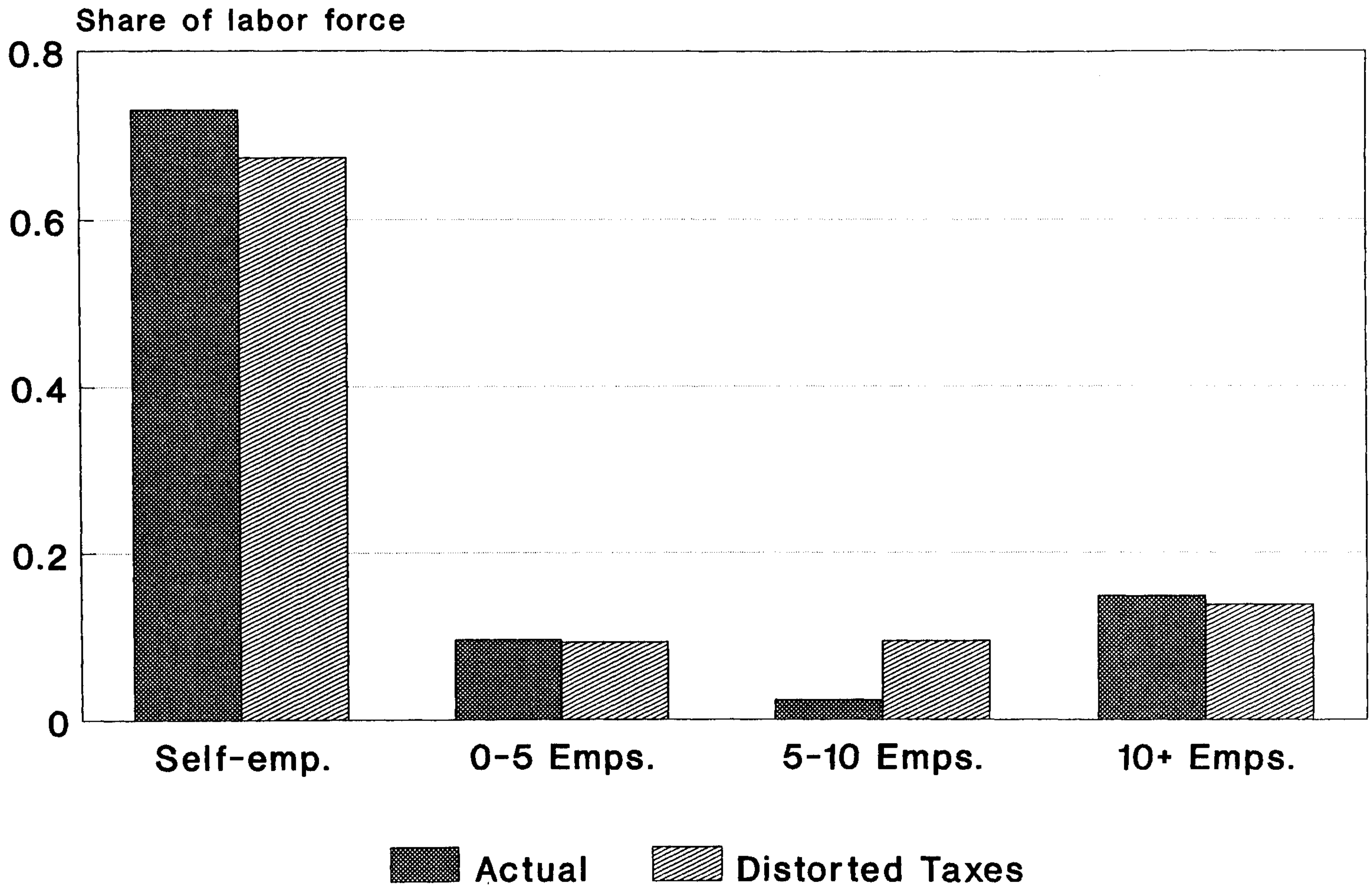
[22] This K/Y ratio is an approximation, since no figures of any kind are available for the capital stock in Ghana. It is possible to construct a measure of K using the investment time series from the national accounts, but this omits capital held by small enterprises, self-employed people, and households. The choice of K/Y here is prompted by some attempts to construct a measure from the data. The model results are not particularly sensitive to the choice, although of course it affects the length of the transition path.

Fig. 2: Firm Size Distribution
Actual vs. Model with Distorted Taxes



(Includes entrepreneurs)

5.2 Conducting a policy experiment: neutral taxes

One obvious policy experiment is to consider the effects of switching Ghana's tax system to one which imposes the same tax rate on all establishments, regardless of size. Under such a policy, the self-employed would pay the same tax rate as small firms, and both would pay the same rate as larger firms. The level of the new tax can be set so that the tax change is "revenue-neutral;" in other words, it raises the same total tax revenue as the current tax regime.

Using the model to calculate the tax revenues under alternative neutral tax rates, it turns out that a rate of 0.197, levied on all firms, can generate the same tax revenue as the three-tiered scheme with zero tax on self-employed, 0.50 on firms with fewer than 5 employees, and 0.56 on firms with more than 5 employees. This is clearly a "large" change in tax rates. Larger firms face a dramatic reduction in taxes as the burden is shifted to the self-employed.

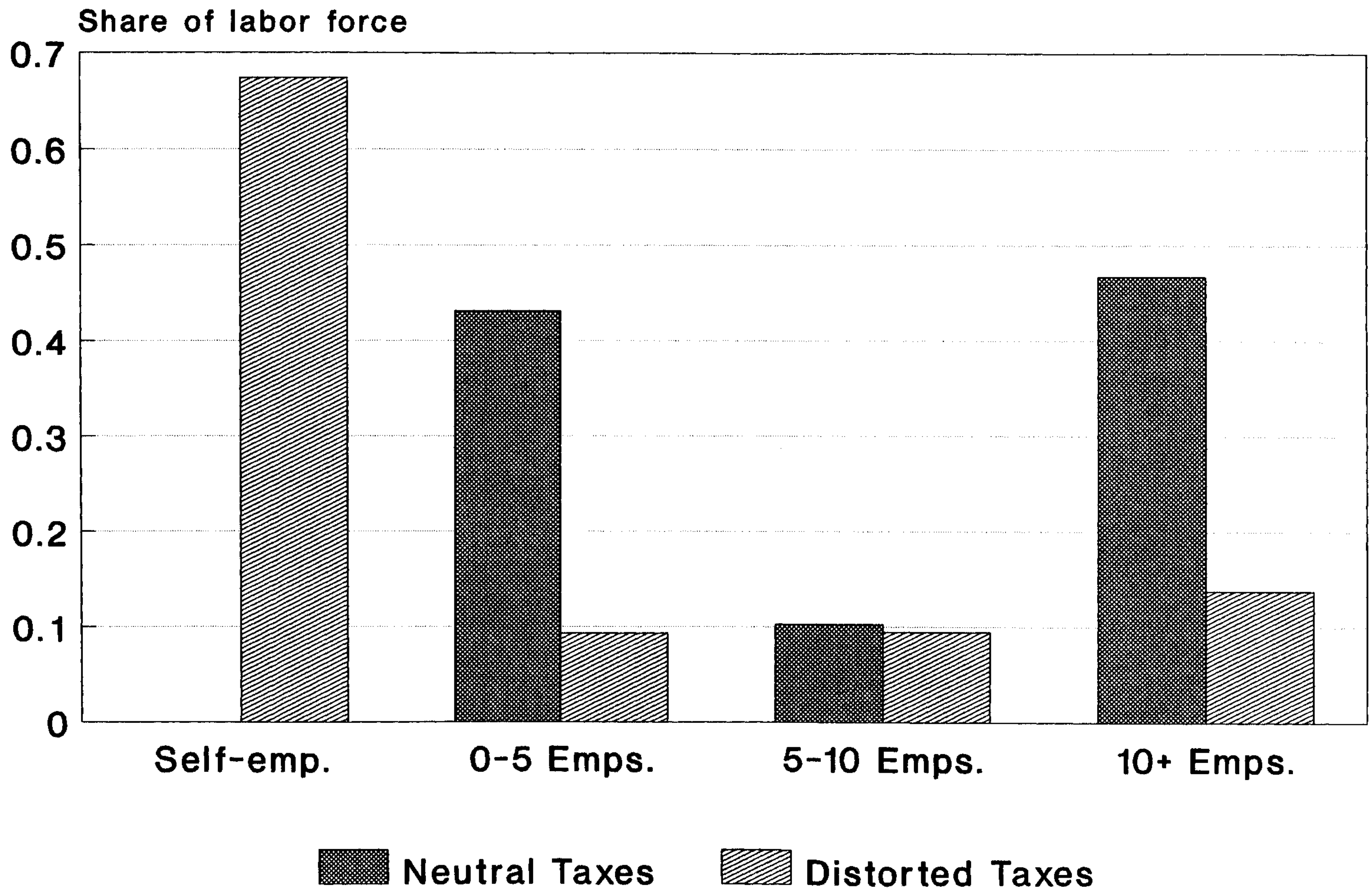
In general, such a policy can be expected to have several effects: first, on the momentary size distribution of firms and on momentary efficiency; second, on the momentary distribution of earnings; and third, on the dynamic trajectory of the economy. It is useful to examine each of these in turn.

5.2.1 Effects on efficiency and the momentary size distribution of firms

Ex ante, it seems clear that by reducing the share of the tax burden borne by larger firms, a shift to neutral taxes should increase the size and number of large firms, while drawing many of the self-employed into the paid labor force. Figure 3 illustrates this effect by comparing the present size distribution of firms with the model's prediction of the distribution obtained under a neutral tax policy.

The proportion of self-employed drops dramatically under this scenario from 0.704 of the manufacturing workforce to zero. Once the large tax advantages associated with self-employment are removed, the inefficiencies become too costly for entrepreneurs. Even firms employing very few workers are more profitable under full-time management. About 0.43 of the workforce remains in firms with fewer than 5 employees, but these are all operated by full-time managers. A substantial fraction of firms operates with fewer than 1

Fig. 3: Employment Distribution
Neutral vs. Distorted Tax Regime



(Includes entrepreneurs)

employee. Whereas under the distortionary tax regime, full-time managers produced only 0.40 of total output, under the neutral tax regime all the economy's production comes from firms with full-time managers. Firms with 10 or more employees go from producing 0.18 of aggregate output to producing 0.537 of total output.

The effect on total output is substantial. By shifting production into more efficient large firms, the neutral tax policy expands production dramatically. With the same capital stock, output nearly doubles from 0.1248 to 0.2304. This increase comes with no direct cost to the economy and should thus be viewed as a pure efficiency gain. The message is that highly distortionary taxes pose a serious drag on the economy in this environment.

5.2.2 Effects on distribution

One question that might arise under the new tax regime is whether the neutral regime has undesirable distributional effects. In particular, as production shifts away from self-employment into larger production units, does the income distribution worsen? Or do increases in the wage rate offset the loss of rents?

There are a number of ways to measure distribution in the model economy. A commonly used measure is the Gini coefficient. This is straightforward to compute for the model economy. For the model with distortionary taxes, the Gini coefficient is 0.7035. For the economy with neutral taxes, the Gini coefficient is 0.6735. Lower numbers imply greater equality in the distribution of income. Thus, perhaps surprisingly, the change to a neutral tax regime actually leads to a modest increase in income equality. The reason for this is that wages rise, and the number of people managing large firms actually falls. This suggests that the change in tax policy will not have negative distributional consequences; on the contrary, it leads to an improvement in this dimension as well.

5.2.3 Dynamic effects of tax reform

In this model, the effects of the shift to a neutral tax can be followed over time, as the economy moves along a growth trajectory. In the simple environment used here, the economy moves to a steady state over a period of years. The model suggests that under current tax policies, abstracting from any technical change or other exogenous events, the Ghanaian economy would attain a steady state value of capital in 22 years, with production roughly double the current level. The increased production would result entirely from capital accumulation; in this framework, I abstract from changes in human capital or entrepreneurial skills.

By contrast, a shift to a neutral tax regime — given the parameters used here — would *immediately* lead to a level of output higher than the steady state value attained under current policies. In other words, the efficiency gain from tax reform would be greater than the entire benefit from two decades of capital accumulation.

Moreover, the neutral tax regime shifts upwards the entire growth trajectory of the economy. Figure 4 shows the path of capital accumulation under the two tax scenarios; Figure 5 shows the growth trajectories for production under the two alternatives. It is apparent from Figure 5 that the tax reform generates an immediate efficiency gain and also that the economy attains a steady state level of production that is also double the level attained under the distorted tax regime.

In addition, the long-term *rate* of growth (from Year 1 to Year 22) is higher under the neutral tax regime, since higher proportions of investment are attained. This is reflected in the steeper growth trajectory shown in Figure 5, or it can be measured as the average annual compound growth rate from initial output level to steady state output level: the distorted tax scenario produces average annual compound growth rate of 2.58 percent, while the neutral tax scenario generates average growth of 3.31 percent.[23]

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[23] It is of course misleading to use average annual growth rates here, since the growth trajectory is exponential. Initial growth rates are very high, but the economy approaches the steady state with very low growth.

Fig. 4: Capital Accumulation
Distorted vs. Neutral Taxes

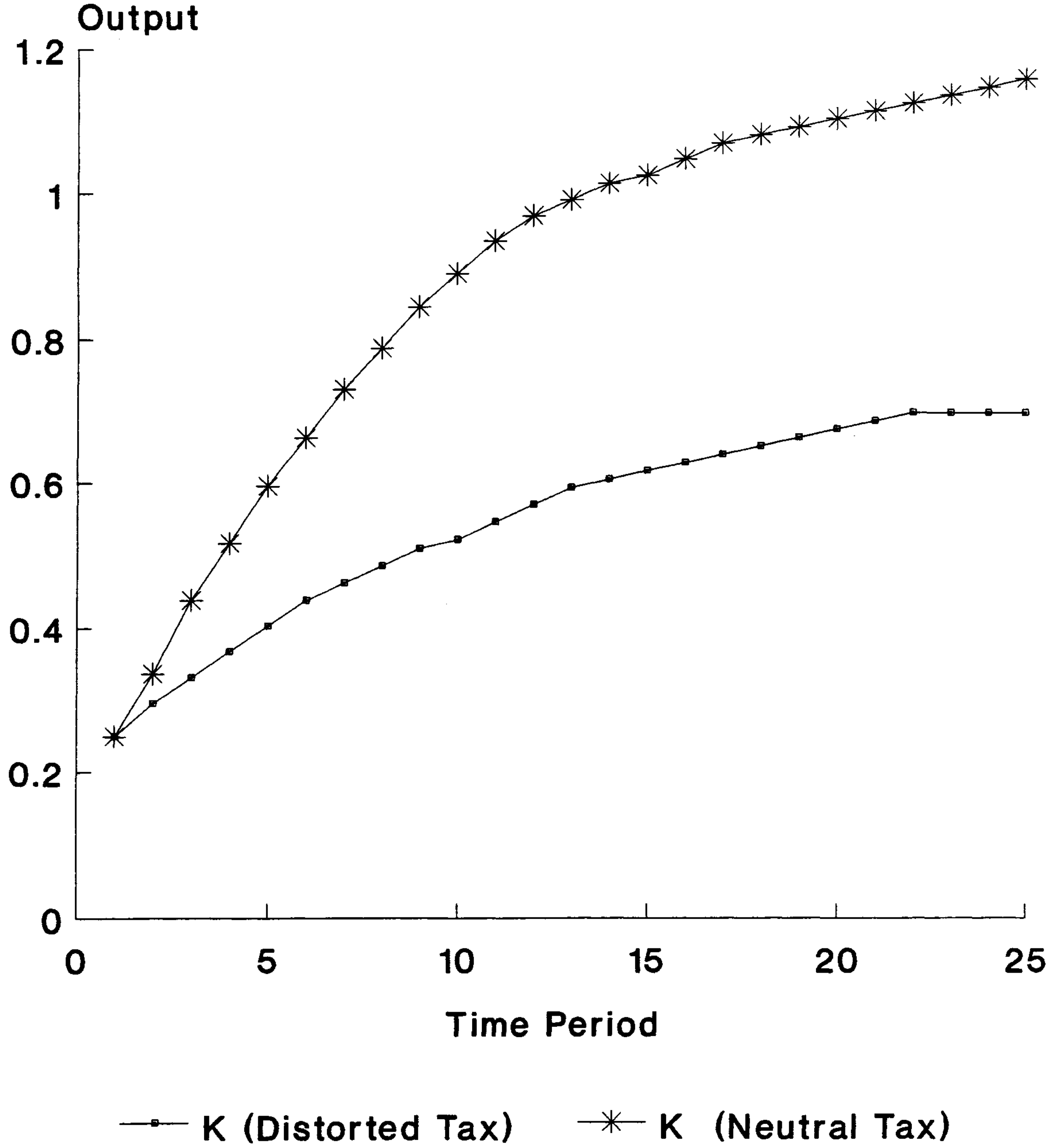
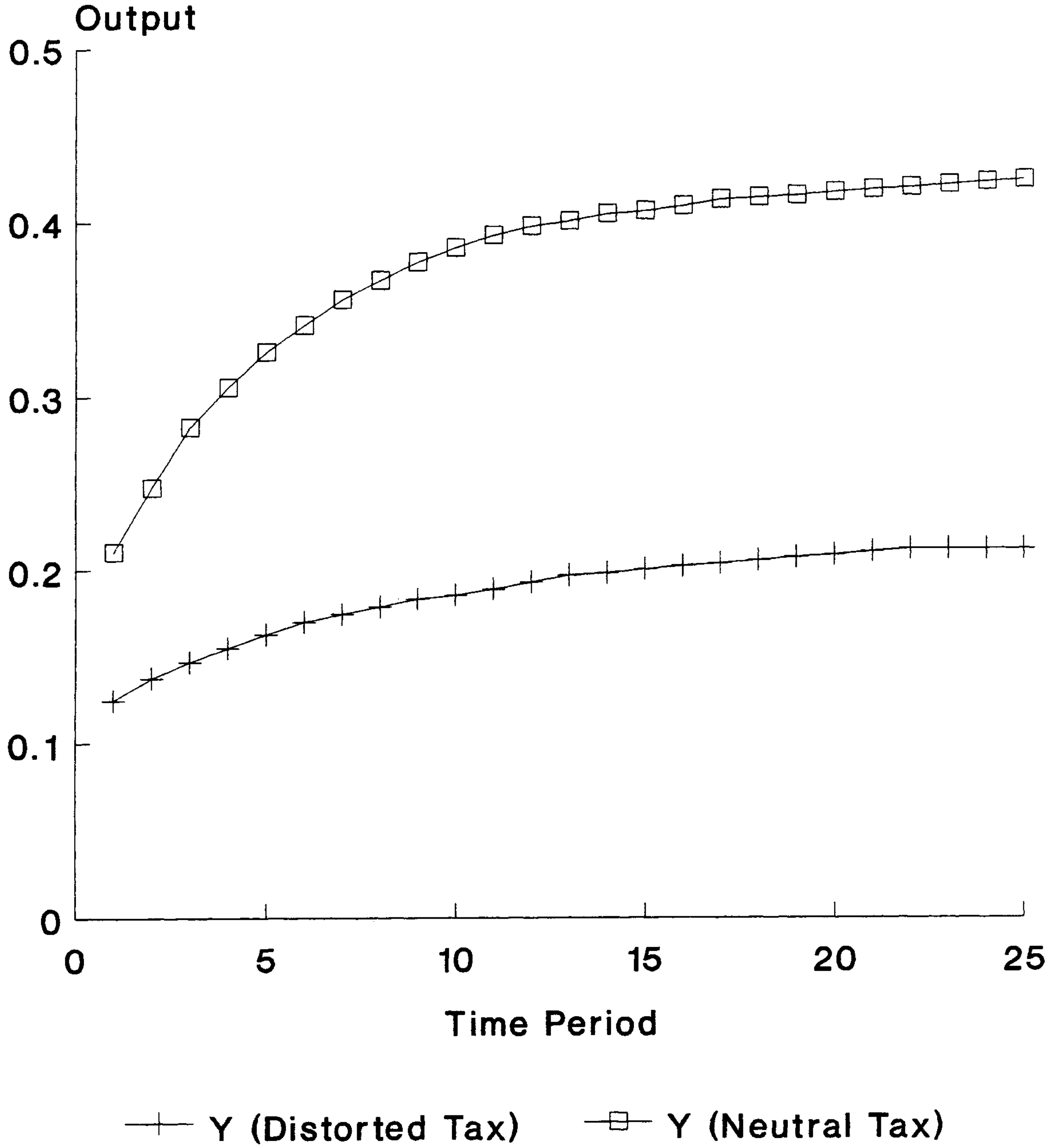


Fig. 5: Production Trajectory Distorted vs. Neutral Taxes



The steady state distributions of firms and workers look much like the initial distributions. Although capital accumulation has some tendency to concentrate production in a smaller number of establishments (as shown by Lucas 1978), this effect is small relative to other changes in the economy. Thus, Figure 6 shows the steady state distribution of firms under the distorted tax policy and the neutral tax policy, compared to the original distribution.

5.3 Conclusions of the policy experiment

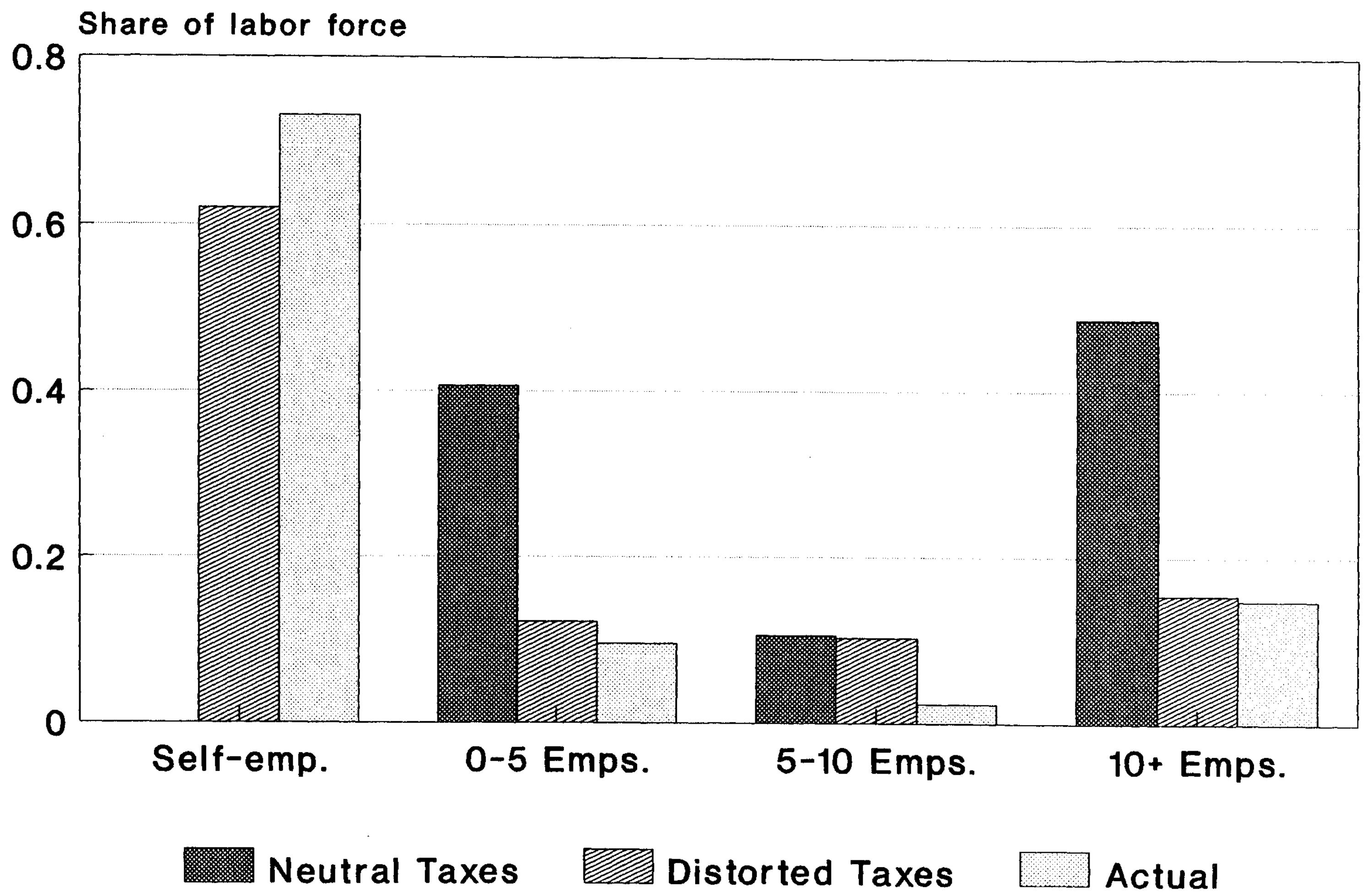
The effects of this policy experiment are dramatic. This experiment suggests that a shift to a neutral tax regime would lead to an immediate near-doubling of output due entirely to increased efficiency and productivity. The gains from the tax reform would persist and even increase over time. Although there is a modest cost in terms of heightened inequality, this would appear to be overshadowed by the gains in productivity.

5.4 Sensitivity of the model

The results attained here depend both on the structure of the model and on the parameters and scenarios used. The structure of the model implies that a shift to a neutral tax scheme will lead to reduction or elimination of self-employment combined with an increase in overall productivity. This occurs because the model defines single-person establishments to be slightly less productive than other establishments, barring distortions in the tax rate. Moreover, the model implies that concentration of production in firms with higher-ability entrepreneurs will increase the overall productivity level; a shift to fewer and larger establishments will increase efficiency.

The magnitude of these changes depends, however, on the particular policy scenario and to a limited extent on parameters. Specifically, the assumed levels of taxation in the current policy experiment are responsible for the dramatic efficiency gains associated with the shift to a neutral tax regime. Other

Fig. 6: Steady State Employment Distrib.
Actual, Neutral and Distorted Taxes



(Includes entrepreneurs)

parameters appear, on the basis of preliminary sensitivity tests, to be relatively insignificant within their plausible range. For example, ρ, θ, γ and other technological parameters could vary within moderate ranges with little effect on the results. The parameter ψ already makes self-employment a reasonably attractive option; changes in its value would only reinforce the conclusions obtained here.

6. Conclusions and implications

Several conclusions emerge from this research. First, distortions in the structure of indirect and corporate taxes have the potential to create important effects on economic efficiency and growth. Under a plausible set of parameter values, the model suggests that the Ghanaian economy would be benefitted by policy changes designed to reduce the bureaucratic and regulatory costs associated with moving from self-employment into larger establishments. Moreover, these benefits — both to individuals and to the economy — are potentially large.

A second set of conclusions involves the usefulness of models of this type. Although there are some problems in obtaining the necessary data to apply such models to developing countries, there is a high payoff in using a model that offers an explicit treatment of firm size and also an explicit dynamic general equilibrium framework. Such models open up new classes of problems for analysis and offer a valuable new tool for development policy analysis.

Finally, these results point to the need for improved data concerning the costs of taxes and regulations facing firms of different sizes. The kind of empirical work described by de Soto (1989) can improve the accuracy of models of this type and can thus lead to better prediction concerning the magnitude of changes. Moreover, other empirical work could enhance our understanding of the different costs and productivity levels of different sized firms; clearly, tax policies are only one of a number of reasons for the high level of self-employment in Ghana.

6.1 Directions for further research

The results presented in this paper depend to some degree on parameter choices and tax reform scenarios. One immediate direction for further research is to carefully examine the sensitivity of model outcomes to alternative parameter values, functional forms, and parameterizations of the policy environment.

This model lends itself well to answering questions about cross-country phenomena related to the size distribution of firms. Why are small enterprises so important in poor countries relative to rich countries? How and why does the size distribution of firms change as economies grow? Why does self-employment account for such a large proportion of the labor force in Ghana relative to the United States? A calibrated model with more serious treatment of technological growth would offer useful insights into the changing structure of production and employment and could be matched against cross-country data. Specifically, I have begun to use this model to compare Ghana's small-establishment sector with those of Mexico and the United States.[24]

Another interesting question to ask is whether policies skewing the size distribution of firms have an impact on an economy's ability to acquire technology. Suppose for example that large firms are better able than small firms to gain access to certain types of improved technologies. Then policies that penalize large firms might have a negative impact on technology adoption. This would imply that distortionary tax and regulatory policies could have even larger effects on growth.

More broadly, there are other classes of questions that can be addressed with this model. What are the effects of distortions in capital markets on the size distribution of firms and the growth trajectory? A large literature (e.g., Aryeetey et al. 1994) suggests that in developing countries, formal financial institutions

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[24]Lucas (1978) showed, in a static context, that as the economy-wide ratio of capital to labor changes, under reasonable parameter values, the wage rises relative to the rental rate of capital (and relative to the price of output, which is taken as the numéraire). This induces people to move, on the margin, from own-account entrepreneurial activities into the wage labor force. As a result, the number of firms in the economy decreases, and the average number of employees per firm increases. In a separate paper (Gollin, 1995) I reproduce Lucas's result in a dynamic model, where capital accumulates over time (and hence causes the capital/labor ratio to rise).

may not meet the needs of small-scale establishment, causing small enterprises and self-employed people to face higher effective rates of interest on borrowing. A model of this type could also be used to address land policy questions, such as the effects of land reform designed to equalize the size of establishments across individuals. A two-sector version of the model could shed some light on questions of migration and sectoral change.

The set of research issues that can be addressed with a model of this type is potentially large. Inital results suggest that this methodology can contribute to the understanding of important policy questions for developing countries.

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Appendix

Appendix Table 1: Proportion of workforce consisting of entrepreneurs, own-account workers, and unpaid family laborers: manufacturing sector and entire economy. Countries are ordered by real GDP per capita.

Country	GDP per Capita[1]	Manuf. Sector	Total Labor Force
Malawi	496		0.825
Central African Rep.	514	0.571	0.834
Nigeria	978	0.780	0.753
Honduras	1385	0.407	0.471
Pakistan	1432	0.389	0.614
Bangladesh	1510	0.792	0.745
Philippines	1689	0.279	0.508
Bolivia	1721	0.502	0.413
Egypt	1869	0.277	0.474
El Salvador	1876	0.399	0.346
Peru	2092	0.249	0.393
Morocco	2173		0.254
Paraguay	2178	0.287	0.305
Botswana	2198	0.286	0.236
Sri Lanka	2215		0.352
Guatemala	2247	0.464	0.504
Ecuador	2830	0.514	0.501
South Africa	3068		0.070
Tunisia	3075	0.302	0.289
Panama	3332	0.232	0.328
Colombia	3380	0.244	0.293
Costa Rica	3569	0.207	0.271
Iran	3685	0.397	0.407
Turkey	3807	0.311	0.573
Poland	3826	0.069	0.259
Brazil	3882	0.127	0.330
Thailand	3942	0.300	0.695
Syria	3994	0.384	0.440
Hungary	4645	0.100	0.133
Chile	4890	0.228	0.296
Uruguay	5185	0.229	0.248
Malaysia	5746	0.156	0.381
Mexico	6253	0.245	0.435
Greece	6783	0.305	0.444
Venezuela	7082	0.204	0.301
Korea, Rep.	7251	0.156	0.383
Portugal	7478	0.119	0.246
Ireland	9637	0.056	0.196
Spain	9802	0.125	0.214
Israel	9843	0.111	0.166
New Zealand	11363	0.104	0.191

Finland	12000	0.055	0.135
Singapore	12653	0.051	0.132
Italy	12721	0.141	0.252
United Kingdom	12724	0.133	0.106
Austria	12955	0.052	0.135
Netherlands	13281	0.027	0.103
Belgium	13484	0.059	0.162
France	13918	0.049	0.136
Sweden	13986	0.053	0.091
Denmark	14091	0.050	0.102
Australia	14458	0.062	0.149
Germany, W.	14709	0.044	0.099
Japan	15105	0.119	0.197
Norway	15518	0.029	0.095
Canada	16362	0.016	0.094
Hong Kong	16471	0.105	0.118
United States	17945	0.019	0.082

Source: Data on real GDP per capita are taken from the Penn World Tables, Mark 5.6. Figures are given in constant dollar terms, using 1985 as a base year, and following a Chain Index. Data on labor force structure are taken from International Labor Organization Yearbook, 1993.