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The Causes and Costs of Misallocation

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Why do living standards differ so much across countries? This is one of the long-standing questions in economics. A consensus in the development literature is that differences in productivity are a large, if not necessarily the dominant, source of these differences: that is, even after adjusting for differences in the quantity and quality of factors of production such as capital and labor, poor countries produce much less output per worker than rich countries, and this difference accounts for much of the variation in income per capita across countries.[1] But what accounts for productivity differences across countries? One explanation is that frontier technologies and best practice methods are slow to diffuse to low-income countries. The recent literature on misallocation, which is the focus of this article, offers a distinct but complementary explanation: low-income countries are not as effective in allocating their factors of production to their most efficient use.

Casual empiricism suggests that both slow diffusion and misallocation are potentially relevant. A visit to any less-developed country reveals that much production, whether in agriculture, manufacturing, or services, seems to use outdated

[1] Early contributions making this point include Klenow and Rodriguez-Clare (1997), Prescott (1998), and Hall and Jones (1999). See also the surveys of Caselli (2005) and Jones (2016).

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methods. But many studies and anecdotes detail how corruption, regulation, or direct government involvement distort the allocation of resources from their most efficient use, especially in poorer economies. More generally, the notion that the allocation of inputs across establishments is an important component of aggregate productivity is reinforced by studies in the United States and elsewhere that find reallocation of inputs from less- to more-productive establishments to be an important component of aggregate productivity growth (for example, see Baily, Hulten, and Campbell 1992; Foster, Haltiwanger, and Syverson 2008).

Three key questions arise: First, how important is misallocation as a source of aggregate productivity differences across countries? Second, what are the main causes of misallocation? Third, beyond the direct cost of lower contemporaneous output, are there additional costs associated with misallocation? In this article, we provide our perspective on these three questions. It is not our intention to survey the literature, and as a result, we inevitably neglect many important references and contributions. We instead refer the reader to available survey articles of this literature, for instance Restuccia and Rogerson (2013) and Hopenhayn (2014).

Potential Sources of Misallocation

The nature of misallocation on which we focus is quite specific. Economists routinely study distortions that affect resource allocations along many dimensions, but we are specifically interested in distortions that affect the allocation of inputs *across* producers of a given good. For example, in the context of the standard neoclassical growth model, a proportional tax on income will distort household decisions regarding consumption and labor supply, and hence may be described as causing misallocation along these margins. But this type of misallocation, affecting the amounts of capital and labor used in production, is not the sort of misallocation we emphasize. Instead, we are interested in situations in which the allocation of a given amount of capital and labor across heterogeneous producers is distorted. This would happen, for example, when different producers of the same good are taxed at different rates.

An example will serve to fix ideas and facilitate exposition. Aggregate output is produced by many heterogeneous producers that differ in their individual levels of productivity.[2] Specifically, assume there are N potential producers of a homogeneous good and that producer i has a production function $y_i = A_i \cdot f(h_i, k_i)$, where y_i, is output, h_i is labor input, k_i is capital input, f is a strictly increasing and strictly concave production function, and variation in A_i reflects differences in productivity across producers. Assume also that there is a fixed cost for any producer who operates, measured in units of output and denoted by c. Given an aggregate amount of labor and capital, denoted by H and K respectively, there is a unique choice of which

[2] As summarized in Syverson (2011), large dispersion of productivity even within narrowly defined industries is a robust feature of reality.

producers should operate and how labor and capital should be allocated across them in order to maximize total output net of fixed operating costs.

Three conceptually distinct channels will affect the amount of output, and hence the overall level of productivity. The first channel, which we call the *technology* channel, reflects the values of the producer-level productivity A_i; if all of the A_i are larger, output will be greater. The second channel, which we call the *selection* channel, reflects the choice of which producers should operate. The third channel is the *misallocation* channel and reflects the choice of how capital and labor are allocated among those producers that operate. Conceptually, selection effects are a special case of misallocation, but from an empirical perspective we do not observe potential producers who do not operate, making it more difficult to measure selection effects without additional structure. An important theme in our discussion is that these three channels are not independent: any policy or institution that distorts the allocation of resources across producers—creating misallocation—will potentially generate additional effects through both the selection and technology channels.

In our example, output maximizing choices have the following form: a threshold rule determines which producers operate (that is, producers operate if the productivity level $A_i > \overline{A}$) and conditional upon operation, producers with higher values of A_i will be allocated a greater amount of labor and capital. The efficient allocation will induce a distribution of producer sizes. More specifically, the allocation of inputs that maximizes output will equate the marginal products of labor and capital across all producers with positive inputs. Thus, thinking about factors that interfere with equalization of marginal products is a useful way to identify possible sources of misallocation.

Many articles, spanning the fields of development economics, industrial organization, labor economics, finance, international economics, and others have documented specific sources of misallocation in particular contexts.[3] They serve to impress upon us the pervasiveness of misallocation. Rather than provide a laundry list of very specific potential sources of misallocation, we instead emphasize three general categories of factors.

First, misallocation may reflect statutory provisions, including features of the tax code and regulations. Specific examples would include provisions of the tax code that vary with firm characteristics (such as the size or age of the firm), tariffs applied to narrowly defined categories of goods, labor market regulations such as

[3] A list of studies on misallocation in specific areas could be extremely long, but we highlight a few examples. In the development literature, Banerjee and Duflo (2005) document credit market imperfections among manufacturers in India. De Mel, McKenzie, and Woodruff (2008) establish wedges between the marginal product of capital and borrowing rates among small producers in Sri Lanka using experimental methods. Besley and Ghatak (2010) survey work on property rights and misallocation. In industrial organization, Olley and Pakes (1996) study regulation in the US telecommunications industry and find an important role for misallocation. Caballero et al. (2008) document "zombie lending" practices in Japan, a process by which banks continue to extend credit to poorly performing businesses in order to avoid writing down bad loans. Heckman and Pagés (2004) summarize work on the effects of labor market regulations using microdata from Latin America and the Caribbean. Guner, Ventura, and Xu (2008) document the effects of product market regulation in Japan and India. Melitz and Redding (2014) summarize the literature on trade barriers and misallocation.

employment protection measures, product market regulations that restrict size or limit market access, and land regulations. Even a regulation that applies uniformly to all firms within an industry may generate misallocation within the industry. For example, a given employment protection measure will differentially affect expanding and contracting firms.

Second, misallocation may reflect discretionary provisions made by the government or other entities (such as banks) that favor or penalize specific firms. Such provisions are often referred to as "crony capitalism" or even "government corruption." Examples are subsidies, tax breaks, or low interest rate loans granted to specific firms, along with unfair bidding practices for government contracts, preferential market access, or selective enforcement of taxes and regulations.

Third, misallocation may reflect market imperfections. Examples include monopoly power, market frictions, and enforcement of property rights. A producer with monopoly power may produce less than the efficient level but charge a higher markup. A highly productive firm with little collateral may not be able to access enough capital to produce at the efficient level. Bloom et al. (2013) suggests that the size of highly productive firms in India is restricted by the inability to delegate management outside of the family on account of poor enforcement of property rights. Lack of land titling may affect the allocation of land.

There are three messages that we want the reader to take away from this overview. First, the set of plausible underlying sources of misallocation is wide-ranging. Second, many sources are very narrow in scope—being particular to specific sectors, types of firms, or even regions. And third, many of these sources, especially those reflecting discretionary provisions, are not amenable to systematic measurement. This combination makes life challenging for any researcher interested in assessing the aggregate importance of misallocation.

Measuring Misallocation: Methodology

Misallocation seems pervasive. But is it quantitatively important? To address the question of whether misallocation is an important source of cross-country differences in total factor productivity, the literature has adopted two main approaches, which we label the *direct* and the *indirect* approaches.

The essence of the direct approach is to focus on specific sources of misallocation and to assess their consequences. One source of information is quasi-natural experiments that shed light on a particular source of misallocation. While some studies have successfully followed this path, as a practical matter, the scope for this type of assessment seems to be somewhat limited. As a result, the typical study employing the direct approach seeks to measure the source of misallocation and assess its quantitative effects via a structural model. This approach has a long tradition in public finance as a way to measure the distortions from various taxes. Of course, a researcher must be aware that details of the structural model may have important effects on the findings. However, we stress that evaluating the extent of misallocation necessarily requires computing a counterfactual—how much

additional output could be generated by reallocating inputs among producers. One cannot entirely avoid structure in answering this question.

But the direct approach faces another challenge. Implementing it requires quantitative measures of the underlying source of misallocation. If statutory provisions are the key source of misallocation, then this is perhaps not a problem. However, if the most important sources of misallocation reflect discretionary provisions, then measurement may be very difficult. Even if regulation is an important source of misallocation in aggregate, the highly specialized and complex nature of regulation within specific industries may still make it very difficult to develop and analyze an appropriate structural model.

In contrast, the indirect approach seeks to identify the extent of misallocation without identifying the underlying source of the misallocation. As noted earlier in our simple example, the efficient allocation of inputs equates marginal products across all active producers. Thus, directly examining variation in marginal products provides the opportunity to measure the amount of misallocation without specifying the underlying source of misallocation. This approach also requires some structure, but unlike the direct approach it does not require specifying a full model. In our simple example, given cross-section data on output, labor, and capital, it is sufficient to specify the production function f in order to directly compute the implied amount of misallocation. To see why, note that with data on y, k, and h for each producer and a production function f, we can infer the A_i. Given a production function f and the A_i, we can directly solve for the allocation of inputs among producers that would maximize output. Comparing this to actual output provides an assessment of the extent of misallocation. Note that because this exercise takes the set of producers as given, it does not address selection. So even though selection effects are conceptually akin to what we have called misallocation, this procedure will only isolate the misallocation effect.

Although the indirect approach requires less structure than the direct approach, it faces one key challenge. In more general frameworks, efficient allocations need not entail equality of marginal products across producers at every point in time. If inputs are chosen before the realization of producer-specific shocks, or if there are adjustment costs, then this condition need not hold. Also, measurement error in firm-level data will lead us to infer variation in marginal products across producers even when none truly exists. We later discuss these issues in more detail.

How Important is Misallocation? Results Using the Indirect Approach

In Restuccia and Rogerson (2008), we used a version of the Hopenhayn (1992) industry equilibrium model calibrated to match features of the US economy to explore the extent to which misallocation caused by firm-specific taxes and subsidies would impact aggregate total factor productivity. These firm-specific taxes and subsidies were hypothetical, but chosen as a representation of the many different factors that might generate misallocation. In one of our scenarios, termed "correlated distortions," high-productivity establishments are systematically taxed and low-productivity establishments are systematically subsidized. We showed that

this can substantially depress total factor productivity. One key message from this research is that for misallocation to have large effects, it needs to depress inputs systematically at high-productivity producers. It follows that studies identifying misallocation among relatively small and less-productive enterprises may not be particularly relevant in terms of assessing aggregate effects.

The Indirect Approach

Whereas in Restuccia and Rogerson (2008) we analyzed misallocation from hypothetical policy distortions, Hsieh and Klenow (2009) noted that the extent of misallocation could be estimated given appropriate microdata and some structure. Their procedure essentially follows the strategy described in the previous section but in a setting where each firm produces a distinct variety of goods that are valued by consumers according to a constant elasticity of substitution aggregator. Each producer behaves as a monopolistic competitor when deciding its level of output, but markets for labor and capital are competitive. The implied demand structure is important because it allows the authors to infer total factor productivity when the data includes only total revenue (as opposed to physical output).

When Hsieh and Klenow (2009) apply their method to four-digit manufacturing industries in China, India, and the United States, they find large effects of misallocation on total factor productivity. In particular, if misallocation were eliminated, total factor productivity in manufacturing would increase by 86–110 percent in China, 100–128 percent in India, and 30–43 percent in the United States. Taken at face value, these results indicate that misallocation is quantitatively important, even in a high-income economy like the United States, and that it is an important factor in accounting for productivity differences across rich and poor countries. These estimates are for the manufacturing sector, not the overall economy. Available evidence suggests that cross-country differences in manufacturing productivity tend to be much smaller than aggregate productivity differences. Hsieh and Klenow (2009) estimated that total factor productivity differences in manufacturing between the United States and China and India during the relevant period are on the order of 130 and 160 percent respectively, in contrast to total factor productivity differences on the order of 300 and 600 percent at the aggregate level.

We note that these productivity losses from misallocation assume that all dispersion in revenue marginal products across producers within a sector is the result of distortions or institutions that can be acted upon by policy. To the extent that some differences need not reflect misallocation due to policies, their estimates overstate the total amount of misallocation. We return to this issue later.

Although the Hsieh and Klenow (2009) approach measures misallocation without identifying the source of the misallocation, their analysis does nonetheless allow them to examine how the extent of misallocation is correlated with various observables. For example, state ownership in China is intimately related with misallocation, in that state-owned firms are much larger than efficiency would dictate. Another important finding is that high-productivity producers are too small in all three economies, but the size of this effect is stronger in China and India than in the United States. Bento and Restuccia (forthcoming) corroborate this finding for a

larger set of developing countries: the extent to which more-productive plants face greater implicit taxes is strongly related to GDP per capita across countries.

Limitations of the Indirect Approach

The indirect approach essentially assumes a production structure and then uses the data to estimate wedges in the first-order conditions that characterize an efficient allocation. This approach interprets the wedges as reflecting distortions to efficient allocations. But related to our earlier discussion, there are good reasons to be wary of this interpretation. We discuss three specific reasons that we believe are potentially significant. We note that Hsieh and Klenow (2009) acknowledged and attempted to address each of them.

The first issue concerns the nature of heterogeneity in production functions across producers. With enough freedom to choose heterogeneous production functions across producers, data on inputs and outputs would not allow one to infer differences in marginal products. But what about some restricted and seemingly reasonable degrees of heterogeneity? For example, the benchmark results in Hsieh and Klenow (2009) assume all producers within a sector use the same Cobb–Douglas production function. It follows that capital-to-labor ratios are equal for all producers in an efficient allocation, implying that any variation in capital-to-labor ratios will be interpreted as misallocation. An alternative interpretation is that producers use different production methods so that capital shares in the Cobb–Douglas production function are heterogeneous across producers. In the extreme, all differences in capital-to-labor ratios reflect heterogeneity in producer-level production functions, rather than misallocation. Hsieh and Klenow (2009) show that although this alternative interpretation implies less misallocation, the remaining misallocation still implies large productivity losses. This result implies that the dominant sources of distortions act symmetrically on labor and capital so that the capital to labor ratio is roughly unaffected by distortions.

The second issue we consider is adjustment costs. A voluminous literature estimates substantial adjustment costs for both labor and capital at the individual producer level (for example, see Cooper and Haltiwanger 2006; Bloom 2009; and the survey in Bond and Van Reenen 2007). This raises the possibility that marginal products of capital and labor in production differ across producers because of adjustment costs and transitory firm-specific shocks. Being mindful of this issue, Hsieh and Klenow's (2009) preferred interpretation of their findings is to focus on the *differences* in misallocation across economies, rather than the levels per se. The idea is that some amount of "base level" misallocation is appropriately understood as the result of adjustment costs or some other misspecification, and that a reasonable starting point is to assume that this level is the same across economies. This moderates their estimates of the amount of misallocation: if China and India were to reduce misallocation to the level found in the United States, total factor productivity in manufacturing in those countries would increase by 31–51 percent and 40–59 percent, respectively. While smaller than the earlier values, it remains true that misallocation can account for almost half of the observed total factor productivity differences in manufacturing.

But is it reasonable to argue that all economies have some common level of measured misallocation that should be ignored in this context? Asker, Collard-Wexler, and De Loecker (2014) argue that the answer to this question is no. They show that observed differences in the dispersion of marginal revenue products can be consistent with efficient allocations if there are adjustment costs on capital coupled with transitory firm-level shocks that are more variable in poorer countries. While we believe that this study serves as an important cautionary note regarding the indirect approach, two remarks are important. First, it is necessary to ask why idiosyncratic shocks are more variable in poorer countries—if the higher variability of shocks reflects greater variability in the policy environment then it seems appropriate to interpret the higher dispersion of marginal revenue products in poorer countries as reflecting misallocation. Second, it highlights the need to examine misallocation using panel data at the establishment level, instead of cross-section data. If measured misallocation is due to adjustment costs, it will generate specific time-series patterns. More generally, with panel data, researchers could carry out the indirect approach on specifications that explicitly include adjustment costs. David and Venkateswaran (2017) carry out exactly this type of analysis using panel data from China under the assumption that capital adjustment costs are convex. While adjustment costs and idiosyncratic policy distortions can both generate the cross-sectional dispersion in the marginal product of capital across firms, they have opposing effects on the autocorrelation of investment. Using dynamic moments from their panel dataset, the authors show that most of the cross-sectional variation in marginal revenue products is due to policy distortions with a relatively minor share due to adjustment costs. This result appears robust to considering nonconvex adjustment costs because at the annual frequency, inaction due to fixed costs is estimated to be minor. But more analysis of this type using panel data is an important priority for future research.

Third, the higher dispersion of marginal products in China and India could reflect greater amounts of measurement error in these countries relative to the United States. Hsieh and Klenow (2009) carry out several calculations to assess this possibility, which, while not conclusive, do not support such an interpretation. Recent work by Bils, Klenow, and Ruane (2017) goes much further. They use the panel component of the datasets for India and the United States used in Hsieh and Klenow (2009) to estimate measurement error in each country and infer the extent of differences in productivity due to misallocation after accounting for measurement error. They have three main findings. First, measurement error accounts for a substantial amount of the dispersion in marginal revenue products. Second, the contribution of measurement error is becoming more important over time in the United States but is relatively stable in India. And third, after accounting for measurement error, the contribution of misallocation to understanding productivity differences between India and the United States is very similar to what Hsieh and Klenow (2009) found in their original analysis, that is manufacturing total factor productivity gains of 40–60 percent in India relative to the United States.

While progress is being made in extending the indirect method to address the limitations discussed, we also think it is useful to develop alternative approaches. For example, Bartlesman, Haltiwanger, and Scarpetta (2013) focus on the covariance

between firm size and productivity, and how it is affected by firm-specific taxes and subsidies. They assume a specification that implies cross-sectional differences in marginal products even in an efficient allocation, and calibrate their model so that moments of the US cross-sectional data on revenue productivity dispersion and employment are consistent with efficiency. They use the calibrated model to assess the amount of misallocation in manufacturing in a sample of seven other economies—the United Kingdom, France, Germany, Netherlands, Romania, Hungary, and Slovenia—during the 1990s. Rather than inferring the actual distortions faced by each firm in their dataset, they infer a statistical representation of distortions that matches salient moments of the data. Relative to the United States, they find that the effect of misallocation on total factor productivity ranges from 3 percent in Germany to 12 percent in Romania. Their limited choice of countries was dictated by the desire to have data that was consistently collected across countries, so drawing broad conclusions about difference across countries is not possible. But studies like this open the possibility of comparing the estimates of misallocation for a given country based on different methods.

Further Indirect Evidence on Misallocation in Different Countries and Sectors

The analysis in Hsieh and Klenow (2009) found important effects of misallocation within manufacturing in China and India relative to the United States. A variety of studies have extended this finding to other countries and other sectors. Busso, Madrigal, and Pagés (2013) carry out a comparable analysis of manufacturing in ten Latin American countries and conclude that differences in misallocation between these economies and the United States is an important source of total factor productivity gaps in manufacturing. Kalemli-Ozcan and Sørensen (2016) study misallocation of capital among private manufacturing firms in 10 African countries. Their sample also includes firms from India, Ireland, Spain, and South Korea that can be used as benchmarks. Subject to the caveat of small sample sizes, they find that capital misallocation in Africa is significantly higher than in developed countries, though not as severe as in India.

The above results all pertain to the manufacturing sector. Relatively few papers have addressed misallocation in the service sector. Busso, Madrigal, and Pagés (2013) include analyses of specific service sectors, such as retail, and find that misallocation in services sectors is much larger than in manufacturing. De Vries (2014) finds very large misallocation in the retail sector in Brazil. Dias, Marques, and Richmond (2016a) study misallocation in manufacturing and services in Portugal and also find that misallocation is much larger in services. One limitation of these studies is that they do not include a benchmark, such as the US economy. If misallocation measures for the US economy are also larger in service sectors than in manufacturing, then it is not clear if misallocation differences are indeed more severe in service sectors. Also, an important caveat is that output in a number of relevant service sectors, such as education, health care, and banking, is likely to be very poorly measured.

The agricultural sector is of particular importance in comparing the world's richest and poorest economies as this is where productivity gaps are greatest and a

large share of labor in poor countries is allocated to agriculture (Gollin et al. 2002; Restuccia, Yang, and Zhu 2008). Caselli (2005) reports that differences in output per worker, expressed in terms of the ratio of countries in the 90th percentile to the 10th percentile of the income distribution, were 22 at the aggregate level, 4 in nonagriculture, and 45 in agriculture.

Adamopoulos and Restuccia (2014) document a long list of policies and institutions in the agricultural sector in developing countries that can potentially create misallocation. They also document striking differences in the distribution of farm sizes across countries with the typical operational land scale of a farm in poor countries being only 2 to 3 percent of the operational size in rich countries. The authors develop a model of agriculture and nonagriculture extended to produce a nondegenerate endogenous distribution of farms sizes in agriculture and consider abstract representations of distortions to match the observed distribution of farm sizes across countries. They find that the misallocation created by farm-size distortions can account for much of the farm-size and productivity differences in agriculture between rich and poor countries. Additionally, they show that the implied farm-size distortions are consistent with data on within-country variation in crop-specific price distortions and their correlation with farm size.

Restuccia and Santaeulalia-Llopis (2017) study misallocation across household farms in Malawi. They have data on the physical quantity of outputs and inputs as well as measures of transitory shocks and so are able to measure farm-level total factor productivity. They find that the allocation of inputs is relatively constant across farms despite large differences in measured total factor productivity, suggesting a large amount of misallocation. In fact, they found that aggregate agricultural output would increase by a remarkable factor of 3.6 if inputs were allocated efficiently. Their analysis also suggests that institutional factors that affect land allocation are likely playing a key role. Specifically, they compare misallocation within groups of farmers that are differentially influenced by restrictive land markets. Whereas most farmers in Malawi operate a given allocation of land, other farmers have access to marketed land (in most cases through informal rentals). Using this source of variation, Restuccia and Santaeulalia-Llopis find that misallocation is much larger for the group of farmers without access to marketed land: specifically, the potential output gains from removing misallocation are 2.6 times larger in this group relative to the gains for the group of farms with marketed land.

Other studies also document misallocation in agriculture. For instance, Adamopoulos, Brandt, Leight, and Restuccia (2017) study the case of China between 1993 and 2002, where the land market is severely restricted by the "household responsibility system." Land ownership and allocation decisions reside with the collective village, and use rights of land are distributed uniformly among household members registered in the village. While there are no explicit restrictions on land rental in China, fear of redistribution leads to implicit "use it or lose it" rules. In this context, farm operational scales are essentially limited to the use rights of land for each household, and hence, not surprisingly, the authors find that land allocations are unrelated to farm productivity. In particular, eliminating misallocation in this context is found to increase agricultural productivity by 1.84-fold, with 60 percent of

this gain arising from reallocation of factors across farms within villages. Exploiting the panel dimension of the data to remove potential transitory variation in farm productivity, the authors show that reallocation gains are still substantial, representing 81–86 percent of the cross-sectional productivity gains.

Chen, Restuccia, and Santaeulàlia-Llopis (2017) study the case of Ethiopia, where the current land market institutions are the result of a long history of divisive land relationships and conflicts. Land ownership resides with the state, and local authorities allocate land-use rights equally among households, controlling for soil quality and household size. Using detailed micro household-level data, the authors document substantial misallocation of land and other factors of production in the agricultural sector. An efficient reallocation of inputs can increase aggregate agricultural productivity by a factor of 2.4, with 75 percent of this increase derived from reallocation within zones (counties) in Ethiopia. The authors also exploit regional variation in the extent of rented land due to differential implementation of a land certification program that started in the early 2000s. Even though most rentals still occur between family members and relatives, they found that regions with more land rentals have significantly less misallocation: a 1 percentage point higher share of land rental is associated with a 0.8 percentage point decrease in the efficiency gain from reallocation.

Misallocation over Time

The results described so far have focused on differences in misallocation across countries at a point in time. It is also of interest to ask whether changes in misallocation over time within a country are an important source of changes in productivity over time. This is akin to connecting misallocation with growth accounting.

The literature has identified changes in misallocation as an important component of low-frequency movements in productivity in three contexts. Chen and Irrazabal (2015) show that misallocation decreased during Chile's decade-long period of growth following the crisis of the early 1980s, and was an important part of productivity growth during this time. Fujii and Nozawa (2013) show that capital misallocation in manufacturing became more pronounced after 1990 in Japan, a period characterized by poor productivity growth. And Gopinath, Kalemli-Ozcan, Karabarbounis, and Villegas-Sanchez (2015) find increased capital misallocation and roughly constant labor misallocation in Southern European countries subsequent to these countries joining the euro in 1999, a period of slower productivity growth in these countries. Note that changes in total factor productivity over time tend to be much smaller than differences in the cross-section, so even modest changes in misallocation can play a dominant role in the context of the time series changes observed in the data.[4]

A promising avenue for further study is to focus on changes in misallocation during periods in which important policy or regulatory changes occurred that

[4] See also Reis (2013) and Dias, Marques, and Richmond (2016b) for the case of Portugal, and Calligaris (2015) for Italy. Ziebarth (2013) is an interesting analysis of long-run changes in the context of the United States. In particular, he found that misallocation levels among US manufacturers in the late 19th century were similar to those in present-day India and China.

one might reasonably believe have important effects on misallocation. Hsieh and Klenow (2009) took a first step in this direction. They found a decrease in misallocation in China during the period of 1998 to 2005, a finding consistent with the view that various reforms enacted during this period served to lessen the importance of distortions. Interestingly, despite widespread reform in other sectors, land market institutions have remained essentially the same in China, and Adamopoulos et al. (2017) found that misallocation in the agricultural sector in China has remained roughly constant for the period of study (1993–2002).

Hsieh and Klenow (2009) found that misallocation in India worsened over the period from 1987 to 1994, a result which seems puzzling given the nature of reforms enacted there. One important reform during this time was the elimination of the license "raj" system, a system of controls on the entry of firms into the manufacturing sector. Bollard, Klenow, and Sharma (2013) pursued this further and found that although this period witnessed rapid productivity growth for their sample of very large firms, little of the productivity growth was due to changes in misallocation. There are of course multiple interpretations of this finding; perhaps the raj system was not an important source of misallocation among large firms, or perhaps it is not even an important source of misallocation overall. Alternatively, as noted earlier, the indirect method might not be isolating true misallocation. A recurring theme in this work is the need to reconcile results based on differing approaches.

The research by Bartleseman, Haltiwanger, and Scarpetta (2013) described earlier also included a time series component. They found that misallocation decreased over the period of the 1990s in the transition economies of Eastern Europe. This finding is also consistent with the notion that increased market reforms were leading to less misallocation, but the extent of the change is somewhat modest, increasing productivity by a few percentage points.

Several papers have assessed changes in misallocation over the business cycle, typically focusing on fairly dramatic episodes such as crises or protracted recessions. Oberfield (2013) studies misallocation in Chile during the crisis of the early 1980s, Sandleris and Wright (2014) examine misallocation in Argentina during its crisis in the early 2000s, and Ziebarth (2015) assessed misallocation during the US Great Depression. All of these authors find that misallocation increased sharply in each of these episodes and accounted for a large part of measured drops in aggregate total factor productivity. However, in our view, changes in misallocation measures at business cycle frequency need to be treated with extreme caution. As emphasized earlier, these measures can be heavily influenced by adjustment costs that may give rise to factor hoarding. To us, it remains very much an open question whether true misallocation of resources increases during these episodes.

Causes of Misallocation: The Direct Approach

The broad message that emerges from the many studies that employ the indirect approach is that misallocation is an important source of productivity differences across countries. But what is the underlying source of this misallocation? To

answer this question, we discuss the efforts to isolate causes of misallocation using the direct approach. Our goal is to assess the aggregate importance of misallocation attributed to several categories of distortions, particularly with an eye toward asking whether we can isolate factors that might generate effects of the magnitude found using the indirect method. In this regard, the current state of this literature is somewhat disappointing. The existing literature has identified some factors that can account for large effects of misallocation in agriculture. But it has yet to identify any particular factor that can account for the magnitudes of misallocation found in manufacturing.

Regulation

One of the earliest studies of misallocation due to regulation is the analysis of firing costs in Hopenhayn and Rogerson (1993). Firing costs are an adjustment cost created by policy, and the resulting variation in marginal products therefore reflects true misallocation. Using a quantitative version of the model in Hopenhayn (1992), these authors find that firing costs equal to one year's wages will lead to steady-state productivity losses of roughly 2 percent.[5] While these effects are comparable to a year of productivity growth for a typical country, they are nonetheless small relative to the magnitude of cross-country differences that we offered as the key motivating observation for the misallocation literature.

A potentially broader category of policies, what Guner, Ventura, and Xu (2008) call "size-dependent policies," reflects measures that implicitly levy higher taxes on firms that are larger in terms of sales, labor, or capital. Examples include regulations that only become effective beyond some employment threshold, outright restrictions on the number of employees, or restrictions on the amount of physical space that a retail establishment may operate. They analyze simple but abstract versions of such policies, and find that while they can have large effects on the number of firms and the firm size distribution, they have relatively small effects on total factor productivity.[6]

A large literature in development economics has studied duality and informality as a source of low productivity in poor countries (Lewis 1954; Rauch 1991; La Porta and Shleifer 2014). This literature is a natural predecessor to quantitative studies of misallocation, as one of its key ideas is that development requires the reallocation of resources out of subsistence and informal activities into "modern" activities. Busso, Fazzio, and Levy (2012) study the relation between productivity and informality in Mexico using detailed microdata. They exploit a precise

[5] Lagos (2006) uses a Mortensen–Pissarides matching model to study how labor market policies such as unemployment insurance and employment protection affect productivity via selection effects. He finds that changes in the replacement rate and firing costs decrease aggregate total factor productivity on the order of 2–3 percent.

[6] In related work, Garcia-Santana and Pijoan-Mas (2014) study the quantitative effect of small-scale reservation laws in India, a form of firm-size restriction. In a calibrated version of their model using plant-level data for India, eliminating these laws increases manufacturing output by almost 7 percent and manufacturing total factor productivity (TFP) by 2 percent. Also, Gourio and Roys (2014) and Garicano, Lelarge, and Van Reenen (2016) study the effects of size-dependent labor regulations using plant-level data from France where firms with 50 or more employees face substantial additional labor regulations.

definition of informality based on the institutions and laws that regulate relations between workers and firms, which in the case of Mexico involves the asymmetric regulation of salaried and nonsalaried workers, and separate notions of informality and illegality. Using these definitions, the authors document productivity, size, and misallocation distributions for each group. Controlling for firm size and legal status, informal firms are much less productive than formal firms, yet command a large share of resources and hence contribute significantly to low productivity in Mexico. While this study documents the correlation between informality and productivity, an important limitation is that it does not address causation. Related to this issue, Leal Ordóñez (2014) calibrates a model using data from Mexico that assumes firms can avoid regulation by choosing to hire capital below a certain threshold. His model accounts for the large share of activity in the informal sector but he finds that making enforcement uniform would only increase total factor productivity by slightly more than 4 percent (see also D'Erasmo and Moscoso Boedo 2012).

Government regulation can also hinder the reallocation of individuals across space. Hsieh and Moretti (2015) study misallocation of individuals across 220 US metropolitan areas from 1964 to 2009. They document a doubling in the dispersion of wages across US cities during the sample period. Using a model of spatial reallocation, they show that the increase in wage dispersion across US cities represents a misallocation that contributed to a loss in aggregate GDP per capita of 13.5 percent. They argue that across-city labor misallocation is directly related to housing regulations and the associated constraints on housing supply. Fajgelbaum, Morales, Suárez Serrato, and Zider (2015) study how the spatial allocation of workers and firms responds to US state taxes. They find that eliminating tax dispersion across US states produces modest increases in output, but note that this in part reflects the fact that dispersion in taxes across US states is not so large. Tombe and Zhu (2015) provide direct evidence on the frictions of labor (and goods) mobility across space and sectors in China and quantify the role of these internal frictions and their changes over time on aggregate productivity. The reduction of internal migration frictions is key and together with internal trade restrictions account for about half of the growth in China between 2000 and 2005.

Market activity can also be regulated via state-owned enterprises. The misallocation of resources in manufacturing between private and state-owned enterprises in China is a key source of productivity losses in the analysis of Song, Storesletten, and Zilibotti (2011). More recently, Brandt, Tombe, and Zhu (2013) study the importance of misallocation within the nonagricultural sector across state and nonstate enterprises and across provinces over time in China. They find that misallocation reduces nonagricultural total factor productivity by an average of 20 percent for the period 1985–2007. More than half of this productivity loss is due to within-province misallocation of capital between state and nonstate sectors. While across-province distortions remain fairly constant over time and there is a reduction in the share of state-owned enterprises over time, the authors find increased state/nonstate capital misallocation between 1998 and 2007. We are not aware of comparable studies for countries other than China.

Property Rights

A long tradition in development economics emphasizes property rights as a key institution shaping resource allocation and productivity (Besley and Ghatak 2010). Land reforms are common in developing countries (de Janvry 1981; Banerjee 1999; Deininger and Feder 2001) and represent an important example. They are often associated with a limit on farm size and restrictions on land markets so as to redistribute land from large landholders to landless and smallholder households. Adamopoulos and Restuccia (2015) study an example of such a comprehensive land reform in the Philippines using a quantitative model and panel microdata on farms that cover the period before and after the reform. They find that the reform substantially reduced farm size and agricultural productivity (reductions of 34 and 17 percent, respectively). The negative productivity effect reflects both a selection effect and a misallocation effect. Full enforcement of the farm size cap would have doubled the reduction in agricultural productivity.[7]

Trade and Competition

The effect of trade policy on aggregate productivity has been studied through the lens of models that extend the work of Eaton and Kortum (2002) and Melitz (2003). The key point is that tariffs and other forms of trade protection distort the allocation of resources across heterogeneous producers. Several studies provide model-based estimates of these effects, as surveyed in Kehoe, Pujolás, and Rossbach (forthcoming). An early example is Eaton, Kortum, and Kramarz (2011), who studied the effect of a 10 percent reduction in trade costs for all countries. Caliendo and Parro (2015) study the effects of NAFTA using this type of model. These studies find modest productivity effects.[8] But importantly, other studies have tackled the issue of trade liberalization and productivity directly by studying episodes of trade reform and viewing them as quasi-natural experiments. Two early examples are Pavcnik (2002) and Trefler (2004).[9] Pavcnik (2002) studies productivity changes in a micro-level panel dataset for Chile during an episode of substantial reductions in trade barriers that exposed plants to foreign competition. She isolates the contribution of trade to productivity growth by exploiting the variation in outcomes between plants in the import-competing/export-oriented sectors and plants in the nontraded sector. She finds that productivity increased by 19 percent and that roughly two-thirds of this was due to reallocation of resources from less- to more-productive producers. Trefler (2004) studies the Canada–United States Free Trade

[7] Similarly, de Janvry, Emerick, Gonzalez-Navarro, and Sadoulet (2015) study a land reform in Mexico in the 1990s in which farmers were given ownership certificates of land, removing the pre-existing link between land rights and land use, and show substantial labor and land reallocations associated with the reform.

[8] Waugh (2010) uses a version of the Eaton and Kortum (2002) model to infer trade barriers using data on observed trade flows and finds that eliminating trade restrictions substantially reduces cross-country income and productivity disparity. Tombe (2015) similarly argues that trade barriers are an important determinant of cross-country differences in productivity.

[9] Other examples include Bernard, Jensen, and Schott (2006) for the United States, Fernandes (2007) for Colombia, and Topalova and Khandelwal (2011) for India. See also the discussion in Holmes and Schmitz (2010).

Agreement and similarly exploits the heterogeneity in affected sectors. He finds productivity increases in excess of 15 percent for both shrinking (that is, import competing) sectors as well as expanding (exporting) sectors.

Khandelwal, Schott, and Wei (2013) study another specific episode of trade reform—the elimination of export quotas on Chinese textile and clothing by the United States, the European Union, and Canada in 2005. While export quotas allocated via market arrangements generate standard misallocation effects on aggregate productivity, their empirical analysis shows that the quota removal generated larger effects because the government had allocated quotas to less-productive state-owned enterprises. They find that more than 70 percent of the overall productivity gain is due to quota misallocation whereas the remaining 30 percent is due to standard misallocation from eliminating the quotas.

Trade policy may also affect misallocation via its effect on competition, which is often proxied by markups. Edmond, Midrigan, and Xu (2015) calibrate a model to Taiwanese manufacturing data and find that moving from autarky to free trade decreases markup heterogeneity and leads to an increase in total factor productivity of slightly more than 12 percent.[10]

Financial and Informational Frictions

Financial market imperfections are perhaps the single most studied source of misallocation. The positive correlation between financial market development and output per capita is a robust empirical finding (Levine 1997). The literature on financial market development and economic development is too large to discuss in any detail (for a survey of the broader related literature on financial development, see Buera, Kaboski, and Shin 2015). We focus on papers in this literature that have quantified the misallocation of capital across producers due to credit constraints. This literature has generated a range of estimates, some of them quite large.

Consistent with our earlier warning about the importance of model features, it is now well understood that the effects depend in an important way on such features, specifically the scope for individuals to accumulate assets in order to grow out of financial constraints. This in turn is heavily influenced by the persistence of productivity (or demand) at the producer level. As the literature has made more attempts to model this feature and discipline it using microdata, the resulting effects of capital misallocation on total factor productivity have diminished. For example, Midrigan and Xu (2014) find that the magnitude of this effect is no more than about 10 percent (see also Buera, Kaboski, and Shin 2011; Greenwood, Sanchez, and Wang 2013; Moll 2014). Gopinath et al. (2015) found that a large part of the increased misallocation of capital in Mediterranean countries after 1999 is accounted for by financial frictions, but the magnitude of the effect is on the order of a 3 percent drop in total factor productivity.

[10] Epifani and Gancia (2011) show that dispersion of markups across manufacturing industries is significantly greater in poorer countries than in richer countries, but did not assess what this implies for cross-country differences in productivity.

Other relevant market frictions include imperfect information, imperfect insurance, and imperfect enforcement of contracts. For example, David, Hopenhayn, and Venkateswaran (2016) identify information frictions by combining production and stock market data of firms and find that these types of frictions can reduce aggregate productivity by 7–10 percent in China and India. Imperfect insurance and credit restrictions have also played a prominent role in development economics (Udry 2012).[11] Caselli and Gennaioli (2013) study the effects of poor contract enforcement as it affects management of family-run firms, and show that the effects on aggregate total factor productivity can be substantial.

Summary

Studies using the direct approach often find sources of misallocation that reduce total factor productivity, but even taken together, the effects from these studies are small compared to the indirect effects noted earlier. One possibility is that the indirect effects estimated earlier are overestimates of the extent of differences in misallocation. Alternatively, it is possible that the aggregate effects are the result of many different individual factors, each of which contributes a small part, so that we will never isolate a single dominant factor. Or perhaps the existing analyses of direct effects, based on relatively simple models and somewhat generic treatments of potential sources of misallocation, may not adequately capture the full extent of frictions that are present in less-developed counties.

Additional Consequences of Misallocation

The policies and institutions that distort firm-level choices of labor and capital at a point in time, thereby generating misallocation, are also likely to affect entry and exit decisions as well as firm-level investments that influence future productivity. These effects operate via the selection and technology channels discussed earlier and represent consequences beyond those estimated using the indirect method.

A growing body of work emphasizes the broader consequences of misallocation in settings with selection and/or technology effects. All of the previously noted empirical studies of trade liberalizations using producer-level data find an important role for both selection effects and producer-level productivity gains. Bustos (2011) specifically finds that producers in Argentina invest more in technology upgrading in response to trade liberalizations.[12] Selection effects are featured prominently in the theoretical analysis of Melitz (2003). More recently

[11] Munshi and Rosenzweig (2016) emphasize risk and differential insurance arrangements between rural and urban sectors in restricting labor mobility, therefore potentially generating labor misallocation across space.

[12] Bloom, Draca, and Van Reenen (2016) provide similar evidence for firms in Europe. Aw, Roberts, and Xu (2011) estimate a structural model of trade and research and development investment using data on Taiwanese electronics producers. In simulations, they find that trade liberalizations increase producer-level productivity via increased investment in research and development.

these models have been extended to allow for endogenous plant-level productivity responses as well (for examples, see Costantini and Melitz 2008; Caliendo and Rossi-Hansberg 2012; Rubini 2014; Mayer, Melitz, and Ottaviano 2017). In the financial frictions literature, the bulk of productivity effects are due to distorted occupational choice decisions (highly productive entrepreneurs that do not operate, as in Buera, Kaboski, and Shin 2011) and technology investment (Midrigan and Xu 2014). In the agricultural sector, land institutions that prevent the reallocation of land to best uses also act as a deterrent for highly productive farmers who may instead choose to work outside of agriculture (Adamopoulos et al. 2017). In the context of labor market regulations, Da-Rocha, Tavares, and Restuccia (2016) study the effect of firing costs on productivity in a model that includes an endogenous choice for innovation, and find that the dynamic effects on productivity are substantial, increasing the total factor productivity loss from around 2 percent due to static misallocation to an overall effect of 4 percent, for firing costs equivalent to one year's wages. Peters (2016) studies a model of innovation in which limited competition leads to heterogeneity in markups, and shows that the dynamic effect of markup heterogeneity is more than four times larger than the static misallocation effects.

From a modeling point of view, the key issue is to extend the simple static model of heterogeneous producers that we outlined earlier to a dynamic setting that includes endogenous decisions that influence future productivity. Restuccia (2013) provides an early example of using such a model to analyze the consequences of hypothetical distortions. He assumes there are upfront investments in productivity when a new establishment is created, and higher investments yield higher-productivity establishments in expectation. In this setting, implicit taxes on higher-productivity establishments lower the incentive for investments that are expected to raise productivity and hence lower the overall distribution of establishment-level productivities. He uses this framework to shed light on the productivity gap between Latin America and the United States.[13] Another recent paper along these lines is Hsieh and Klenow (2014) on the life cycle of manufacturing plants in India, Mexico, and the United States. Their analysis is motivated by the empirical observation that older plants in India and Mexico are much less productive relative to young plants than is the case in the United States. Given this difference in relative productivities, it is efficient that older plants in India and Mexico are relatively small compared to their counterparts in the United States. They show that, in analyses including life-cycle investment in productivity improvements at the establishment level, the greater implicit taxes faced by more-productive establishments in India and Mexico can potentially account for a large share of the differences in productivity gradients with age across plants.

Bento and Restuccia (forthcoming) build a model that allows for productivity investments both at the time of entry as well as along the life cycle post-entry.

[13] Many other contributions have recognized the feedback from misallocation to the determination of firm-level productivity levels; see Hopenhayn (2016), Da-Rocha, Tavares, and Restuccia (2017), and the references therein.

They find that the greater implicit taxes faced by more-productive establishments in India compared to the United States reduces aggregate productivity in India by 53 percent and average establishment size by 86 percent. They decompose this productivity effect into three components: a static effect of misallocation, a life-cycle effect due to lower life-cycle investment in productivity, and an entry productivity effect capturing the effect of lower investment in productivity at the time of entry. The reduction in aggregate productivity is roughly equally shared between static misallocation and entry-level productivity investments. In their model, life-cycle investment in productivity plays a minor role because the reduction in life-cycle productivity growth is offset by its effect on establishment entry.

In related work, Ayerst (2016) attempts to connect misallocation with barriers to technology adoption and diffusion lags across countries, based on the insight that policies and institutions that generate misallocation may create disincentives to adopt the most modern and best technologies. Bigio and La'O (2016) study the effect of policy distortions in an environment with production networks as emphasized in the survey article of Jones (2013). They find that the productivity effects of policy distortions in a model with production networks are roughly four times that in the model of the economy that abstracts from the network structure.

Overall, the work just described suggests that studies of misallocation should look for opportunities to go beyond static effects of misallocation, and focus on the potentially much larger dynamic effects. We believe that micro-level panel data will be critical to producing compelling empirical evidence about these channels.

Where to from Here?

To take stock, we revisit the three questions posed in the introduction.

First, how important is misallocation? Misallocation appears to be a substantial channel in accounting for productivity differences across countries, but the measured magnitude of the effects depends on the approach and context. Productivity losses from misallocation reported using the indirect approach are typically an order of magnitude or more larger than the losses associated with specific policies and institutions reported using the direct approach. More work is needed on the various mechanisms that can potentially amplify the effect of misallocation on aggregate productivity and in particular in connecting policies that generate misallocation with observed micro productivity distributions.

Second, what are the causes of misallocation? The research has not found a dominant source of misallocation; instead, many specific factors seem to contribute a small part of the overall effect. Our view is that studies that follow the direct approach are more likely to reach concrete, persuasive, and specific conclusions of practical policy relevance. However, the indirect approach can be especially valuable in diagnosing important dimensions of misallocation: for example, whether it is more significant in some sectors, or whether it is related to specific factors of production such as capital, labor, or land.

Third, are there additional costs to misallocation? The answer is clearly "yes," and whereas much of the literature has focused on static misallocation, we think the dynamic effects of misallocation deserve much more attention going forward.

In moving ahead, we expect that the increasing availability of micro datasets, especially firm-level panel datasets, is likely to yield opportunities to exploit changes in policies and institutions and variations across individuals, firms, regions, and other relevant dimensions, and will offer new opportunities to study the role of misallocation.

We are also intrigued by aspects of misallocation that reach beyond the issues of how labor and capital might be misallocated across firms. For example, discrimination, culture, and social norms can lead to misallocation of talent across employment status, occupations, and sectors. Hnatkovska, Lahiri, and Paul (2012) document the misallocation of talent in India that arises as a result of the caste system, and document that these barriers have decreased dramatically over the last 20 years. In a similar spirit, Hsieh, Hurst, Jones, and Klenow (2015) discuss shifts in the allocation of talent across occupations in the United States. For example, in 1960 around 94 percent of doctors and lawyers were white men, whereas by 2008, the share declined to 62 percent. Given that innate talent is unlikely to feature such a concentration across gender and races, the occupational distribution in 1960 reflects misallocation of talent and the observed convergence represents an improvement in the allocation. They estimate that convergence in the occupational distribution across races and gender can account for 15 to 20 percent of growth in aggregate output per worker in the United States between 1960 and 2008. We think this work suggests a promising direction for additional research on the allocation of talent and how it differs across economies.

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