Barriers to Entry and Development*

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Abstract

Perhaps the most challenging question in development economics is why some countries are so much poorer than the U.S. In this paper, we ask whether large barriers to entry are a quantitatively important reason for the income gap between the poorest countries and the U.S. Our contribution is to develop a tractable model that captures the effects of barriers to entry and that we can use to answer this question. We also model the other main classes of distortion typically considered in the development literature. We carry our model to the data and calibrate it so as to match the main macro facts of development from the Penn World Tables. We find that this requires very large barriers to entry in the poorest countries, which account for about half of their income gap with the U.S. This suggests that if barriers to entry were torn down then the poorest countries would escape poverty.

Keywords: barriers to entry; monopoly power; rent extraction; total factor productivity.

JEL classification: EO0; EO4.

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1 Introduction

Perhaps the most challenging question in development economics is why some countries are so much poorer than the U.S. In their classic book, North and Thomas (1973) argued that barriers to entry prevent the development of poor countries because they give monopoly power to groups of individuals that would lose economic rents if better technologies and more productive working arrangements were adopted. These insider groups protect their rents by blocking the adoption of better technologies and more productive working arrangements, thereby preventing development.[1] Holmes and Schmitz Jr. (1995), Parente and Prescott (1999), Acemoglu (2005), and Herrendorf and Teixeira (2005) developed this idea further. In this paper, we ask whether large barriers to entry are a quantitatively important reason for the income gap between the poorest countries and the U.S.

The evidence on the existence of barriers to entry in poor countries goes back at least to de Soto (1989). He documented that Peru had large barriers to starting a formal business and argued that this was a big reason for its poverty. Building on de Soto's work, Djankov et al. (2002) measured barriers to starting a formal business for a sample of 85 countries during 1997. They found that the developing countries of their sample had much larger barriers to starting a formal business than the developed ones. There is also some evidence on the detrimental effects of barriers to entry. To begin with, using a sample of OECD countries, Alesina et al. (2003) found that product market regulation is negatively related to investment and Nicoletti and Scarpetta (2003) found that it is negatively related to TFP. In both studies barriers to entry turn out to be the dimension of product market regulation that has the biggest negative impact. Industry case studies are another source of evidence on the detrimental effects of barriers to entry, documenting cases mostly from rich countries in which reductions in barriers to entry – and the implied increases in competition – raised labor productivity or TFP; see Clark (1987), Wolcott

[1] Lindbeck and Snower (2001) define insiders as incumbent workers that enjoy more favorable employment opportunities than others (the outsiders), on account of labor turnover costs. Here we use insiders more generally to refer to individuals that are shielded from outsider competition by entry barriers.

(1994), McKinsey-Global-Institute (1999), Holmes and Schmitz (2001a,b), Parente and Prescott (2000), Galdon-Sanchez and Schmitz Jr. (2002), Lewis (2004), and Schmitz Jr. (2005). In sum, there is evidence that barriers to entry are much larger in poor countries but exist also in rich countries. There is also evidence – mostly from rich countries – that barriers to entry are harmful. What is missing is evidence from poor countries about how harmful they are there.

Our contribution in this paper is to develop a tractable model that captures the main effects of barriers to entry and that we can carry to the data to answer our question whether barriers to entry are a quantitatively important reason for poverty. We start with a standard development model that splits the aggregate economy into an agricultural sector and many nonagriculture sectors ("manufacturing"). The agricultural sector produces agricultural consumption and the nonagricultural sectors produce manufactured consumption, intermediate goods, and capital. The agricultural sector uses the usual inputs land and labor along with intermediate inputs and capital from manufacturing. Since land is in fixed supply, the agricultural technology has decreasing returns to the reproducible factors. Preferences are such that the income elasticity of agricultural consumption is less than one ("Engel's Law").

The novelty of our work is to introduce barriers to entry and rent extraction by insider groups into this model. We follow the development literature, e.g. Parente and Prescott (1999), and assume that barriers apply to entry into manufacturing whereas entry into agriculture is free. The reasoning behind this assumption is that many agricultural goods can be produced through subsistence farming, which makes it hard to erect barriers and establish monopoly power in the agricultural sector. We also assume that insider groups in the manufacturing sectors can choose the technologies or working arrangements, and that they can extract rents by deliberately choosing inefficient technologies or working arrangements. Solving the rent–extraction problem of the insider groups is challenging here because each group needs to take into account how the capital stock in its sector reacts to its choice of technology or working arrangements. In other words, the problem of each insider group is dynamic here. We characterize the solution to this problem and show that larger barriers to entry reduce total factor productivity (TFP henceforth) and the capital–labor ratio. This is consistent with the evidence reported by Nicoletti and Scarpetta (2003) and Alesina et al. (2003). To our knowledge, we are the first to construct a model that qualitatively accounts for this evidence.

Most of the development literature has studied distortions other than barriers to entry.[2] We argue that we can capture the effects of these other distortions by higher taxes, by lower agricultural TFP, and by lower efficiency units of labor, all compared to the U.S. We define taxes broadly to include actual taxes, but also bribes, side payments, and the like.[3] Reasons for lower agricultural TFP include less fertile farm land, worse climate, or less developed transportation systems.[4] Lower efficiency units of labor capture lower endowments of human capital but also the time lost dealing with inefficient bureaucracies, overwhelming regulation, and similar obstacles.

To take this model to the data, we identify the U.S. with the undistorted model economy, for which we use off–the–shelf parameter values to the extent possible. We then choose the sizes of barriers to entry and of the other three classes of distortions so as to match quantitatively the cross–sectional variation in the main macro statistics of development reported by the Penn World Tables 96 (PWT96 henceforth). A qualitative summary of these statistics is as follows: poor countries have larger shares of the workforce in agriculture than rich countries, larger shares of agricultural goods in consumption, smaller shares of investment in output, and higher relative prices of investment goods and food.

We find that matching these macro–facts of development requires very large barriers to entry in the poorest countries, which account for about half of their income gap with the U.S. Moreover, there are relatively large taxes and low efficiency units of labor in these countries, which each account for around twenty percent of the observed cross–country

[2]A recent example is Hsieh and Klenow (2007).

[3]See Restuccia and Urrutia (2001) and Herrendorf and Valentinyi (2006) for further discussion.

[4]See Herrendorf et al. (2007) on transportation and agricultural productivity.

differences in income. Agricultural TFP in the poorest countries is also considerably lower than in the U.S. but this leads to income differences of less than five percent only. In sum, we find that large barriers to entry are the most important reason for why some countries are so poor. Our finding that cross–country differences in the efficiency units of labor account for around twenty percent of the income gap with the U.S. is close to what development–accounting studies find about cross–country differences in human capital; see e.g. Hall and Jones (1999), Hendricks (2002), and **?**. This is remarkable because our calibration strategy does not use any information about cross–country differences in years of schooling, from which these studies construct their measures of human capital.

Although we have not directly targeted this, our calibrated model also predicts that the cross–country labor productivity gap in agriculture is many times the gap in nonagriculture. This is consistent with the evidence from the development literature that the problem of poor countries lies in their agricultural sectors.[5] Importantly, our model delivers this although the most important distortion – barriers to entry – applies to nonagriculture. The main reason for this is that barriers increase the relative prices of both intermediate goods and capital, which drastically decreases the use of these two factors of production in agriculture.[6]

Our paper contributes to the recent development literature that offers theories of cross–country differences in TFP and income. Examples include Holmes and Schmitz Jr. (1995), Stokey (1995), Parente and Prescott (1999), Acemoglu and Robinson (2000), Acemoglu and Zilibotti (2001), Restuccia and Rogerson (2003), Amaral and Quintin (2004), Herrendorf and Teixeira (2005), and Erosa and Hidalgo (2007). The variety of possible ways in which distortions can affect TFP and income suggests that there are several, not just one, answers to the question why are some countries are so much poorer than the U.S. Here we establish that large barriers to entry are a major distortion that must not be ignored.

[5]Some classic references are Schultz (1964), Ruttan and Hayami (1970), and Kuznets (1971). Recent references are Caselli (Forthcoming: 2005) and Restuccia et al. (2006).

[6]A similar propagation mechanism is present in the work of Schmitz (2001) about government inefficiencies in investment production.

Since barriers to entry lead to monopoly power of the insider groups, our work also contributes to the literature on the cost of monopoly. Harberger (1954) argued that this cost is small if monopoly just increases the price and reduces the quantity. While Laitner (1982) subsequently pointed out that the cost of monopoly can be larger when there is capital, he still estimated it to be a few percentage points of GDP only. More recently, Parente and Prescott (1999) argued that monopoly can be much more detrimental if it also decreases TFP. Our work goes beyond Parente and Prescott (1999) in two crucial dimensions. First, we model the interaction between monopoly and capital accumulation whereas they used a static model without capital accumulation. While abstracting from capital accumulation simplifies matters, it does shut down an important channel through which the detrimental effects of monopoly get propagated to the whole economy. Second, except for barriers to entry and the other classes of distortions, we have written down a standard development model with capital that we can carry to the data and use to measure the costs of the monopoly power implied by barriers to entry. In contrast, the model of Parente and Prescott (1999) does not naturally lend itself to measurement.

The next section lays out the environment and section 3 defines the equilibrium. In section 4, we show existence and uniqueness of equilibrium and characterize the differences between the equilibrium of the undistorted and the equilibrium of the distorted economy. Section 5 describes our calibration and reports findings. We conclude with a discussion of our modeling assumptions in section 6. An Appendix contains all proofs.

2 Environment

Time t is discrete and there is no uncertainty. The economy is populated by a measure one of households, which have identical preferences over sequences of an agricultural and a manufactured consumption good. We represent preferences by a time–separable utility function $\sum_{t=0}^{\infty} \beta^t u(c_{at}, c_{mt})$ with a period utility from the Stone–Geary class of non–homothetic utility functions:

$$u(c_a, c_m) = \alpha \log(c_a - \underline{c}) + (1-\alpha)\log(c_m).$$

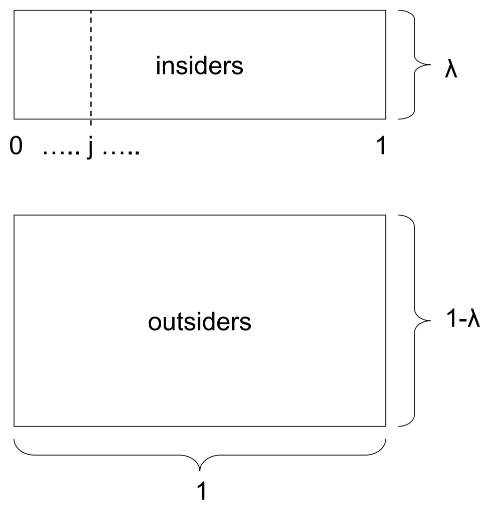
$\beta \in (0,1)$ is the discount factor, c_a and c_m are the consumption of the agricultural and the manufactured good, and $\alpha \in (0,1)$ is a relative weight. The positive constant $\underline{c}$ implies that the income elasticity of agricultural consumption will be smaller than one and Engel's Law will hold.

In each period households are endowed with one unit of labor. In the initial period they are also endowed with equal shares l of the total available land and with strictly positive quantities b_0 of capital. Capital depreciates at rate $\delta \in (0,1)$.

There are three final goods sectors, which produce agricultural consumption, manufactured consumption, and investment. There is also a continuum of sectors $j \in [0,1]$ that produce intermediate inputs for the final good sectors. We will refer to the first sector as agriculture and to all remaining sectors as manufacturing. While the two final manufacturing sectors use intermediate inputs only, the agricultural sector uses also capital, land, and labor. The intermediate good sectors themselves use capital and labor but no other intermediate goods.

Households differ in their type. A measure $1-\lambda$ are outsiders, which are all identical. A measure $\lambda \in (0,1)$ are insiders in one of the intermediate good sectors $j \in [0,1]$. The density over the insiders of the different intermediate good sectors is uniform. In other words, there are equally many insiders in all intermediate–good sectors. Figure 1 illustrates the resulting distribution of household types. The type determines where the household can use its labor endowment. The insiders of type $j \in (0,1)$ can transform their labor endowment into insider labor services in intermediate good sector j and into labor services in agriculture. Each outsider can transform his labor endowment into outsider labor services in any intermediate good sector and into labor services in agriculture. Note that for simplicity we do not allow the insiders of type j to transform their labor endowment into outsider labor services in other intermediate good sectors $n \neq j$. Note

Figure 1: The household types



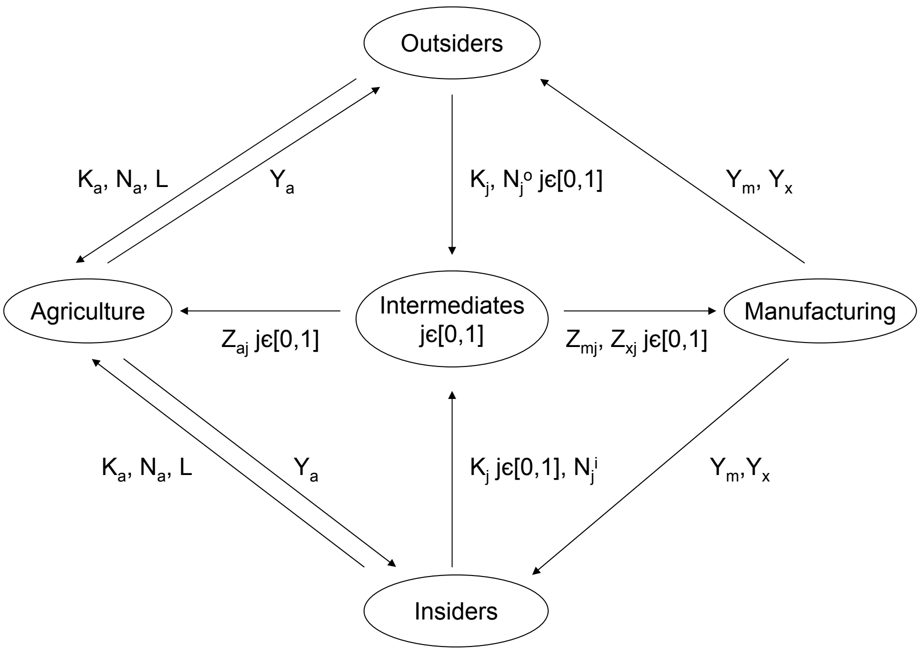
too that for simplicity all households have the same endowments of labor and land, so only the physical capital endowment may depend on the household type.

Before we specify the technologies, we summarize the key features of our environment in Figure 2. The figure illustrates that all households rent capital, K_a, labor N_a, and land, L, to the agricultural sector and capital, K_j, to the intermediate good sectors. The difference between outsiders and insiders is that the outsiders rent outsider labor, N_j^o, to all intermediate good sectors whereas the insiders rent insider labor, N_j^i, only to their intermediate good sector. All households purchase agricultural consumption goods, Y_a, from agriculture and manufactured consumption goods, Y_m, and investment goods, Y_x, from final manufacturing. The intermediate good sectors sell intermediate inputs Z_{aj} to agriculture and Z_{mj} and Z_{xj} to the final manufacturing sectors.

We now specify the different technologies. All technologies have constant returns and in each sector there is a stand–in firm that behaves competitively. The agricultural sector produces according to:

$$Y_a = A_a {K_a}^{\theta_k} L^{\theta_l} (\psi N_a)^{\theta_n} {Z_a}^{\theta_z}, \qquad \text{where } Z_a \equiv \left(\int_0^1 {Z_{aj}}^{\frac{\sigma-1}{\sigma}} dj \right)^{\frac{\sigma}{\sigma-1}}. \tag{1}$$

Figure 2: Environment



A_a is agricultural TFP and $\psi \in (0, 1]$ are the efficiency units of labor per unit of labor rented. $\theta_k, \theta_l, \theta_n, \theta_z \in (0, 1)$ are the share parameters of capital, land, labor, and intermediate inputs. Constant returns require $\theta_k + \theta_l + \theta_n + \theta_z = 1$. The elasticity of substitution between the intermediate goods is denoted by σ.

The final manufacturing sectors produce according to:

$$Y_m = Z_m = \left(\int_0^1 Z_{mj}{}^{\frac{\sigma-1}{\sigma}} dj \right)^{\frac{\sigma}{\sigma-1}},$$
$$Y_x = A_x Z_x = A_x \left(\int_0^1 Z_{xj}{}^{\frac{\sigma-1}{\sigma}} dj \right)^{\frac{\sigma}{\sigma-1}}.$$

A_x is the TFP of producing investment goods from intermediate goods.

Each intermediate good can be produced with a technology that uses capital and insider labor only and a technology that uses capital and outsider labor. We indicate the two technologies by the superscripts i and o, so Z_j^i and Z_j^o are the quantities of intermediate good j produced with insider and outsider labor. The technologies are:

$$Z_j^i = A_j^i (K_j^i)^\theta (\psi N_j^i)^{1-\theta}, \tag{2a}$$

$$Z_j^o = A^o (K_j^o)^\theta (\psi N_j^o)^{1-\theta}. \tag{2b}$$

A_j^i is specific to the insider technology in intermediate good sector j whereas A^o applies to all outsider technologies. The use of intermediate inputs in the final good sectors may not exceed the sum of the intermediate goods produced with both technologies:

$$Z_{aj} + Z_{mj} + Z_{xj} \leq Z_j^i + Z_j^o.$$

We follow the development literature and consider tax distortions as a possible source of relative price variation. We lump sum rebate the tax revenues to the households. Taxes are broadly defined as any distortions that increases a goods price and that leads to income for some agents. Examples are value–added taxes, tariffs, bribes, and rents from monopoly power other than those accruing in the labor markets of the intermediate good sectors. Since we have three final goods and since we rebate the tax revenues, it is sufficient to consider the two final–goods taxes τ_a on agricultural consumption and τ_x on investment. We also consider a tax τ_z on intermediates used in agriculture.

We finish the description of the environment with the market structure. Trade takes place in sequential markets. In each period there are markets for both consumption goods, the investment good, capital, land, outsider labor, each type of insider labor, and each intermediate good.

3 Equilibrium Definition

We distinguish between an undistorted and a distorted version of our model economy. We normalize $A_a = 1$ for the undistorted economy and restrict $A_a \leq 1$ for the distorted economy. We denote by $\overline{A}$ the largest possible value of A_j^i and A^o.

If $\psi = A_a = 1$, $A^o = \overline{A}$, and $\tau_a = \tau_x = \tau_z = 0$ the model economy is undistorted and the insider and outsider technologies are identical. Household types then are just names that do not have any consequences for equilibrium prices or quantities. We set $A_j^i = \overline{A}$ in this case.

If $\psi, A_a \in (0, 1]$, $A^o \in (0, \overline{A})$, and $\tau_a, \tau_x, \tau_z \in (-\infty, \infty)$, then our model economy is distorted. The primitive ψ captures everything that reduces the efficiency units of labor that get supplied when households work for unit of time. This includes not only the effects of lower human capital endowments but also those of inefficient bureaucracies or overwhelming regulation. The primitive A_a summarizes everything that makes agriculture less efficient, for example less fertile farm land, worse climate, or less developed transportation systems.[7]

The primitive A^o summarizes the barriers that outsiders face when they enter the nonagricultural sectors. We express them as a share of output instead of a fixed entry cost because this maintains constant returns.[8] Note that entry barriers apply when households want to leave agriculture and enter nonagriculture. The reason is that most agricultural goods are easily produced in the unofficial economy or in subsistence farming. This should make it hard to erect barriers and establish monopoly power in the agriculture sector. There are different interpretations for A^o. Caselli and Coleman (2001) argue that working in nonagricultural requires a minimum degree of human capital (e.g. literacy) that is not required in agriculture. Since we have assumed that all households in an economy have the same ψ, A^o picks up that the outsiders may be less educated than the insiders, and so they may have a lower marginal product in nonagriculture. Second, as discussed in the introduction, poor countries are plagued by many formal and informal barriers to entry. For example, de Soto (1989) gives a detailed account of the mindboggling variety of administrative steps and bureaucratic procedures required to start a formal business in Peru. In addition, there are accounts of many informal barriers to entry. They often

[7] See Herrendorf et al. (2007) on transportation and agricultural productivity.

[8] This could be derived in a more disaggregate environment where the outsiders pay a fixed cost to start operating a decreasing–returns–to–scale technology in an intermediate good sector.

result from the preferential treatment of insiders, for example in the form of subsidized credit.

We assume that the insiders of each intermediate good sector can exploit the monopoly power resulting from the entry barriers by acting as a group: in each period the group of insiders of type j collectively chooses next period's TFP for its insider technology, $A_j^{i\prime} \in [0, \overline{A}]$. This choice happens simultaneously with the other decisions. As Holmes and Schmitz Jr. (1995) and Parente and Prescott (1999), we assume away problems of coordination or free riding.

The choices of each insider group are strategic at the sector level in that it takes into account how its TFP choice affects the relative price of its intermediate good, the capital and labor allocated to its sector, and the consumption and investment choices of its members. In contrast, the insider groups take as given all *aggregate* variables. In other words, each insider group is large in its intermediate–good sector but small with respect to the rest of the economy.

Before we go into the details of our equilibrium concept we sketch its broad features. Since the different insiders, outsiders, and insider groups each solve identical problems, we focus on symmetric equilibrium. We also focus on recursive equilibrium in which all decision makers condition their actions in each period only on the observable state variables. Moreover, except for the choices of the insider groups, all agents behave competitively.

We start with the description of the state variables.[9] Since we focus on symmetric equilibrium, all intermediate good sectors, insider types, and outsider types will each have the same equilibrium allocations. We therefore simplify our notation and drop the sector index j. We denote individual state variables by lower–case letters: b^i and b^o are the capital holdings of a particular insider and a particular outsider. We denote sector–wide state variables by upper case letters: the insider TFP of a particular intermediate good sector is A^i and the capital holdings of the other insiders of this sector are B^i. We denote economy–wide state variables by upper–case calligraphic letters: $\mathcal{A}^i$ is the insider TFP

[9] The following material draws on Teixeira (1999).

in the other sectors, $\mathcal{B}^i$ are the capital holdings of the insiders in the other sectors, and $\mathcal{B}^o$ are the capital holdings of the other outsiders.

In sum, the individual state is (b^i, b^o), the sector–wide state is (A^i, B^i), and the economy–wide state is $(\mathcal{A}^i, \mathcal{B}^i, \mathcal{B}^o)$. The laws of motions of the sector–wide and the economy–wide states are given by:

$$
\begin{aligned}
(A^i, B^i)' &= G(\mathcal{A}^i, \mathcal{B}^i, \mathcal{B}^o, A^i, B^i), \qquad && \text{where } G = (G_1, G_2), \\
(\mathcal{A}^i, \mathcal{B}^i, \mathcal{B}^o)' &= \mathcal{G}(\mathcal{A}^i, \mathcal{B}^i, \mathcal{B}^o), && \text{where } \mathcal{G} = (\mathcal{G}_1, \mathcal{G}_2, \mathcal{G}_3).
\end{aligned}
$$

To economize on the notation, we abbreviate some state variables: $S \equiv (A^i, B^i)$ and $\mathcal{S} \equiv (\mathcal{A}^i, \mathcal{B}^i, \mathcal{B}^o)$.

We choose manufactured consumption as the numeraire. The relative prices of agricultural goods and capital and the rental prices of outsider labor, capital, and land are functions of the aggregate state only: $p_a(\mathcal{S})$, $p_x(\mathcal{S})$, $w^o(\mathcal{S})$, $r_k(\mathcal{S})$, and $r_l(\mathcal{S})$. The relative price of a particular intermediate good and the rental price of a particular type of insider labor depend also on the insider TFP in the corresponding intermediate good sector: $p_z(\mathcal{S}, A^i)$ and $w^i(\mathcal{S}, A^i)$.

We now describe the households' problems. Recall that households can invest in any sector of the economy irrespective of whether they work there or not. Consequently the capital stock that the insiders own differs in general from the capital stock with which they produce. To emphasize this we have represented the two different capital stocks by the different symbols B^i and K^i.

A particular outsider chooses his current consumption and future capital stock, taking as given the economy–wide state $\mathcal{S}$, the corresponding law of motion $\mathcal{G}$, and his own capital stock b^o:

$$
\begin{aligned}
v^o(\mathcal{S}, b^o) = & \max_{c_a^o, c_m^o, b^{o\prime} \geq 0} \{u(c_a^o, c_m^o) + \beta v^o(\mathcal{S}', b^{o\prime})\} \qquad (3) \\
s.t.\ \ & (1+\tau_a)p_a(\mathcal{S})c_a^o + c_m^o + (1+\tau_x)p_x(\mathcal{S})[b^{o\prime} - (1-\delta)b^o] \\
& \qquad = r_k(\mathcal{S})b^o + w^o(\mathcal{S}) + r_l(\mathcal{S})l + T^o(\mathcal{S}), \\
& \mathcal{S}' = \mathcal{G}(\mathcal{S}),
\end{aligned}
$$

where v^o denotes his value function and $T^o(\mathcal{S})$ denotes the lump sum tax rebate to each outsider. The solution to this problem implies the outsider policy function $(c_a^o, c_m^o, b^{o\prime})$ $(\mathcal{S}, b^o)$.[10]

A particular insider chooses his current consumption and future capital stock, taking as given the economy–wide state $\mathcal{S}$, the corresponding law of motion $\mathcal{G}$, its sector's state S, the corresponding law of motion G, and his own capital stock b^i:

$$
\begin{aligned}
v^i(\mathcal{S}, S, b^i) = & \max_{c_a^i, c_m^i, b^{i\prime} \geq 0} \{u(c_a^i, c_m^i) + \beta v^i(\mathcal{S}', S', b^{i\prime})\} \qquad (4) \\
s.t.\ \ & (1+\tau_a)p_a(\mathcal{S})c_a^i + c_m^i + (1+\tau_x)p_x(\mathcal{S})[b^{i\prime} - (1-\delta)b^i] \\
& \qquad = r_k(\mathcal{S})b^i + w^i(\mathcal{S}, A^i) + r_l(\mathcal{S})l + T^i(\mathcal{S}), \\
& (\mathcal{S}, S)' = (G(\mathcal{S}), G(\mathcal{S}, S)),
\end{aligned}
$$

where $T^i(\mathcal{S})$ denotes the lump sum tax rebate to each insider. The solution to this problem implies the insider policy function $(c_a^i, c_m^i, b^{i\prime})(\mathcal{S}, S, b^i)$.

We continue with the problem of each insider group. Recall that while it takes all aggregate price functions and laws of motion as given, it takes into account how its TFP choice affects the relative price of its intermediate good, the capital and labor used with its insider technology, and the consumption and investment choices of its members. So, it chooses $A^{i\prime}$ so as to maximize the indirect utility of its members plus the continuation

[10]Note that to economize on notation we have omitted profits. This is without loss of generality because constant returns and price–taking behavior imply that they are zero.

value, taking as given the economy–wide state $\mathcal{S}$, the corresponding law of motion $\mathcal{G}$, the sector–wide state S, and the law of motion of the sector–wide insider capital, G_2:

$$V^i(\mathcal{S}, S) = \max_{A^{i\prime} \in [0, \overline{A}]} \{u((c_a^i, c_m^i)(\mathcal{S}, S, B^i)) + \beta V^i(\mathcal{S}', S')\} \tag{5}$$
$$s.t. \;\; (\mathcal{S}, \mathcal{B}^i)' = (G(\mathcal{S}), G_2(\mathcal{S}, S)).$$

A solution to this problem implies the policy function $A^{i\prime}(\mathcal{S}, S)$.

We now turn to the sector allocation functions. All input factors and production quantities except for those of the intermediate good sector depend just on the aggregate state S: $(Y_a, K_a, L, N_a, Z_a)(\mathcal{S})$, $(Y_m, Z_m)(\mathcal{S})$, $(Y_x, Z_x)(\mathcal{S})$. Those of the intermediate good sector depend also on insider TFP A^i: $(Z^i, K^i, N^i, Z^o, K^o, N^o)(\mathcal{S}, A^i)$. Listing the supplies of the different goods on the left–hand sides and the demands on the right–hand sides, market clearing requires:

$$Y_a(\mathcal{S}) = (1-\lambda)\, c_a^o(\mathcal{S}, b^o) + \lambda\, c_a^i(\mathcal{S}, S, b^i), \tag{6a}$$

$$Y_m(\mathcal{S}) = (1-\lambda)\, c_m^o(\mathcal{S}, b^o) + \lambda\, c_m^i(\mathcal{S}, S, b^i), \tag{6b}$$

$$Y_x(\mathcal{S}) = (1-\lambda)\, b^{o\prime}(\mathcal{S}, b^o) + \lambda\, b^{i\prime}(\mathcal{S}, S, b^i) - (1-\delta)[(1-\lambda)\, b^o + \lambda\, b^i], \tag{6c}$$

$$Z^i(\mathcal{S}, A^i) + Z^o(\mathcal{S}, A^i) = Z_a(\mathcal{S}) + Z_m(\mathcal{S}) + Z_x(\mathcal{S}), \tag{6d}$$

$$(1-\lambda)\, b^o + \lambda\, b^i = K_a(\mathcal{S}) + K^o(\mathcal{S}, A^i) + K^i(\mathcal{S}, A^i), \tag{6e}$$

$$N^i(\mathcal{S}, A^i) \leq \lambda, \qquad N^o(\mathcal{S}, A^i) \leq 1-\lambda, \tag{6f}$$

$$1 - N^i(\mathcal{S}, A^i) - N^o(\mathcal{S}, A^i) = N_a(\mathcal{S}), \tag{6g}$$

$$(1-\lambda)l + \lambda l = l = L(\mathcal{S}). \tag{6h}$$

The first three conditions require that the markets for the two consumption goods and for investment clear. The fourth condition requires that the market for a particular intermediate good clears, and the fifth condition requires that the market for capital clears. The next two conditions require that the markets for the different types of labor clear. The last condition requires that the market for land clears.[11]

Several consistence requirements have to hold in equilibrium. To begin with, the economy–wide states, the sector–wide states, and the individual states need to be consistent with each other:

$$\mathcal{A}^i = A^i, \tag{7a}$$

$$\mathcal{B}^i = B^i = b^i, \tag{7b}$$

$$\mathcal{B}^o = b^o. \tag{7c}$$

The laws of motion that the decision makers take as given when they make their choice need to be consistent with their policy functions:

$$\mathcal{G}_1(\mathcal{S}) = G_1(\mathcal{S}, \mathcal{A}^i, \mathcal{B}^i) = A^{i\prime}(\mathcal{S}, \mathcal{A}^i, \mathcal{B}^i), \tag{7d}$$

$$\mathcal{G}_2(\mathcal{S}) = G_2(\mathcal{S}, \mathcal{A}^i, \mathcal{B}^i) = b^{i\prime}(\mathcal{S}, \mathcal{A}^i, \mathcal{B}^i, \mathcal{B}^i), \tag{7e}$$

$$\mathcal{G}_3(\mathcal{S}) = b^{o\prime}(\mathcal{S}, \mathcal{B}^o). \tag{7f}$$

Moreover the value function of the insider group needs to consistent with the value function of the particular insider:

$$V^i(\mathcal{S}, \mathcal{A}^i, \mathcal{B}^i) = v^i(\mathcal{S}, \mathcal{A}^i, \mathcal{B}^i, \mathcal{B}^i). \tag{7g}$$

Finally the lump sum rebates need to equal the tax revenues:

$$T^o(\mathcal{S}) = \tau_z p_z(\mathcal{S}) Z_a(\mathcal{S}) + \tau_a p_a(\mathcal{S}) c_a^o(\mathcal{S}, \mathcal{B}^o) + \tau_x p_x(\mathcal{S})[b^{o\prime}(\mathcal{S}, \mathcal{B}^o) - (1-\delta) b^o], \tag{7h}$$

$$\begin{aligned} T^i(\mathcal{S}) &= \tau_z p_z(\mathcal{S}) Z_a(\mathcal{S}) \\ &\quad + \tau_a p_a(\mathcal{S}) c_a^i(\mathcal{S}, \mathcal{A}^i, \mathcal{B}^i, \mathcal{B}^i) + \tau_x p_x(\mathcal{S})[b^{i\prime}(\mathcal{S}, \mathcal{A}^i, \mathcal{B}^i, \mathcal{B}^i) - (1-\delta) b^i]. \end{aligned} \tag{7i}$$

[11]Note that in symmetric equilibrium we can drop the integrals. Note too that we have abstracted from borrowing and lending between insiders and outsiders. This is without loss of generality because below we focus attention on steady state equilibrium.

Definition 1 (Equilibrium in the undistorted economy) *Given* $\mathcal{A}^i = A^i = A^o = \overline{A}$, $\psi = A_a = 1$, *and* $\tau_a = \tau_x = \tau_z = 0$, *an equilibrium in the undistorted economy is*

– *price functions* p_a, p_z, p_x, w^o, w^i, r_k, r_l

– *sector allocation functions* (Y_a, K_a, L, N_a, Z_a), (Y_m, Z_m), (Y_x, Z_x), $(Z^i, K^i, N^i, Z^o, K^o, N^o)$

– *laws of motion* $(\mathcal{G}, G)$

– *value functions* v^o, v^i

– *policy functions* $(c_a^o, c_m^o, b^{o\prime})$, $(c_a^i, c_m^i, b^{i\prime})$

such that:

– *all production factors are paid their marginal products*

– *the value functions satisfy* (3)–(4)

– *the policy functions solve* (3)–(4)

– *the market clearing conditions* (6) *hold*

– *the consistency requirements* (7) *are satisfied.*

Definition 2 (Equilibrium in the distorted economy) *Given* $A^o \in (0, \overline{A})$, $\psi, A_a \in (0, 1]$, *and* $\tau_a, \tau_x, \tau_z \in (-\infty, \infty)$, *an equilibrium in the distorted economy is*

– *price functions* p_a, p_x, p_z, w^o, w^i, r_k, r_l

– *tax rebate functions* T^o, T^i

– *sector allocation functions* (Y_a, K_a, L, N_a, Z_a), (Y_m, Z_m), (Y_x, Z_x), $(Z^i, K^i, N^i, Z^o, K^o, N^o)$

– *laws of motion* $(\mathcal{G}, G)$

– *value functions* v^o, v^i, V^i

– *policy functions* $(c_a^o, c_m^o, b^{o\prime})$, $(c_a^i, c_m^i, b^{i\prime})$, $A^{i\prime}$

such that:

– *if a production factor is used in a sector, then it is paid its marginal value product; if a production factor is not used in a sector, then its marginal value product does not exceed its rental rate;*

– *the value functions satisfy* (3)–(5)

– *the policy functions solve* (3)–(5)

– *the market clearing conditions* (6) *hold*

– *the consistency requirements* (7) *are satisfied.*

4 Steady State Equilibrium: Existence, Uniqueness, and Characterization

We now show the existence and uniqueness of the steady–state equilibria in both economies and we characterize the differences between them. Since our utility function features a subsistence level of agricultural consumption $\underline{c}$, existence of equilibrium requires that the agricultural sector can produce this subsistence level. Conditions (22a) and (24b) in the appendix ensure this for the undistorted and distorted economy, respectively.

Proposition 1 (Steady–state equilibrium in the undistorted economy)
Let $\mathcal{A}^i = A^i = A^o = \overline{A}$ *be such that condition* (22a) *in the appendix is satisfied. Then there exists a unique steady state equilibrium.*

Proof. See Appendix A.2.

In the distorted economy existence of steady–state equilibrium also requires that the insider groups are not too large and the upper bound $\overline{A}$ on the insider productivity is not too small. The two inequalities of (24c) in the appendix ensure that this is the case.

Proposition 2 (Steady–state equilibrium in the distorted economy)
Let $\sigma \in (0,1)$*,* $A^o \in (0, \overline{A}]$ *and* $(\psi, A_a, \lambda, \overline{A}, \tau_a, \tau_x, \tau_z)$ *be such that conditions* (24b) *and* (24c) *in the appendix are satisfied.*

- *There exists a unique steady state equilibrium.*
- *In the steady–state equilibrium the insiders work only in their intermediate good sectors, and they strictly prefer this; the outsiders work only in agriculture, and they are indifferent between this and working in the intermediate good sectors.*

- *The steady–state equilibrium value of A^i lies in $[A^o, \overline{A}]$, and it decreases if A^o decreases or λ increases.*

Proof. See Appendix A.3.

To gain intuition for these results, it may be useful to consider for a moment a monopolist producer in an intermediate sector, instead of a group of insiders. Such a monopolist would increase the relative price of the intermediate good above the competitive one so as to restrict production. Demand is inelastic here, $\sigma \in (0, 1)$, so he would increase the relative price until potential entrants are just indifferent between entering and staying out. The difference with an insider group is that it cannot *directly* choose a higher relative price of the intermediate good it produces because that price is determined by the competitive firms. However, the insider group can *indirectly* choose a higher relative price by choosing lower TFP. With inelastic demand for intermediate goods, this increases the relative price by more than it decreases the insiders' marginal product, so it increases the real insider marginal value product.

An insider groups' monopoly power is limited by the possible entry of outsiders into its intermediate goods sector. If outsiders enter, then the relative price must be such that the outsider marginal value product is the same in the intermediate good sector and in agriculture. Choosing an even lower TFP then decreases the marginal insider product, but it does not affect the relative price anymore. So, choosing an even lower TFP then decreases the insider marginal value product and makes the insider group worse off. Taking these two arguments together it follows that the insider groups choose $A^{i\prime}$ such that the outsiders are just indifferent between entering the intermediate good sector and staying out.

We can also provide some intuition for the comparative static results of proposition 2. To begin with, the lower is A^o the larger is the relative price of intermediate goods that makes the outsiders indifferent between working in agriculture and the intermediate–good sector. Since choosing a lower $A^{i\prime}$ increases p_i as long as the outsiders strictly prefer agriculture, a lower A^o makes choosing a lower $A^{i\prime}$ optimal. Turning to the comparative statics of the group size, larger insider groups can produce a given demand for their product with lower $A^{i\prime}$. So a larger λ decreases the optimal $A^{i\prime}$. Note that these arguments are related to the necessary conditions for existence, (24c), which require that $\overline{A}$ is large enough and λ is not too large. The first condition ensures that the insider groups can satisfy the demand for their product when they choose $A^i = \overline{A}$ and the second condition ensures that the insiders do not produce more than the demand for their product when they choose $A^i = A^o$.

The result that larger barriers to entry (a smaller A^o) reduce the TFP of the intermediate goods sectors is consistent with a large body of evidence. To begin with Nicoletti and Scarpetta (2003) found that product market regulation is negatively related to TFP in a panel of OECD countries. Importantly, barriers to entry are the most crucial element of product market regulation. Moreover, Nickell (1996) found that more competition in UK sector led to higher TFP growth. Finally, many industry case studies for developed and developing countries found that more competition increase labor productivity and TFP; see for example Clark (1987), Wolcott (1994), McKinsey-Global-Institute (1999), Holmes and Schmitz (2001a,b), Parente and Prescott (2000), Galdon-Sanchez and Schmitz Jr. (2002), Lewis (2004), and Schmitz Jr. (2005).

For the quantitative work that follows it is important to realize that entry barriers and rent extraction do not only have a direct effect on the TFP of the intermediate good sectors but also important indirect effects. The first one works through the capital–labor ratios in the intermediate good sectors. Equation (14e) of Appendix A.1 shows that the capital–labor ratios in the intermediate good sectors decrease in A^i:

$$\frac{K^i}{\lambda} = (A^i)^{\frac{1}{1-\theta}} \psi \left[\frac{A_x \beta \theta}{(1+\tau_x)[1-\beta(1-\delta)]} \right]^{\frac{1}{1-\theta}} . \tag{8a}$$

Since A^i decreases when A^o decreases larger barriers imply a lower capital–labor ratio in the intermediate good sectors. The second indirect effect works through the relative prices of capital and intermediate goods on agriculture's use of these two input factors. Larger barriers increase these relative prices, which reduces the capital–labor ratio and the intermediates–labor ratio in agriculture. Equations (16b) and (16c) of Appendix A.1 show this formally:

$$\frac{K_a}{1-\lambda} = (A^o)^{\frac{1}{1-\theta}} \psi \, \frac{\theta_k(1-\theta)}{\theta_n \theta} \left[\frac{A_x \beta \theta}{(1+\tau_x)[1-\beta(1-\delta)]} \right]^{\frac{1}{1-\theta}}, \tag{8b}$$

$$\frac{Z_a}{1-\lambda} = (A^o)^{\frac{1}{1-\theta}} \psi \, \frac{\theta_z(1-\theta)}{\theta_n (1+\tau_z)} \left[\frac{A_x \beta \theta}{(1+\tau_x)[1-\beta(1-\delta)]} \right]^{\frac{\theta}{1-\theta}}. \tag{8c}$$

Putting (8a) and (8b) together, we obtain an expression for the aggregate capital–labor ratio in the distorted economy, which also decreases when A^o decreases:

$$\frac{K}{N} = K = \psi \left[\lambda (A^i)^{\frac{1}{1-\theta}} + (1-\lambda)(A^o)^{\frac{1}{1-\theta}} \frac{\theta_k(1-\theta)}{\theta_n \theta} \right] \left[\frac{A_x \beta \theta}{(1+\tau_x)[1-\beta(1-\delta)]} \right]^{\frac{1}{1-\theta}}.$$

In sum larger barriers (a smaller value of A^o) reduce the capital–labor ratio in all sectors and on the aggregate. This is consistent with the evidence reported by Alesina et al. (2003). A similar propagation mechanism is present in the work of Schmitz (2001), who argued that if the government produces investment goods inefficiently, then this reduces the labor productivity of all sectors that use these investment goods. Schmitz found sizeable effects on income of around a factor 3.

5 Quantitative Analysis

5.1 Calibration

We calibrate our model economy by mapping the undistorted economy into the U.S. economy. We choose to do this because the U.S. economy has relatively small distortions and is the biggest and most studied developed economy. We map the distorted economy into the aggregate of the 34 poorest countries in the 1996 Benchmark Data of the Penn World Tables (PWT96 henceforth). We choose these 34 countries because the poorest 25% of the sample population live in them.[12] We aggregate over these 34 countries instead

[12]From poorest to richest, they are: Tanzania, Malawi, Yemen, Madagascar, Zambia, Mali, Tajikistan, Nigeria, Benin, Sierra, Leone, Mongolia, Kenya, Congo, Bangladesh, Nepal, Senegal, Vietnam, Pakistan,

calibrating our model country by country because we will use data from two different sources, namely the PWT96 and the FAO. Unfortunately the FAO data is only available for 24 of the 34 poorest countries of the PWT96.

Table 1: Individually calibrated parameters

β	δ	θ	θ_k	θ_l	θ_n	θ_z	A_x	τ_x	λ	l^{PC}	l^{US}
0.94	0.06	0.33	0.13	0.14	0.26	0.47	1.32	2.2	0.36	0.44	1.44

We start with the model parameters for which off–the–shelf values are available. We follow Cooley and Prescott (1995) and set $\beta = 0.95$ and $\delta = 0.06$. We use the parameter values of **?** for the U.S. factor shares in sector gross output: $\theta = 0.33$, $\theta_k = 0.13$, $\theta_l = 0.14$, $\theta_n = 0.26$, $\theta_z = 0.47$.

We continue with parameter values that we calibrate individually. With regards to A_x and τ_x, we use that $p_x = 1/A_x$ in the undistorted model economy and $p_x = (1 + \tau_x)/A_x$ in the distorted model economy. In the PWT96 the price of investment relative to manufacture consumption equals 0.76 for the U.S. and 2.4 for the poor country. Thus we set $A_x = 1.3$ and $\tau_x = 2.2$. We calibrate the land endowments, l, and the size of the insider groups, λ, from data provided by the Food and Agricultural Organization (2004), which is available for the 24 of the 34 poorest countries of the PWT96. Aggregating over these 24 countries, we find for the poor country that the ratio of arable land to the active population is 0.44 and the share of the active population in agriculture is 64%. Recalling that the total active population has measure one in our model, we therefore set $\lambda = 1 - N_a^{PC} = 0.36$ and $l^{PC} = 0.44$. Following a similar logic, we set $l^{US} = 1.4$ for the U.S. Table 1 summarizes the parameter values that we calibrate individually.

We have eight more parameters to calibrate: α, $\underline{c}$, ψ, $\overline{A}$, A^o, A_a, τ_a, τ_z.[13] Our strategy is to choose them so as to match the following eight development facts from the PWT96: the income difference between the U.S. and the poor country; the shares of agricultural

Cote d'Ivoire, Cameroon, Moldova, Azerbaijan, Bolivia, Uzbekistan, Kyrgyzstan, Armenia, Guinea, Syria, Sri Lanka, and Albania.

[13]Recall that we normalized $A_a = 1$ for the undistorted economy.

Table 2: Jointly calibrated parameters

α	$\underline{c}$	ψ	$\overline{A}$	A^o	A_a	τ_a	τ_z
0.09	0.004	0.52	0.25	0.04	0.32	0.24	1.5

consumption in total consumption measured in international dollars in the poor country and the U.S.; the shares of investment in GDP measured in international dollars in the poor country and the U.S.; the share of the active population in agriculture in the U.S.; the domestic relative prices of agriculture in the U.S. and in the poor country. Note that since we match the relative prices in the U.S., units in our model are equal to those in the PWT96. Consequently, we can use the international relative prices from the PWT96 when we evaluate model quantities in international prices.

Table 3 summarizes the values of our targets.[14] The first part refers to targets that we use for the individual calibration and the second part refers to targets that we use for the joint calibration. We can see the common regularities: the poor country has a much larger share of agricultural consumption, a much smaller share of investment, and larger relative prices of agricultural goods and investment. Except for the cross–country difference in the relative price of agricultural goods, these regularities are well known; see for example Heston and Summers (1988), Easterly (1993), Jones (1994), Restuccia and Urrutia (2001), and Herrendorf and Valentinyi (2006).

We conduct a grid search and choose the parameter values that minimize the percentage difference between the eight target values in the data and the model. Table 2 reports the calibrated parameter values. We should mention that the calibration implies that the insiders choose a smaller value of A^i than possible: $A^i = 0.14$. To put the calibration results into perspective, note that

$$\frac{A^o}{\overline{A}} = 0.16, \qquad \frac{A^o}{A^i} = 0.29, \qquad \frac{A_a}{1} = 0.32.$$

[14]We should mention that Y_c stands for total consumption in international prices.

We can see that outsider TFP in the intermediate–good sectors is 16 percent of the maximum possible TFP. Moreover, if the outsider entered, then they would produce with 29 percent of the insider TFP. In other words, there are large barriers to entry in the distorted economy. There are also large taxes in the poor country: more than 20% on agricultural output, 150% on intermediate inputs to agriculture, and more than 200% on investment goods. Furthermore, the agricultural TFP of the distorted economy is four percent of that in the undistorted economy and the efficiency units of labor are about half of those in the undistorted economy. The large differences between the undistorted and the distorted economy suggest that all of four distortion may play an important role in accounting for the income difference between the U.S. and the poor country. In the next subsection, we will explore how large their roles are.

Table 3: Targets for individual calibration (PC for poor country)

	$\frac{p_x}{p_m}^{US}$	$\frac{p_x}{p_m}^{PC}$	$\frac{l}{N}^{US}$	$\frac{l}{N}^{PC}$	N_a^{PC}
Data = Model	0.76	2.4	1.4	0.44	0.64

Targets for joint calibration

	$\frac{Y^{US}}{Y^{PC}}$	$\frac{Y_a}{Y_c}^{US}$	$\frac{Y_a}{Y_c}^{PC}$	$\frac{Y_x}{Y}^{US}$	$\frac{Y_x}{Y}^{PC}$	N_a^{US}	$\frac{p_a}{p_m}^{US}$	$\frac{p_a}{p_m}^{PC}$
Data	17.7	0.14	0.42	0.21	0.12	0.03	0.65	2.1
Model	18.8	0.14	0.37	0.20	0.07	0.03	0.66	2.1

5.2 Findings

We start by decomposing the income difference between the distorted and the undistorted economy into the parts due to different distortions. We are also interested in the implied cross-country differences in the aggregate capital–labor ratio and in aggregate TFP. We calculate aggregate TFP as the residual that would result if aggregate final output was produced according to an aggregate Cobb–Douglas production function with capital share

θ:

$$Y_a + Y_m + Y_x = A\,(K_a + K^i)^\theta.$$

Adopting this definition of TFP from the growth–accounting literature (instead of using our model to derive aggregate TFP) allows us to compare our results with those obtained by that literature.

To decompose the cross–country differences, we take the undistorted economy and introduce first taxes, then we lower the efficiency units of labor, then we lower agricultural TFP, and finally we introduce barriers. Note that we must introduce barriers last because condition (24c) for the existence of equilibrium would be violated if we introduced them before any of the other distortions. The reason is that without the other distortions the economy is so rich and the share of manufactured consumption is so large that the insiders groups of given size cannot produce the demand for intermediate goods even if they choose $A^i = \overline{A}$.

Table 4: Decomposition of the aggregate differences (U for undistorted and D for distorted economy)

Distortions	$\frac{Y^U}{Y^D}$	$\frac{A^U}{A^D}$	$\frac{\frac{K}{N}^U}{\frac{K}{N}^D}$
No distortions	1.0	1.0	1.0
Taxes only	1.9	1.1	5.7
Taxes, efficiency units only	3.6	1.6	10.9
Taxes, efficiency units, agr. TFP only	4.1	1.9	10.9
Taxes, efficiency units, agr. TFP, barriers	18.8	5.0	55.9

Table 4 reports that barriers to entry account for 52 percent of the total income difference.[15] Higher taxes and lower efficiency units of labor account for 22 percent each while lower agricultural TFP accounts only for 4 percent of the income gap with the

[15] Since the effects are multiplicative this follows by taking logs:

$$\frac{\log(18.8) - \log(4.1)}{\log(18.8)} = 0.52.$$

U.S. Interestingly our number for the effect of lower efficiency units in the poor country is close to what development–accounting studies find for the effect of low endowment with human capital; see for example Hall and Jones (1999), Hendricks (2002), and **?**. This is remarkable because our calibration strategy does not use any information about cross–country differences in years of schooling, from which these studies construct their measures of human capital. The fact that our estimates nonetheless are broadly in line with their estimates lends support to the view that unmeasured quality differences in human capital may not be large.[16]

Table 4 also reports that barriers to entry account for most of the cross–country difference in aggregate TFP A. Moreover, barriers to entry together with low agricultural TFP account for almost the whole cross–country difference in aggregate TFP. This means that taxes must affect the aggregate economy mainly through reducing the capital–labor ratio. Indeed, the table shows that the cross–country difference in taxes account for a sizeable part of the cross–country difference in the capital–labor ratio.

Table 5: Decomposition of the sectoral differences (U for undistorted and D for distorted economy)

Distortions	$\frac{\frac{Y_a}{N_a}^U}{\frac{Y_a}{N_a}^D}$	$\frac{\frac{Y^i}{N^i}^U}{\frac{Y^i}{N^i}^D}$	$\frac{\frac{Z_a}{N_a}^U}{\frac{Z_a}{N_a}^D}$	$\frac{\frac{K_a}{N_a}^U}{\frac{K_a}{N_a}^D}$
No distortions	1.2	1.0	1.0	1.0
Taxes only	3.1	1.8	4.5	5.7
Taxes, efficiency units only	5.6	3.4	8.7	10.9
Taxes, efficiency units, agr. TFP only	19.6	3.4	8.7	10.9
Taxes, efficiency units, agr. TFP, barriers	121.5	8.2	122.7	154.5

We did not target directly the cross–country differences in sectoral labor productivity. Table 5 reports that they come out more than fifteen times larger in agriculture than in manufacturing. The prediction that there is a much larger labor–productivity gap in agriculture is consistent with the evidence Restuccia et al. (2006) report. Note that the

[16]Erosa et al. (2005) and Manuelli and Seshadri (2005) have recently taken the opposite view.

magnitudes of our findings are hard to relate to their's because their data set is from 1985 and it does not contain many of the 34 economies that make up our poor country. Note too that even if there are no distortions there remains a small labor productivity difference in agriculture. This comes from the fact that the poor country has a lower land endowment than the US.

It is important to realize that cross–country difference in barriers to entry into nonagriculture drive most of the uneven cross–country differences in sectoral labor productivity: without barriers the gap with the U.S. in agriculture is about 6 times larger than in nonagriculture whereas with barriers it about 15 larger. There are two main reasons for this. The first one is as in Restuccia et al. (2006): the fixed factor land implies that returns to the reproducible production factors in agriculture are decreasing. So if in poor countries a majority of the population farms to produce the level of food consumption close to the subsistence level, then the land–labor ratio will be low in agriculture. The second reason why barriers to entry drive most of the uneven cross–country differences in sectoral labor productivity is that they drastically reduce the intermediates–labor and capital–labor ratios in agriculture, as we discussed at the end of section 4.

6 Discussion

In this section we discuss our modeling choices. We also discuss the robustness of our results to alternative modeling choices.

6.1 Insider groups choose TFP directly

We start with our assumption that each insider group chooses TFP directly and without any cost. This is a convenient reduced form that represents any choice or lobbying effort that reduce TFP. Real–world examples include the blocking of new and more productive technologies and the stipulation of inefficient work practices or low effort. Concrete examples for the latter are the number of holidays, staffing requirements, task descriptions, the number of breaks, and monitoring procedures.[17]

Our specification is consistent with lower than possible TFP resulting from the use of inefficient technologies or from the inefficient use of a given technology. All that matters is that the frontier technology or the most efficient work rules and practices are available as public goods once the richest countries have innovated them.[18] All other countries can then adopt them without having to innovate them again. The assumption that adoption is costless simplifies matters but does not drive our result that insider groups choose lower than possible sector TFPs.

6.2 Monopoly power only in the labor market

Our rent–extraction mechanism is a special case. The general case would have monopoly power in both the goods and the labor market, so rents would go to both firms/entrepreneurs and workers. In terms of modeling, this would come at the costs of having several parameters, which would be messy and hard to discipline using the existing evidence. Examples of the general case (and its problems) are Cole and Ohanian (2004) and Spector (2004). Our special case has the monopoly power only in labor market, so rents go to workers only. This has the advantage of having just two parameters (the entry barriers A^o and the size of the insider group λ), which is simple and can be calibrated. Examples of our special case (and its advantages) are Holmes and Schmitz Jr. (1995) and Parente and Prescott (1999). In sum, the reason for using our simple rent extraction mechanism is that it is parsimonious and analytically tractable while delivering that barriers to entry lead to economic rents and low TFP.

[17] Clark (1987), Wolcott (1994), McKinsey-Global-Institute (1999), Holmes and Schmitz (2001a,b), Parente and Prescott (2000), Galdon-Sanchez and Schmitz Jr. (2002), Lewis (2004), and Schmitz Jr. (2005) offer real–world examples of how these are used.

[18] Romer (1990) provides a model of endogenous growth through innovations. His model may be thought of as describing the technology leader who comes up with what the followers can adopt or block.

6.3 Insider groups cannot choose wages or hours worked

In our model the insider groups can choose TFP, but not wages or hours worked. We could incorporate a wage choice as in Parente and Prescott (1999) without changing any of our results. We leave it out because this would complicate our analysis further. In contrast, it is restrictive to assume that the insider groups cannot choose how much time the insiders work. If they could, then they could restrict their sectors' outputs by choosing low insider working time and high insider TFP. If leisure is a normal good, then this would lead to higher insider utility than reducing sector TFP [Cozzi and Palacios (2003)].

We nonetheless abstract from the choice of hours worked because there is no evidence that hours worked in developing countries are systematically lower than in the OECD countries. If anything, the opposite seems to be true. Given the evidence that there are insider groups in developing countries, they do not seem to succeed at collectively reducing their members' hours worked by substantial amounts. Moreover, Clark (1987), Wolcott (1994), McKinsey-Global-Institute (1999), and Parente and Prescott (2000) provide evidence that rent extraction in developing countries happened through the choice of inefficient work rules and practices, and not through reductions in hours worked.

To be sure, in a few European countries insider groups succeeded at collectively reducing their members hours worked. In particular, Prescott (2004) documents that France has much lower hours worked and higher labor productivity than the U.S. This outcome requires a close cooperation between centralized labor unions and the government. Even in the U.S., trade unions have never reached a similar degree of centralization as in France. One should therefore expect that rent extraction in the U.S. has not happened through reductions in hours. Holmes and Schmitz (2001a,b), Galdon-Sanchez and Schmitz Jr. (2002), and Schmitz Jr. (2005) document various case studies where indeed rent extraction has instead happened through labor unions choosing inefficient work rules and practices. The rent extraction process in most developing countries seems too chaotic to replicate even U.S. outcomes, so it is not surprising that insider groups there do not seem to succeed at reducing the hours worked by their members.

6.4 Insider groups stay together forever

Since we study steady-state equilibrium we find it natural to assume that the insider groups stay together forever. We emphasize that the duration of insider groups is not crucial for our results though. The reason is that each insider group's problem boils down to choosing the sector TFP that maximizes the insider wage in the next period; see appendix A.3.1. So one period is the minimum duration of insider groups required for our results. In what follows we suggest two alternative specifications in which the insider groups last exactly one period.

The first alternative would be to assume that in each period the members of the different insider groups are randomly chosen among all the insiders. Since in symmetric steady state equilibrium all insiders are identical, each insider group would still only need to know the average capital holdings of its members to maximize their utility. Thus, nothing would change.

The second alternative would be to assume that in each period the members of the insider groups are randomly chosen from the whole population. The individual capital holdings would then depend on how many times each individual has been chosen to be an insider in the past, so we would have a distribution of individual capital holdings. Besides complicating the notation greatly (and being pretty unrealistic), this would not matter for our results either. The first reason is that our preferences allow for aggregation, so the distribution of individual capital holdings would not have any effect on the aggregates of consumer choices. The second reason is that, as each insider group's problem boils down to maximizing insider wage income, the distribution of capital holding would not matter.

6.5 Why don't societies buy the insider groups out?

Rent extraction through inefficient work rules and practices leads to substantial losses of income. This raises the question why the outsiders in our model do not buy out the insider groups. Our model remains silent on how insider groups originate and disappear, so it cannot address buy outs. Taking the distortion as given without explaining its origin is common practice in the part of the growth and development literature that explores the implications of distortions. We view this as a useful first step in identifying the most damaging distortions, given that they exist in the real world.

The next step is to understand how the distortions can emerge and why they can persist. This requires an altogether different modeling approach that brings out political economy forces at the cost of the quantitative richness of the model economy. In this line of research, Krussel and Ríos-Rull (1996) and Bridgeman et al. (2007) made some progress on the question why barriers emerge. They formalized the argument of Olson (1982) that if the costs of erecting barriers to entry to each industry are small, then they will be erected. In Krussel and Ríos-Rull (1996) this works through voting whereas in Bridgeman et al. (2007) this works through lobbying. Unfortunately, both of these models are still far too stylized to be carried too the data.

We would also like to understand why society cannot buy out insider groups through compensatory schemes. The literature offers two answers. Parente and Prescott (1999) argued informally that compensatory schemes are not time consistent: once barriers to entry have been removed, society can tax away the compensatory transfers it paid to the groups or erect new barriers to entry. Kocherlakota (2001) showed in a stylized static model that limited enforcement and sufficient inequality can imply that a Pareto–improving compensatory scheme does not exist. More work is needed to formalize these arguments in a dynamic setting that can be carried to the data.

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Appendix: Derivations and Proofs

We will keep the notation to a minimum. Only if crucial for the argument will we mention how the endogenous variables depend on the state variables.

A.1 Equilibrium Conditions

A.1.1 Households' first–order conditions

Recalling that each household is endowed with a unit of land and a unit of labor, we can write the problem of a household of type $\nu \in \{o, j\}$ as:[19]

$$\begin{aligned} & \sum_{t=0}^{\infty} \beta^t [\alpha \log(c_{at}^{\nu} - \underline{c}) + (1-\alpha)\log(c_{mt}^{\nu})] \\ \text{s.t.} \quad & (1+\tau_a)p_{at}c_{at}^{\nu} + c_{mt}^{\nu} + (1+\tau_x)p_{xt}x_t^{\nu} = r_{kt}b_t^{\nu} + r_{lt}l + w_t^{\nu} + T_t^{\nu}, \\ & x_t^{\nu} = b_{t+1}^{\nu} - (1-\delta)b_t^{\nu}, \\ & b_0^{\nu} > 0 \text{ given,} \end{aligned}$$

where $T_t^{\nu} = \tau_z p_{zt} Z_{at} + \tau_a p_{at} c_{at}^{\nu} + \tau_x p_{xt} x_t^{\nu}$ is the lump–sum rebate of taxes.

The two static first–order conditions determine the composition of consumption:

$$\begin{aligned} (1+\tau_a)p_a c_a^{\nu} &= \alpha c^{\nu} + (1-\alpha)(1+\tau_a)p_a \underline{c}, \\ c_m^{\nu} &= (1-\alpha)c^{\nu} - (1-\alpha)(1+\tau_a)p_a \underline{c}, \end{aligned}$$

[19]The intermediate goods for agriculture do not show up in the budget constraint because we let agricultural firms purchase them directly from intermediate good firms.

where c^ν is the income that the household spends on consumption:

$$c^\nu \equiv (1+\tau_a)p_a c_a^\nu + c_m^\nu = r_k b^\nu + r_l l + w^\nu + \tau_a p_a c_a^\nu + \tau_z p_z Z_a - p_x x^\nu.$$

Aggregation across all household types implies:

$$(1+\tau_a)p_a C_a = \alpha C + (1-\alpha)(1+\tau_a)p_a \underline{c}, \tag{9a}$$

$$C_m = (1-\alpha)C - (1-\alpha)(1+\tau_a)p_a \underline{c}, \tag{9b}$$

where

$$C \equiv (1+\tau_a)p_a Y_a + Y_m. \tag{9c}$$

For future reference, we mention that for two observations (9) has a unique solution for α and $\underline{c}$. More specifically, imagine we observe $(\tau_a^{US}, \tau_a^{poor}, p_a^{US}, p_a^{poor}, C_a^{US}, C_a^{poor}, C^{US},$ $C^{poor})$. Solving (9a) then gives:

$$\alpha = \frac{C_a^{US} - C_a^{poor}}{\frac{C^{US}}{(1+\tau_a^{US})p_a^{US}} - \frac{C^{poor}}{(1+\tau_a^{poor})p_a^{poor}}}, \tag{10a}$$

$$\begin{aligned} \underline{c} &= \frac{C_a^{poor} - \alpha C^{poor}/[(1+\tau_a^{poor})p_a^{poor}]}{1-\alpha} \\ &= \frac{\frac{C^{poor}}{(1+\tau_a^{poor})p_a^{poor}} \frac{C^{US}}{(1+\tau_a^{US})p_a^{US}} \left[\frac{C_a^{poor}}{C^{poor}/[(1+\tau_a^{poor})p_a^{poor}]} - \frac{C_a^{US}}{C^{US}/[(1+\tau_a^{US})p_a^{US}]}\right]}{\frac{C^{US}}{(1+\tau_a^{US})p_a^{US}}\left[1 - \frac{C_a^{US}}{C^{US}/[(1+\tau_a^{US})p_a^{US}]}\right] - \frac{C^{poor}}{(1+\tau_a^{poor})p_a^{poor}}\left[1 - \frac{C_a^{poor}}{C^{poor}/[(1+\tau_a^{poor})p_a^{poor}]}\right]}. \end{aligned} \tag{10b}$$

It is easy to see that if the income elasticity of agricultural goods is smaller than one, then these expressions are well defined, that is, $\alpha \in (0,1)$ and $\underline{c} > 0$.

We now turn to the Euler equation. Aggregating across household types, we obtain

$$\frac{1}{C_{mt}}(1+\tau_x)p_{xt} = \frac{\beta}{C_{mt+1}}[(1+\tau_x)p_{xt+1}(1-\delta) + r_{kt+1}].$$

In steady–state equilibrium, this reduces to:

$$r_k = (1+\tau_x)p_x \frac{1-\beta(1-\delta)}{\beta}. \tag{11}$$

A.1.2 Firms' first–order conditions

Agriculture. The marginal value products in agriculture satisfy:

$$r_k = \theta_k p_a A_a \psi^{\theta_n} {K_a}^{\theta_k - 1} L^{\theta_l} {N_a}^{\theta_n} {Z_a}^{\theta_z}, \tag{12a}$$

$$r_l = \theta_l p_a A_a \psi^{\theta_n} {K_a}^{\theta_k} L^{\theta_l - 1} {N_a}^{\theta_n} {Z_a}^{\theta_z}., \tag{12b}$$

$$w^i \geq \theta_n p_a A_a \psi^{\theta_n} {K_a}^{\theta_k} L^{\theta_l} {N_a}^{\theta_n - 1} {Z_a}^{\theta_z}, \quad \text{“=”if } N_a^i > 0, \tag{12c}$$

$$w^o \geq \theta_n p_a A_a \psi^{\theta_n} {K_a}^{\theta_k} L^{\theta_l} {N_a}^{\theta_n - 1} {Z_a}^{\theta_z}, \quad \text{“=” if } N_a^o > 0, \tag{12d}$$

$$(1+\tau_z)p_{zj} = \theta_z p_a A_a \psi^{\theta_n} {K_a}^{\theta_k} L^{\theta_l} {N_a}^{\theta_n} {Z_a}^{\theta_z - 1} \left(\frac{Z_a}{Z_{aj}}\right)^{\frac{1}{\sigma}}. \tag{12e}$$

(11) and (12a) imply that

$$(1+\tau_x)p_x \frac{1-\beta(1-\delta)}{\beta} = \theta_k p_a A_a \psi^{\theta_n} {K_a}^{\theta_k - 1} L^{\theta_l} {N_a}^{\theta_n} {Z_a}^{\theta_z}. \tag{12f}$$

Using that $p_{zj} = p_z$ and $Z_{aj} = Z_a$ in symmetric equilibrium, dividing (12e) by (12f), and solving for K_a/Z_a, we find

$$\frac{K_a}{Z_a} = \frac{\theta_k}{\theta_z} \frac{(1+\tau_z)p_z}{(1+\tau_x)p_x} \frac{\beta}{1-\beta(1-\delta)}. \tag{12g}$$

Moreover, imposing that $Z_{aj} = Z_a$, (12e) implies that

$$p_a = \frac{(1+\tau_z)p_z {Z_a}^{1-\theta_z}}{\theta_z A_a \psi^{\theta_n} {K_a}^{\theta_k} L^{\theta_l} {N_a}^{\theta_n}}. \tag{12h}$$

Manufacturing. The first–order conditions for intermediate good j in final manufacturing are:

$$\left(\frac{Z_m}{Z_{mj}}\right)^{\frac{1}{\sigma}} = p_{zj},$$
$$p_x A_x \left(\frac{Z_x}{Z_{xj}}\right)^{\frac{1}{\sigma}} = p_{zj}.$$

Solving for Z_{mj} and Z_{mxj}, we obtain:

$$Z_{mj} = \left(\frac{1}{p_{zj}}\right)^{\sigma} Z_m, \tag{13a}$$
$$Z_{xj} = \left(\frac{p_x A_x}{p_{zj}}\right)^{\sigma} Z_x. \tag{13b}$$

Note that in symmetric equilibrium this simplifies to:

$$1 = p_z = p_x A_x,$$

or

$$p_x = \frac{1}{A_x}.$$

Intermediate goods. In symmetric equilibrium, all intermediate good sectors are the same, so we can drop the sector index. The marginal value products in a particular intermediate good sector satisfy:

$$r_k \geq \theta p_z A^i \psi^{1-\theta} \left(\frac{K^i}{N^i}\right)^{\theta-1}, \qquad \text{“=” if } K^i, N^i > 0, \tag{14a}$$
$$w^i \geq (1-\theta) p_z A^i \psi^{1-\theta} \left(\frac{K^i}{N^i}\right)^{\theta}, \qquad \text{“=” if } K^i, N^i > 0, \tag{14b}$$
$$r_k \geq \theta p_z A^0 \psi^{1-\theta} \left(\frac{K^o}{N^o}\right)^{\theta-1}, \qquad \text{“=” if } K^o, N^o > 0, \tag{14c}$$
$$w^o \geq (1-\theta) p_z A^0 \psi^{1-\theta} \left(\frac{K^o}{N^o}\right)^{\theta}, \qquad \text{“=” if } K^o, N^o > 0. \tag{14d}$$

Using that $p_z = 1$ and $p_x = 1/A_x$ in equilibrium, (11), (14a), and (14c) imply that if the insider and outsider technology are operated in symmetric equilibrium, then:

$$K^i = \psi \left(\frac{A^i \varphi}{1+\tau_x} \right)^{\frac{1}{1-\theta}} N^i, \tag{14e}$$

$$K^o = \psi \left(\frac{A^o \varphi}{1+\tau_x} \right)^{\frac{1}{1-\theta}} N^o, \tag{14f}$$

where

$$\varphi \equiv \frac{A_x \beta \theta}{1-\beta(1-\delta)}. \tag{14g}$$

Thus, in symmetric equilibrium the intermediate goods that are produced with the two different technologies are:

$$Z^i = (A^i)^{\frac{1}{1-\theta}} \psi \left(\frac{\varphi}{1+\tau_x} \right)^{\frac{\theta}{1-\theta}} N^i, \tag{15a}$$

$$Z^o = (A^o)^{\frac{1}{1-\theta}} \psi \left(\frac{\varphi}{1+\tau_x} \right)^{\frac{\theta}{1-\theta}} N^o. \tag{15b}$$

A.1.3 Solving for prices and outputs as functions of labor

Agriculture. Using (12d), (14d) with equality, and (14f), we have in symmetric equilibrium:

$$\theta_n p_a A_a \psi^{\theta_n} {K_a}^{\theta_k} L^{\theta_l} {N_a}^{\theta_n - 1} {Z_a}^{\theta_z} = w^o = (1-\theta)(A^o)^{\frac{1}{1-\theta}} \psi \left(\frac{\varphi}{1+\tau_x} \right)^{\frac{\theta}{1-\theta}}. \tag{16a}$$

Using that in symmetric equilibrium $Z_a = Z_{aj}$ and $p_{zj} = 1$ and dividing (12e) by (16a), we obtain the intermediate goods in agriculture as a function of N_a:

$$Z_a = (A^o)^{\frac{1}{1-\theta}} \psi \frac{\theta_z (1-\theta)}{\theta_n (1+\tau_z)} \left(\frac{\varphi}{1+\tau_x} \right)^{\frac{\theta}{1-\theta}} N_a. \tag{16b}$$

Substituting this into (12g) gives the capital stock in agriculture as a function of N_a:

$$K_a = (A^o)^{\frac{1}{1-\theta}} \psi \frac{\theta_k(1-\theta)}{\theta_n \theta} \left(\frac{\varphi}{1+\tau_x}\right)^{\frac{1}{1-\theta}} N_a. \tag{16c}$$

Substituting the expressions for K_a and Z_a back into (1) and (12h), we obtain Y_a and p_a as functions of N_a:

$$Y_a = \frac{(A^o)^{\frac{\theta_k+\theta_z}{1-\theta}} \psi^{\theta_n+\theta_k+\theta_z} A_a {\theta_k}^{\theta_k} {\theta_z}^{\theta_z} (1-\theta)^{\theta_k+\theta_z}}{{\theta_n}^{\theta_k+\theta_z} \theta^{\theta_k} (1+\tau_z)^{\theta_z}} \left(\frac{\varphi}{1+\tau_x}\right)^{\frac{\theta_k+\theta\theta_z}{1-\theta}} {N_a}^{1-\theta_l} l^{\theta_l}, \tag{16d}$$

$$p_a = \frac{(A^o)^{\frac{1-\theta_k-\theta_z}{1-\theta}} \psi^{\theta_l} (1-\theta)^{1-\theta_k-\theta_z} \theta^{\theta_k} (1+\tau_z)^{\theta_z}}{A_a {\theta_k}^{\theta_k} {\theta_n}^{1-\theta_k-\theta_z} {\theta_z}^{\theta_z}} \left(\frac{\varphi}{1+\tau_x}\right)^{\frac{\theta(1-\theta_z)-\theta_k}{1-\theta}} \left(\frac{N_a}{l}\right)^{\theta_l}. \tag{16e}$$

Intermediate good sectors. (15) imply that

$$Z_a + Z_m + Z_x = \psi \left(\frac{\varphi}{1+\tau_x}\right)^{\frac{\theta}{1-\theta}} \left[(A^i)^{\frac{1}{1-\theta}} N^i + (A^o)^{\frac{1}{1-\theta}} N^o\right].$$

Using (16b), this becomes:

$$Z_m + Z_x = \psi \left(\frac{\varphi}{1+\tau_x}\right)^{\frac{\theta}{1-\theta}} \left[(A^i)^{\frac{1}{1-\theta}} N^i + (A^o)^{\frac{1}{1-\theta}} N^o - \frac{\theta_z(1-\theta)}{\theta_n(1+\tau_z)} (A^o)^{\frac{1}{1-\theta}} N_a\right]. \tag{17}$$

In symmetric equilibrium, $A_x Z_x$ equals the depreciation rate times the capital stocks:

$$\begin{aligned} Z_m = {} & \psi \left(\frac{\varphi}{1+\tau_x}\right)^{\frac{\theta}{1-\theta}} \left[(A^i)^{\frac{1}{1-\theta}} N^i + (A^o)^{\frac{1}{1-\theta}} N^o - \frac{\theta_z(1-\theta)}{\theta_n(1+\tau_z)} (A^o)^{\frac{1}{1-\theta}} N_a\right] \\ & - \frac{\delta(K_a + K^i + K^o)}{A_x}. \end{aligned} \tag{18}$$

Using (14e), (14f), and (16c), this gives:

$$\begin{aligned} Z_m = \psi \left(\frac{\varphi}{1+\tau_x}\right)^{\frac{1}{1-\theta}} & \left[\frac{[1-\beta(1-\delta)](1+\tau_x) - \beta\delta\theta}{A_x \beta\theta} \left[(A^i)^{\frac{1}{1-\theta}} N^i + (A^o)^{\frac{1}{1-\theta}} N^o\right]\right. \\ & \left. - \frac{\theta_z[1-\beta(1-\delta)](1+\tau_x) + \beta\delta\theta_k(1+\tau_z)}{A_x \beta\theta\theta_n(1+\tau_z)} (1-\theta)(A^o)^{\frac{1}{1-\theta}} N_a\right]. \end{aligned} \tag{19}$$

The static first–order conditions, (9), of the consumer problem imply:

$$(1-\alpha)(1+\tau_a)p_a(Y_a-\underline{c})=\alpha Y_m.$$

Substituting (16d) and (16e) into this equation, using that $Y_m = Z_m$, and solving for Z_m, we find:

$$\begin{aligned} &Z_m \\ &= \frac{(1-\alpha)(1+\tau_a)(A^o)^{\frac{1-\theta_k-\theta_z}{1-\theta}}\psi^{\theta_l}(1-\theta)^{1-\theta_k-\theta_z}\theta^{\theta_k}(1+\tau_z)^{\theta_z}}{\alpha A_a {\theta_k}^{\theta_k}{\theta_n}^{1-\theta_k-\theta_z}{\theta_z}^{\theta_z}}\left(\frac{\varphi}{1+\tau_x}\right)^{\frac{\theta(1-\theta_z)-\theta_k}{1-\theta}}\left(\frac{N_a}{l}\right)^{\theta_l} \\ &\times\left[\frac{(A^o)^{\frac{\theta_k+\theta_z}{1-\theta}}\psi^{\theta_n+\theta_k+\theta_z}A_a{\theta_k}^{\theta_k}{\theta_z}^{\theta_z}(1-\theta)^{\theta_k+\theta_z}}{{\theta_n}^{\theta_k+\theta_z}\theta^{\theta_k}(1+\tau_z)^{\theta_z}}\left(\frac{\varphi}{1+\tau_x}\right)^{\frac{\theta_k+\theta\theta_z}{1-\theta}}{N_a}^{1-\theta_l}l^{\theta_l}-\underline{c}\right]. \end{aligned} \tag{20}$$

Equating (19) with (20), we obtain the market–clearing condition as a function of N_a, N^i, and N^o:

$$\begin{aligned} &\frac{(1-\alpha)(1+\tau_a)(A^o)^{\frac{1-\theta_k-\theta_z}{1-\theta}}\psi^{\theta_l}(1-\theta)^{1-\theta_k-\theta_z}\theta^{\theta_k}(1+\tau_z)^{\theta_z}}{\alpha A_a {\theta_k}^{\theta_k}{\theta_n}^{1-\theta_k-\theta_z}{\theta_z}^{\theta_z}}\left(\frac{\varphi}{1+\tau_x}\right)^{\frac{\theta(1-\theta_z)-\theta_k}{1-\theta}}\left(\frac{N_a}{l}\right)^{\theta_l} \\ &\quad\times\left[\frac{(A^o)^{\frac{\theta_k+\theta_z}{1-\theta}}\psi^{\theta_n+\theta_k+\theta_z}A_a{\theta_k}^{\theta_k}{\theta_z}^{\theta_z}(1-\theta)^{\theta_k+\theta_z}}{{\theta_n}^{\theta_k+\theta_z}\theta^{\theta_k}(1+\tau_z)^{\theta_z}}\left(\frac{\varphi}{1+\tau_x}\right)^{\frac{\theta_k+\theta\theta_z}{1-\theta}}{N_a}^{1-\theta_l}l^{\theta_l}-\underline{c}\right] \\ &\quad+\frac{\theta_z[1-\beta(1-\delta)](1+\tau_x)+\beta\delta\theta_k(1+\tau_z)}{A_x\beta\theta\theta_n(1+\tau_z)}\left(\frac{\varphi}{1+\tau_x}\right)^{\frac{1}{1-\theta}}(1-\theta)(A^o)^{\frac{1}{1-\theta}}\psi N_a \\ &\quad=\frac{[1-\beta(1-\delta)](1+\tau_x)-\beta\delta\theta}{A_x\beta\theta}\left(\frac{\varphi}{1+\tau_x}\right)^{\frac{1}{1-\theta}}\psi\left[(A^i)^{\frac{1}{1-\theta}}N^i+(A^o)^{\frac{1}{1-\theta}}N^o\right]. \end{aligned} \tag{21}$$

Since $N_a + N^i + N^o = 1$, this is one equation is two unknowns. If one of (N_a, N^i, N^o) is zero (which it will be in symmetric equilibrium), then this is one equation in just one unknown.

A.2 Proof of Proposition 1

When there are no distortions, we have $\psi = 1$, $A^i = A^o = \overline{A}$, and $\tau_a = \tau_x = \tau_z = 0$. In this case, all households are indifferent between working in agriculture and in final manufacturing. For notational convenience we will call the households in the intermediate good sectors the insiders, so the TFP in an intermediate good sector is A^i and $N^o = 0$. We then need to find the $N_a \in (0,1)$ that solves (21).

For (21) to be well defined, it needs to be larger than zero when all labor is in agriculture. Imposing $A^o = \overline{A}$ this gives a necessary condition for existence of equilibrium without barriers:

$$\frac{(\overline{A})^{\frac{\theta_k+\theta_z}{1-\theta}} A_a {\theta_k}^{\theta_k} {\theta_z}^{\theta_z} (1-\theta)^{\theta_k+\theta_z} \varphi^{\frac{\theta_k+\theta\theta_z}{1-\theta}}}{{\theta_n}^{\theta_k+\theta_z} \theta^{\theta_k}} {N_a}^{1-\theta_l} l^{\theta_l} > \underline{c}. \tag{22a}$$

This condition is satisfied if A_a is large enough.

For $N_a = 0$, the left–hand side of (21) is zero and the right–hand side is positive. For $N_a = 1$, the left–hand side is positive and the right–hand side is zero. Using that $N^i = 1 - N_a$, we can also see that the left–hand side is increasing and the right–hand side is decreasing in N_a. Thus, there is a unique $N_a \in (0,1)$ that solves (21). **QED.**

A.3 Proof of Proposition 2

A.3.1 Characterizing A^i in steady state equilibrium

We start by showing that the insider technology must be operated in equilibrium. To see this suppose to the contrary that only the agricultural technology and the outsider technology were operated. The outsiders and insiders would then earn the same marginal value product in agriculture, which would equal the outsider marginal value product in the intermediate good sector. Moreover, p_a would be given to the insider group. But then the insider group could choose $A^i > A^o$ and achieve a higher marginal value product than the outsiders in the intermediate good sector. The latter equals what both the outsiders and the insiders get in agriculture, so we have a contraction.

Given that the agricultural and the insider technology are operated in equilibrium we are left with two cases. In the first case, the outsiders strictly prefer to work in agriculture. In the second case, the outsiders are indifferent between operating and not operating the outsider technology. Note that in the second case the outsider technology may or may not be operated.

Before we can analyze the two cases, we need to characterize the solution to the group's problem. It is sufficient to consider the effect of choosing $A^{i\prime}$ on next period's insider wage $w^{i\prime}$. The reason is that the insiders supply labor inelastically and the group's choice do not affect any price except for $w^{i\prime}$. Maximizing insider utility is then equivalent to maximizing insider wage income and the group affects insider wage income through its effect on $w^{i\prime}$.

$\boldsymbol{N^o = 0}$ **and** $\boldsymbol{N^i = \lambda}$. The semi reduced–form of the insider wage will be a function of A^i, which the group chooses, and of the aggregate state S, which the group does not affect. Since $K^i, N^i > 0$, the first–order conditions (14a) and (14b) hold with equality and the insider wage satisfies:

$$w^i(\mathcal{S}, A^i) = p_z(\mathcal{S}, A^i)^{\frac{1}{1-\theta}} (A^i)^{\frac{1}{1-\theta}} \psi \left(\frac{\theta}{r_k(\mathcal{S})} \right)^{\frac{\theta}{1-\theta}}. \tag{23a}$$

In order to obtain an explicit expression for $p_z(\mathcal{S}, A^i)$ we equate the supply of Z^i, equation (2), with its demand, as implied by equations (12e) and (13):

$$A^i \psi^{1-\theta} K^i(\mathcal{S}, A^i)^\theta \lambda^{1-\theta} = \frac{F(\mathcal{S})}{p_z(\mathcal{S}, A^i)^\sigma},$$

where

$$F(\mathcal{S}) \equiv Z_m(\mathcal{S}) + [p_x(\mathcal{S}) A_x]^\sigma + \left[\frac{\theta_z p_a(\mathcal{S}) Y_a(\mathcal{S})}{1 + \tau_z} \right]^\sigma Z_a(\mathcal{S})^{1-\sigma}.$$

Rearranging this results in:

$$p_z(\mathcal{S}, A^i) = \left[\frac{F(\mathcal{S})}{A^i \psi^{1-\theta} K^i(\mathcal{S}, A^i)^\theta \lambda^{1-\theta}} \right]^{\frac{1}{\sigma}}. \tag{23b}$$

Substituting this expression into (14a) and solving for K_j^i/λ, we find:

$$\frac{K^i(\mathcal{S},A^i)}{\lambda} = \left[\frac{\theta^\sigma F(\mathcal{S})}{\lambda r_k(\mathcal{S})^\sigma (A^i)^{1-\sigma}\psi^{(1-\theta)(1-\sigma)}}\right]^{\frac{1}{\theta+\sigma(1-\theta)}}.$$

Combining this expression with (23b) gives us the semi–reduced form for the relative price:

$$p_z(\mathcal{S},A^i) = \left[\frac{r_k(\mathcal{S})^\theta F(\mathcal{S})^{1-\theta}}{\theta^\theta \lambda^{1-\theta} A^i \psi^{1-\theta}}\right]^{\frac{1}{\theta+\sigma(1-\theta)}}.$$

The semi–reduced form for the insider wage results after substituting this equation into (23a):

$$w^i(\mathcal{S},A^i) = (1-\theta)\left[\frac{F(\mathcal{S}) r_k(\mathcal{S})^{\theta(1-\sigma)}}{\lambda \theta^{\theta(1-\sigma)}}\right]^{\frac{1}{\theta+\sigma(1-\theta)}} \left(A^i \psi^{1-\theta}\right)^{\frac{\sigma-1}{\theta+\sigma(1-\theta)}}.$$

Given that $\sigma < 1$ the group can increase this expression by decreasing A^i. Thus the first case is inconsistent with a solution to the group's problem.

$\boldsymbol{N^o \geq 0}$ **and** $\boldsymbol{N^i = \lambda}$. In this second case, (12d) and (14d) hold with equality, implying that

$$p_z(\mathcal{S},A^i) = \frac{\theta_n p_a(\mathcal{S}) A_a \psi^{\theta_n} K_a(\mathcal{S})^{\theta_k}(1-\lambda)^{\theta_n-1} Z_a(\mathcal{S})^{\theta_z} L^{\theta_l}}{(1-\theta)A^0 \psi^{1-\theta}[K^o(\mathcal{S})/N^o(\mathcal{S})]^\theta}.$$

Using (14f), this becomes:

$$p_z(\mathcal{S},A^i) = \frac{\theta_n p_a(\mathcal{S}) Y_a(\mathcal{S})}{(1-\theta)(A^o)^{\frac{1}{1-\theta}}\psi N_a(\mathcal{S})}\left(\frac{1+\tau_x}{\varphi}\right)^{\frac{\theta}{1-\theta}}.$$

Consequently S uniquely determines p_z. Increasing A^i then increases the marginal value product of insider labor. The group will therefore choose the largest A^i for which this second case applies. At this A^i the outsider technology is just not operated.

We now show that there is a unique A^i at which the outsider technology is just not operated and all markets clear.

A.3.2 Market clearing

The market–clearing condition (21) now takes the form:

$$\begin{aligned}
&\frac{(1-\alpha)(1+\tau_a)(A^o)^{\frac{1-\theta_k-\theta_z}{1-\theta}}\psi^{\theta_l}(1-\theta)^{1-\theta_k-\theta_z}\theta^{\,\theta_k}(1+\tau)^{\theta_z}}{\alpha A_a\psi^{\theta_n}\theta_k{}^{\theta_k}\theta_n{}^{1-\theta_k-\theta_z}\theta_z{}^{\theta_z}}\left(\frac{\varphi}{1+\tau_x}\right)^{\frac{\theta(1-\theta_z)-\theta_k}{1-\theta}}\frac{(1-\lambda)^{\theta_l}}{l^{\,\theta_l}} \\
&\quad\times\left[\frac{(A^o)^{\frac{\theta_k+\theta_z}{1-\theta}}\psi^{\theta_n+\theta_k+\theta_z}A_a\theta_k{}^{\theta_k}\theta_z{}^{\theta_z}(1-\theta)^{\theta_k+\theta_z}}{\theta_n{}^{\theta_k+\theta_z}\theta^{\,\theta_k}(1+\tau)^{\theta_z}}\left(\frac{\varphi}{1+\tau_x}\right)^{\frac{\theta_k+\theta\theta_z}{1-\theta}}(1-\lambda)^{1-\theta_l}l^{\,\theta_l}-\underline{c}\right] \\
&\quad+\frac{\theta_z[1-\beta(1-\delta)](1+\tau_x)+\beta\delta\theta_k(1+\tau_z)}{A_x\beta\theta\theta_n(1+\tau_z)}\left(\frac{\varphi}{1+\tau_x}\right)^{\frac{1}{1-\theta}}(1-\theta)\psi(A^o)^{\frac{1}{1-\theta}}(1-\lambda) \\
&\quad=\frac{[1-\beta(1-\delta)](1+\tau_x)-\beta\delta\theta}{A_x\beta\theta}\left(\frac{\varphi}{1+\tau_x}\right)^{\frac{1}{1-\theta}}\psi(A^i)^{\frac{1}{1-\theta}}\lambda. \qquad (24a)
\end{aligned}$$

We have to show that there is a unique $A^i=[A^o,\overline{A}]$ that satisfies this equation and clears the market.

We first require that agricultural production does not fall short of subsistence consumption. In the distorted economy this takes the form:

$$\frac{(A^o)^{\frac{\theta_k+\theta_z}{1-\theta}}\psi^{\theta_n+\theta_k+\theta_z}A_a\theta_k{}^{\theta_k}\theta_z{}^{\theta_z}(1-\theta)^{\theta_k+\theta_z}}{\theta_n{}^{\theta_k+\theta_z}\theta^{\,\theta_k}(1+\tau)^{\theta_z}}\left(\frac{\varphi}{1+\tau_x}\right)^{\frac{\theta_k+\theta\theta_z}{1-\theta}}(1-\lambda)^{1-\theta_l}l^{\,\theta_l}>\underline{c}, \qquad (24b)$$

which is satisfied if A_a is sufficiently large. We also require that for $A^i=A^o$ the right–hand side is smaller than the left–hand side and for $A^i=\overline{A}$ the right–hand side larger the left–hand side. This leads to the following two conditions:

$$\begin{aligned}
&(A^o)^{\frac{1}{1-\theta}}\psi\,\lambda<\frac{A_x\beta\theta}{[1-\beta(1-\delta)](1+\tau_x)-\beta\delta\theta}\times \\
&\Bigg\{\frac{(1-\alpha)(1+\tau_a)(A^o)^{\frac{1-\theta_k-\theta_z}{1-\theta}}\psi^{\theta_l}(1-\theta)^{1-\theta_k-\theta_z}\theta^{\,\theta_k}(1+\tau_z)^{\theta_z}}{\alpha A_a\theta_k{}^{\theta_k}\theta_n{}^{1-\theta_k-\theta_z}\theta_z{}^{\theta_z}}\left(\frac{1+\tau_x}{\varphi}\right)^{\frac{1-\theta(1-\theta_z)+\theta_k}{1-\theta}}\frac{(1-\lambda)^{\theta_l}}{l^{\,\theta_l}} \\
&\quad\times\left[\frac{(A^o)^{\frac{\theta_k+\theta_z}{1-\theta}}\psi^{\theta_n+\theta_k+\theta_z}A_a\theta_k{}^{\theta_k}\theta_z{}^{\theta_z}(1-\theta)^{\theta_k+\theta_z}}{\theta_n{}^{\theta_k+\theta_z}\theta^{\,\theta_k}(1+\tau_z)^{\theta_z}}\left(\frac{\varphi}{1+\tau_x}\right)^{\frac{\theta_k+\theta\theta_z}{1-\theta}}(1-\lambda)^{1-\theta_l}l^{\,\theta_l}-\underline{c}\right] \\
&\quad+\frac{\theta_z[1-\beta(1-\delta)](1+\tau_x)+\beta\delta\theta_k(1+\tau_z)}{A_x\beta\theta\theta_n(1+\tau_z)}(1-\theta)(A^o)^{\frac{1}{1-\theta}}\psi(1-\lambda)\Bigg\} \\
&<(\overline{A})^{\frac{1}{1-\theta}}\psi\,\lambda. \qquad (24c)
\end{aligned}$$

Condition (24b) ensures that the expression between the inequality signs is positive, so if λ is sufficiently small and $\overline{A}$ is sufficiently large, then both inequalities will be satisfied.

We can now prove existence and uniqueness. The left–hand side of (24a) does not depend on A^i and (24b) ensures that it is positive. The right–hand side of (24a) is monotonically increasing in A^i. Since (24c) ensures that for $A^i = A^o$ the right–hand side is smaller than the left–hand side and for $A^i = \overline{A}$ the right–hand side larger the left–hand side, there is a unique intersection at the unique market–clearing $A^i \in [A^o, \overline{A}]$.

The comparative static effects then follow trivially from (24a). **QED.**

A.3.3 Existence and uniqueness

The environment is stationary. It satisfies the standard assumption that guarantee the existence of unique value functions and a unique steady state equilibrium; see Chapter 4 of Stokey and Lucas (1989). **QED.**