University of Toronto
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Working Paper 502

Factor Misallocation and Development

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October 14, 2013

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Abstract

The large differences in income per capita across countries are mostly explained by differences in total factor productivity (TFP). This article summarizes the evidence on the importance of resource allocation across productive units in explaining the observed differences in TFP across countries.

Keywords: misallocation, productivity, heterogeneous establishments, distortions.

*This article was prepared for The New Palgrave Dictionary of Economics. I thank Tasso Adamopoulos and Margarida Duarte for helpful comments. All errors and omissions are my own.

1 Introduction

A fundamental question in growth and development economics is why some countries are rich and others poor. To illustrate the enormous differences in income per capita across countries consider that the average gross domestic product (GDP) per capita of the richest 10 percent of countries in the year 2000 was a factor of 40-fold that of the poorest 10 percent of countries. In other words, the average person in a rich country produces in just over 9 days what the average person in a poor country produces in an entire year. What are the factors that can explain this enormous difference in standard of living across the world today? Considerable progress has been made in diagnosing the proximate sources of the variation in income per capita across countries with differences in total factor productivity (TFP) considered the dominant factor (see for instance Klenow and Rodriguez-Clare, 1997; Prescott, 1998; and Hall and Jones, 1999).

The key question is then: What are the sources of low TFP in poor countries? The literature has emphasized the possibility that resources may not be efficiently distributed across production opportunities thereby generating lower TFP. Such a perspective has received substantial attention in the literature both in terms of empirical and quantitative work. This perspective has tremendous appeal in understanding productivity differences across countries for at least two reasons. First, in rich economies, it is well established that the reallocation of factors across productive units explains a large portion of productivity growth over time. For example, Baily, Hulten, and Campbell (1992) show that 50 percent of the growth in manufacturing productivity in the United States in the 70s and 80s is attributed to the reallocation

of factors across plants, from contracting less-productive plants to expanding more-productive plants, and from failing plants that exit to entering new plants (see also Foster, Haltiwanger, and Syverson, 2008). Second, it is widely recognized that a number of policies and institutions prevalent in poor countries can distort the allocation of factors across productive units. This is what the literature broadly refers to as misallocation. For instance, it is emphasized that credit markets in poor countries do not operate as efficiently as in rich countries (credit market institutions) and that imperfections in credit markets act as a barrier to the efficient allocation of resources across production opportunities. Similarly, imperfections in land market institutions and labor market institutions can create misallocation. It is also recognized that certain policies (whether intentional or not) can create misallocation as they often effectively apply differently to heterogeneous producers.

The fact that we can produce a long list of factors that can cause misallocation does not immediately imply that misallocation is quantitatively important in explaining low TFP in poor countries. The literature has made substantial progress in empirically documenting the extent of misallocation in poor countries as well as assessing its productivity implications. In addition, the literature has explored many specific factors generating misallocation as well as mechanisms that can amplify their effects on aggregate productivity. In this article, I attempt to synthesize this literature by first describing a very simple model of misallocation. I then follow Restuccia and Rogerson (2013) in classifying the literature into two broad categories. First, the indirect approach which provides broad evidence of misallocation and a quantitative assessment of their effect on aggregate TFP. This approach is

often silent about the underlying channels through which misallocation takes place. Second, the direct approach which consists of analyzing a particular policy/institution and making a quantitative assessment of its importance in generating misallocation and low TFP.

2 A Simple Model of Misallocation

Consider the following simple static economy with production heterogeneity in the spirit of Lucas (1968) and Hopenhayn (1992). A single good is produced. The production unit is an establishment, indexed by i that produces output according to $y_i = z_i n_i^{\gamma}$ where z_i is establishment-level total factor productivity, n_i is the labor input chosen by the establishment, y_i is the amount of output produced, and $\gamma \in (0, 1)$. While in practice establishments may differ in many dimensions, I will focus on exogenous differences in z_i. There is a large number of establishments and a measure one of homogeneous workers that supply labor inelastically to the market. For simplicity, assume that there is a finite number of potential z_i's. Establishments operate in competitive labor and output markets. Let the price of output be normalized to one and denote the wage rate by w. Given prices, an establishment maximizes profits by choosing the labor input. That is,

$$\pi_i(z_i) = \max_{n_i} \{y_i - w n_i\}.$$

The first order condition for profit maximization from this problem is given by

$$\gamma z_i n_i^{\gamma - 1} = w, \tag{1}$$

which implies that the optimal demand for labor given w is

$$\bar{n}_i(z_i) = \left(\frac{z_i\gamma}{w}\right)^{1/(1-\gamma)}. \tag{2}$$

I note that with all establishments facing the same technological parameters (in this simple case, γ) and prices (w), the more productive establishments (higher z_i) are larger; that is, demand more labor, produce more output, and generate more profits. In fact, note from equation (2) that the ratio of employment between two establishments i and j is a monotone function of the ratio of their idiosyncratic productivity $n_i/n_j = (z_i/z_j)^{1/(1-\gamma)}$. In this setup, establishments have an optimal size which is determined by their idiosyncratic productivity and aggregate factors such as the wage rate. Total output in this economy is the aggregate of output from individual establishments. TFP is the ratio of total output to total labor input. Since total labor is normalized to 1, total output and TFP are the same in this economy. It is easy to show that, in this environment, the allocation from the competitive equilibrium (which includes a wage rate that clears the labor market $\sum_i \bar{n}_i(z_i) = 1$) coincides with the efficient allocation.

I now introduce distortions into this economy in the spirit of Restuccia and Rogerson (2008). While in principle there are many policies/institutions that can create misallocation, it is convenient for the purpose of illustration to generate misallocation via tax/subsidy schemes. Consider then the situation where establishments face a tax/subsidy to output τ_i, where $\tau_i > 0$ means a tax and $\tau_i < 0$ a subsidy. Importantly, establishments will face different τ's. I will refer to these policies as idiosyncratic distortions as in Restuccia and Rogerson (2008) to emphasize the fact that it is precisely the differential

tax rates that will create misallocation in this economy. Without entering into the discussion of how the taxes are related to productivity, note that the problem of the establishment now renders a first order condition which is given by

$$(1-\tau_i)\gamma z_i n_i^{\gamma-1} = w, \tag{3}$$

which implies a demand for labor,

$$\bar{n}_i(z_i,\tau_i) = \left(\frac{(1-\tau_i)z_i\gamma}{w}\right)^{1/(1-\gamma)}. \tag{4}$$

Hence, conditional on productivity, establishments that are taxed more heavily are smaller than establishments that are taxed less. Whereas in the undistorted economy all establishments with the same productivity are of the same size, in the distorted economy some establishments are larger than others on the basis of the distortions alone and that entails an inefficiency. More importantly, whereas in the undistorted economy more productive establishments are larger and as a result have a larger fraction of labor and output, in the distorted economy that is not necessarily the case. Note that from equation (4) the ratio of employment between two establishments now depends also on the tax rates faced by these establishments. An unproductive establishment (low z_i) can be large (high n_i) if its τ_i is sufficiently low. Similarly, a productive establishment (high z_i) can be small if its τ_i is sufficiently high. Incidentally, for this reason it is misleading to look only at the size distribution of establishments across countries to make inferences about the differences in the distribution of establishment-level productivity across countries.

Restuccia and Rogerson (2008) emphasize that, given a policy distortion characterized by the function $P(\tau_i, z_i)$ whereby tax/subsidies may be related to establishment productivity, if the policy is such that taxes are applied more heavily to the higher-productivity producers, then the productivity loss associated with that policy will be larger. Much of the direct approach that I will describe later is about measuring and assessing quantitatively policies of this sort.

Up to this point (and in much of the existing literature) misallocation is a narrow, static concept that refers to the reallocation of a given set of aggregate factors across a fixed set of heterogenous productive units. However, I emphasize that broadly understood misallocation can also generate negative effects on aggregate factors (for instance on the accumulation of physical and human capital) as well as on the distribution of establishment-level productivity in the economy itself. I will discuss these broader implications of misallocation later. While in this article I emphasize factor misallocation across microeconomic units within a sector, other forms of misallocation can also play a role such as factor misallocation across sectors, across geographical areas, and across government versus privately-owned enterprises (see for instance Restuccia, Yang, and Zhu, 2008; Restuccia, 2011; and Brandt, Tombe, and Zhu, 2013).

3 The Indirect Approach

The indirect approach aims at measuring the full extent of misallocation in an economy without detail as to what policies or institutions may be causing

it. Hsieh and Klenow (2009) is a seminal contribution providing empirical measures of misallocation. To illustrate their empirical strategy in the simple framework just discussed, note that in an undistorted economy the marginal product of labor is equalized across all establishments. That is, more productive establishments hire more labor precisely to reduce the marginal product of labor down to the given wage rate (see equation 1). In a distorted economy, the marginal product of labor is not equal across establishments that face idiosyncratic distortions. That is, in the distorted economy establishments equate the marginal product of labor to the tax adjusted wage rate which would not be equal across establishments. While their empirical exercise is obviously more involved than this, in a nutshell, given micro data on productivity z_i and employment n_i for individual establishments, we can use equation (1) to assess the extent to which the marginal product of labor does not equalize across establishments. To put it differently, we can use equation (3) to calculate the wedges required (the τ's) for optimization to hold. Hsieh and Klenow (2009) use data for China, India, and the United States and find large deviations in marginal products, with much larger and systematic differences across establishments in India and China than in the United States. What are the productivity implications of the larger wedges in China and India relative to the United States? Using the model, we can evaluate the quantitative impact of those deviations. It can be shown in the simple framework that whereas the efficient allocation results in aggregate TFP as a geometric average of establishment productivity, in the distorted economy, aggregate TFP is lowered by the distortions. Hsieh and Klenow (2009) derive a similar relationship in their more elaborate model, that includes capital,

differentiated products, and industries, and show that the TFP gains from moving to the efficient allocation of factors are very large in both India and China and much larger than in the United States. More specifically, their results show that by reducing the wedges in India and China to those of the United States, manufacturing TFP in China and India could more than double.

A perhaps expected but nevertheless interesting by-product result of the micro data is the implied distribution of establishment-level productivity in China, India, and the United States. The data shows that the distributions of establishments in China and India contain much more mass in establishments with lower productivity compared to the distribution in the United States. The data also shows that the distributions in China and India contain mass of establishments at extremely low levels of productivity, levels for which there is no mass of establishments in the US distribution. Whereas misallocation focuses on the allocation of factors given the distribution of productivities in a country, an ambitious and very important aspect of the literature is to understand the differences in the distribution of establishment-level productivity and their potential connection to misallocation. I will come back to this issue below.

The results from Hsieh and Klenow (2009) have influenced a large body of subsequent work applying similar strategies in a variety of different contexts and country experiences. Broadly speaking, the subsequent literature has confirmed the importance of misallocation in understanding productivity differences. See for instance the work of Busso, Madrigal, and Pages (2013) for Latin American countries as well as Kalemli-Ozcan and Sorensen (2012)

for countries in Africa (see also a more complete review in Restuccia and Rogerson, 2013).

Following an alternative strategy, Bartelsman, Haltiwanger, and Scarpetta (2013) provide additional empirical evidence of misallocation and a quantitative assessment for a set of OECD countries. These authors emphasize the covariance between firm-level productivity and firm size as a critical statistic of misallocation. For instance, note that in the simple framework of section 2, the covariance between establishment productivity and establishment size is high in the undistorted economy whereas this covariance is diminished in the distorted economy. Their results confirm the important role that misallocation plays in understanding aggregate productivity differences across OECD countries.

4 The Direct Approach

The direct approach aims to identify specific policies and institutions that generate idiosyncratic effects and misallocation. What policies and institutions are important in generating idiosyncratic effects and misallocation? As alluded to earlier, there is a long list of potential policies and institutions that can create misallocation and reduce aggregate TFP. But the key question is which of these policies and institutions are most responsible for low TFP in poor countries. The approach in the literature has been to select a particular policy or institution that can be measured in the data and to use a model to assess its quantitative effect on productivity. By narrowing the extent of misallocation to a single policy, the studies following the direct approach

find much smaller productivity effects than the indirect approach, with productivity losses typically in the range of 5 to 30 percent. One important exception is the work of Adamopoulos and Restuccia (forthcoming) where direct empirical measures of idiosyncratic price distortions in the agricultural sector generate much larger productivity losses (differences in productivity of more than 10-fold).

Although with a different emphasis, Hopenhayn and Rogerson (1993) is an early example of this direct approach, where firing taxes are shown to reduce aggregate productivity when establishment productivity varies over time. Firing taxes are a good example of a policy or labor market institution that can create idiosyncratic effects even though the policy is meant to be applied to all establishments lowering their employment level. To see this, note that the firing tax creates a wedge in the downward adjustment of employment–establishments do not lay off as many workers as they would without the tax, as well as a wedge in the upper adjustment–a high level of productivity does not command an increase in employment as large as it would without the tax because of expected mean reversion of the shock. Moreover, in many contexts, such as those of many European countries, firing taxes are applied only to firms with more than a certain number of workers. Since larger firms are associated with higher productivity in an undistorted setting, this exemption of small firms from firing taxes amounts to an idiosyncratic distortion where more productive firms are taxed more heavily than low productivity firms, generating a redistribution of factors from more to less productive establishments and lowering aggregate productivity.

Size-dependent policies –policies that explicitly or implicitly treat produc-

ers differently based on the size of the establishment– abound and Guner, Ventura, and Xu (2008) provide both a documentation of these policies as well as a quantitative assessment of how damaging they are for productivity. Other institutional features such as the functioning of credit markets or enforcement can also create idiosyncratic effects. For instance, Banerjee and Duflo (2005) emphasize the role of credit constraints in generating a wide dispersion in the marginal product of capital across firms in India as a likely explanation for low aggregate TFP in that country. Buera, Kaboski, and Shin (2011) and Greenwood, Sanchez, and Wang (2013) show how cross-country differences in credit market imperfections distort the allocation of factors to generate large productivity losses. Cross-country differences in property rights can create idiosyncratic effects as in Ranasinghe (2012). Sometimes even policies that are not intended to have an idiosyncratic impact in effect do, such as trade policies and regulations. For instance, Bond et al. (2013) document the idiosyncratic effects created by the passage of the Smoot-Hawley Tariff Bill during the Great Depression in the United States while Eslava et al. (2013) study the selection effects in aggregate productivity of a trade reform in Colombia. Leal (forthcoming) studies the effects of the myriad of regulations that determine the large size of the informal sector in Mexico. Another important example of policies/institutions generating idiosyncratic effects and misallocation is in the agricultural sector in poor countries. Adamopoulos and Restuccia (forthcoming) study the role of misallocation in agriculture in explaining the small scale of operation in that sector in poor countries and their low productivity. Policies such as progressive taxes and subsidies that favour small scale production, land market

institutions such as inheritance norms, land fragmentation, and land reform, are shown to substantially lower agricultural productivity.

5 Amplification Mechanisms

In the context of the standard neoclassical model (with a representative firm structure) it is well known that physical and human capital accumulation amplify the effects of differences in TFP on output per capita (see for instance Klenow and Rodriguez-Clare, 1997; Manuelli and Seshadri, 2006; and Erosa, Koreshkova, and Restuccia, 2010). Hence, capital accumulation amplifies the impact of misallocation on cross-country income differences.

Much less explored is how policies and institutions that create misallocation affect the distribution of establishment productivity, thereby amplifying the effects of misallocation on aggregate productivity. This is a very important aspect of broadening the potential impact of misallocation. As discussed earlier, the available micro data across a variety of countries show large differences in the productivity distribution of establishments. To illustrate why the differences in establishment-level productivity may be connected to the same policies that create misallocation, notice that if in the simple framework establishments are allowed to invest in their productivity, then the return to this investment is related to the increased value of the establishment with higher productivity. If distortions are such that high productivity establishments face larger distortions than low productivity establishments, the policy also creates a disincentive to invest in productivity by lowering the return to productivity investment. This is what Restuccia (2013) and Bello, Blyde,

and Restuccia (2011) do in extending the framework of Restuccia and Rogerson (2008) to understand low productivity in Latin American economies, and is the subject of more elaborate analyses in Ranasinghe (2013), Bhattacharya, Guner, and Ventura (2013), Gabler and Poschke (2013), and Hsieh and Klenow (2012). Jones (2011) proposes an amplification mechanism for misallocation that is based on the input-output structure of the economy as the outputs of many firms are used as inputs in other firms.

6 Conclusions

Income per capita and total factor productivity differ greatly across countries. Understanding the proximate causes of this variation is a challenging goal in the literature of growth and development with important welfare and policy implications. Much progress has been made by the literature as briefly summarized in this article but further exciting work remains to be done.

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