CHAPTER 2

UPGRADING THE TAX SYSTEM TO BOOST PRODUCTIVITY

Introduction

A top challenge facing policymakers today is how to raise productivity, the key driver of living standards over the long term. In advanced economies, productivity growth was declining well before the global financial crisis, and the trend worsened in its aftermath (Figure 2.1). A slowdown in productivity has also taken place in developing countries since the crisis, hampering their convergence process toward higher income levels.[1] The IMF's policy agenda has therefore emphasized the need to employ all policy levers, and in particular to promote growth-friendly fiscal policies that will boost productivity and potential output (IMF 2016a).

Total factor productivity (TFP) at the country level reflects the productivity of individual firms, weighted by firm size.[2] Therefore, aggregate TFP depends on firms' individual TFP and also on how available resources (labor and capital) are allocated across firms.[3] Indeed, the poor use of existing resources within countries—referred to here as resource misallocation—has been found to be an important source of differences in TFP levels across countries and over time.[4]

Resource misallocation manifests itself in a wide dispersion in productivity levels across firms, even within narrowly defined industries. High dispersion in firm productivities reveals that some businesses in each country have managed to achieve high levels of efficiency, possibly close to those of the world frontier in that industry. This implies that existing conditions within a country are compatible with higher levels of productivity. Therefore, countries can reap substantial TFP gains from reducing resource misallocation, allowing firms to catch up with the high-productivity firms in their own economies. In some cases, however, the least productive businesses will need to exit the market, releasing resources for the more productive ones. For example, Baily, Hulten, and Campbell (1992) find that 50 percent of manufacturing productivity growth in the United States during the 1980s can be attributed to the reallocation of factors across plants and to firm entry and exit. Similarly, Barnett and others (2014) find that labor reallocation across firms explained 48 percent of labor productivity growth for most sectors in the U.K. economy in the five years prior to 2007.

Resource misallocation is often the result of a large number of poorly designed economic policies and market failures that prevent the expansion of efficient firms and promote the survival of inefficient ones. Reducing misallocation is therefore a complex and multidimensional task that requires the use of all policy levers. Structural reforms play a crucial role, in particular because the opportunity cost of poorly designed economic policies is much greater now in the context of anemic productivity growth.[5] Financial, labor, and product market reforms have been identified as important contributors (see Banerjee and Duflo 2005; Andrews and Cingano 2014; Gamberoni, Giordano, and Lopez-Garcia 2016; and Lashitew 2016). This chapter makes the case that upgrading the tax system is also key to boosting productivity by reducing distortions that prevent resources from going to where they are most productive.[6]

The chapter uses firm-level data and micro-empirical techniques to provide new insights on the following questions:

[1]See Adler and others 2017 on the role of crisis legacies and structural headwinds in slowing the pace of productivity growth.

[2]TFP is the efficiency with which the economy transforms its accumulated factors of production into output.

[3]For a broader discussion of TFP, including drivers of firms' individual TFP, see Adler and others 2017; Adalet McGowen and others 2015; Dabla-Norris and others 2015; Pagés 2010; and the April 2016 *Fiscal Monitor*.

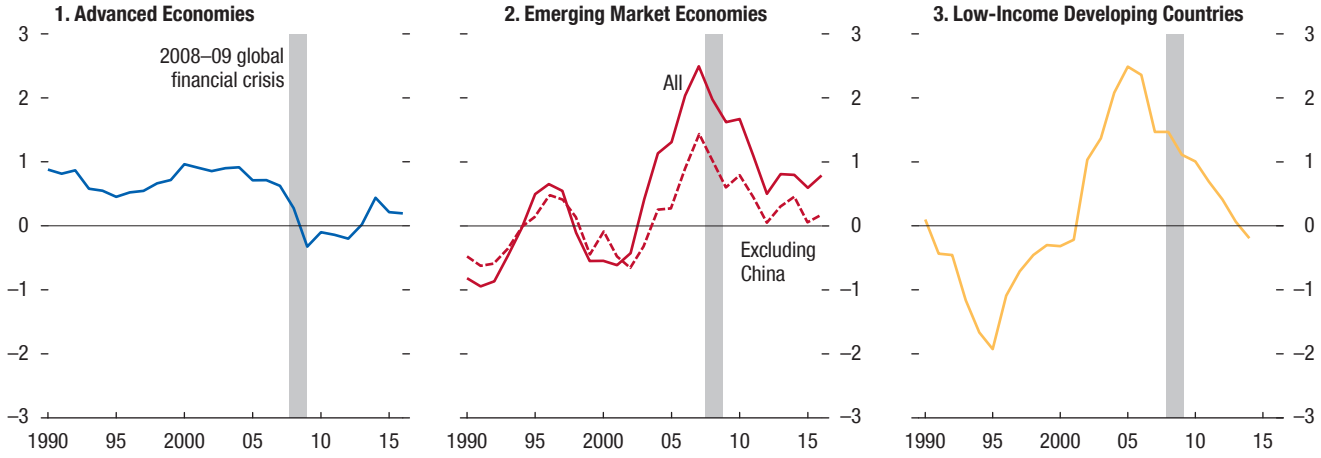
[4]Restuccia and Rogerson (2013) summarize recent literature on resource misallocation. See also Hsieh and Klenow 2009; Caselli 2005; Hall and Jones 1999; Klenow and Rodriguez-Clare 1997; Bartelsman, Haltiwanger, and Scarpetta 2013; and Gopinath and others 2015.

[5]Banerji and others (2017) make the case for complementing and incentivizing structural reforms with fiscal support. The April 2016 *World Economic Outlook* shows that complementary macroeconomic policies are needed to maximize the short-term payoff from product and labor market reforms.

[6]Widely documented channels through which fiscal policy can raise productivity, such as the provision of physical infrastructure and education, are not covered in this chapter. For an overview of these policies, see IMF 2015b.

Figure 2.1. Growth in Total Factor Productivity, 1990–2016
(Five-year average growth rate, percent)

Total factor productivity growth, the key driver of living standards over the long term, is currently anemic across all country groups.



Source: Adler and others 2017.
Note: Group averages are weighted using GDP at purchasing power parity.

- What is the extent of resource misallocation within countries? What are the potential TFP and growth payoffs from reducing resource misallocation?
- How does the tax system affect resource misallocation? To what extent does differential tax treatment of firms affect productivity?
- What tax policy measures can be implemented to reduce distortions and hence misallocation?

The chapter's main findings can be summarized as follows:

- Potential TFP gains from reducing resource misallocation are substantial and could lift the annual real GDP growth rate by roughly 1 percentage point. Payoffs are higher for emerging market and low-income developing countries than for advanced economies, with considerable variation across countries. It is important to note that reforms to tackle resource misallocation will have winners and losers, and therefore the transition will need to be carefully managed.
- Upgrading the design of their tax systems can help countries chip away at resource misallocation by ensuring that firms' decisions are made for business and not tax reasons. Governments can eliminate distortions that they themselves have created. The chapter provides evidence that significant TFP gains can be achieved if countries address tax treatments that discriminate by asset type, sources of financing, or firm characteristics such as informality and size.
- How governments tax matters for productivity.
  - Governments should seek to minimize differentiated tax treatments across assets and financing. This approach would help tilt firms' investment decisions toward assets that are more productive, rather than more tax-favored. For instance, the current debt bias feature of some tax systems not only distorts financing decisions but hampers productivity as well, especially in the case of advanced economies. Disparity in taxes across capital asset types—present in all country groups—also affects firms' investment decisions. Adopting a well-designed allowance for corporate equity (ACE) system or a cash flow tax can eliminate these distortions.
  - Governments should also seek to level the playing field across firms to encourage growth of productive firms. For example, in emerging market and low-income developing countries, stronger tax administration could help reduce the unfair cost advantage enjoyed by informal firms that underreport their sales to the tax authorities. This would provide greater room for more productive, tax-compliant firms to increase their market share. Another example, relevant for all country groups, is to encourage growth and productivity among small firms through efforts to reduce tax compliance costs, freeing

resources that can be used for more productive activities, and targeting tax relief to new rather than small firms in order to avoid the "small business trap."

It is important to acknowledge that eliminating differences in tax treatments across firms may not be feasible or desirable in all cases. Tax policy might want to influence resource allocation when firms do not take into account their externalities—the full economy-wide benefits and costs of their activities. Examples include underinvestment in research or excessive carbon emissions. Importantly, tax reform priorities for each country will need to take into account not only their impact on productivity, but also other government objectives, including better income distribution and revenue mobilization needs.

This chapter first provides an analysis of the extent of resource misallocation within countries. It then focuses on how the design of the tax system may affect resource allocation. More specifically, the chapter shows that distortions created by differential tax treatments across firms—due to their capital intensity across asset types, their sources of financing, their degree of informality, or their size—matter for productivity. The chapter also acknowledges the limitations and extensions of the analysis. Empirical analyses in the chapter are based on extensive firm-level data sets as well as new sources of data on tax policy and tax administration for advanced economies, emerging market economies, and low-income developing countries.

Countries Are Not Using Their Resources Efficiently

What is resource misallocation? Simply put, it is the poor distribution of resources across firms, reducing the total output that can be obtained from existing capital and labor. In a well-functioning economy, businesses that are more productive than their competitors should win market share over time, expanding their production by hiring more labor and acquiring more capital. This implies that firm size and firm productivity should be strongly positively correlated.[7] However, the relationship between size and productivity weakens in the presence of distortions. Distortions can arise from government policies (such as poorly designed tax regimes and regulations, or weak tax enforcement) or ill functioning markets (such as an underdeveloped financial market) that favor some firms over others. Distortions allow less productive businesses to gain market share to the detriment of more productive ones. Distortions can also arise when government policies favor certain types of assets over others, potentially resulting in overinvestment in less productive, tax-favored assets and underinvestment in more productive, tax-disadvantaged assets. Essentially, in the presence of distortions, aggregate TFP suffers because efficient firms produce too little output and inefficient firms produce too much.

How can reducing resource misallocation raise TFP? Resource misallocation manifests itself as the dispersion in *revenue productivity* levels—the product of a firm's physical productivity and the firm's specific output price (see Annex 2.1)—across firms, even within narrowly defined industries that produce similar goods. When dispersion is wide, reallocating resources from firms with low revenue productivity to firms with high revenue productivity increases output, simply by using the same resources more efficiently. For example, consider an economy with two firms within the same industry that have identical technologies but face different tax treatment. Because of a weak tax administration, one firm avoids detection by the tax authority and does not pay taxes, therefore facing a lower user cost of capital. The other firm is tax compliant owing to greater scrutiny from the tax authority, therefore facing a higher user cost of capital. The difference in user cost implies that the subsidized firm can afford to undertake investments in lower-return projects, while the fully taxed firm can only undertake investments in higher-return projects. In this scenario, aggregate output would be higher if capital were to move from the subsidized firm to the fully taxed firm, allowing for more investment in higher-return projects.

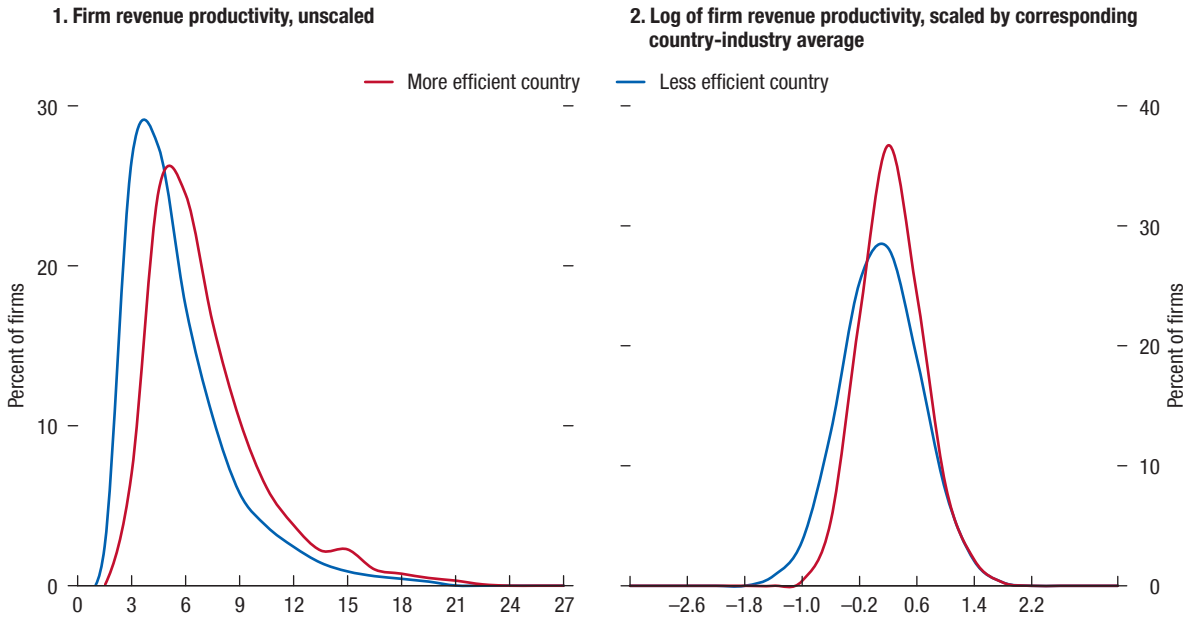
The chapter measures potential TFP gains from reducing resource misallocation by following the framework proposed by Hsieh and Klenow (2009) (see Annex 2.1 for an explanation of the methodology).[8] For the manufacturing sector, Hsieh and Klenow show that if dispersion of firm revenue productivities in China and India were reduced to the levels observed in the United States,

[7]Small firms can be highly productive, for example, if they are new and growing. However, absent other constraints, it is expected that productive firms will grow with age as they access new markets, invest in new technologies, and manufacture a wider variety of higher-quality products. See Hsieh and Klenow 2014; Atkeson and Kehoe 2005; and Foster, Haltiwanger, and Syverson 2013.

[8]The Hsieh and Klenow (2009) model has several important assumptions: (1) a monopolistic competition setting in which each producer makes a distinct variety of a good, with varieties aggregated via a constant elasticity of substitution aggregator, (2) a specific production technology for each industry that is identical across countries, and (3) the presence of firm-specific input and output distortions.

Figure 2.2 Distribution of Firm-Level Revenue Productivities

A higher dispersion in revenue productivities across firms reveals that a country's resources are not going to where they are most productive.



Sources: ORBIS; and IMF staff estimates.
Note: The figure shows the distribution for firms in the manufacturing sector for each type of country. More (less) efficient country is defined as a country at the 75th (25th) percentile of the distribution of resource allocation efficiency, based on the ORBIS sample.

TFP would increase by 30 to 50 percent in China and by 40 to 60 percent in India.[9] In this framework, distortions are derived from data on the dispersion in revenue productivities across firms within narrowly defined industries. Distortions affect *resource allocation efficiency*, an indicator of how well resources are being distributed across firms.[10] This measure of resource allocation efficiency can then be used to estimate the potential *TFP gains* from eliminating distortions (that is, by narrowing the dispersion in revenue productivities across firms).[11]

Resource allocation efficiency is constructed for each industry in each country from firm-level data. For advanced economies, firm-level data from ORBIS are used to estimate resource allocation efficiency in 73 manufacturing industries and 76 services industries (at the four-digit North American Industry Classification System [NAICS] industry level) in nine countries over the period 2006–13.[12] For emerging market economies and low-income developing countries, firm-level data from the World Bank Enterprise Surveys are used to estimate resource allocation efficiency in 18 manufacturing industries (at the two-digit International Standard Industrial Classification [ISIC] industry level) in 54 countries. (See Annex 2.2 for details on data and estimations.)

Panel 1 shows that a less efficient country has some firms with high revenue productivity, but many more firms with low revenue productivity, than a more effi-

[9]In addition to showing the relative TFP gains of China and India with respect to the United States, Hsieh and Klenow (2009) estimate that *fully equalizing* revenue productivities across firms would boost aggregate manufacturing TFP by 86 to 115 percent in China, 100 to 128 percent in India, and 30 to 43 percent in the United States. In this chapter, the potential TFP gains reported are relative to those of a top performer.

[10]Resource allocation efficiency is calculated as the industry's actual TFP (with distortions) divided by the industry's efficient TFP (without distortions). See Annex 2.1.

[11]TFP gains are calculated as the inverse of resource allocation efficiency. See Annex 2.1.

[12]Owing to data constraints, Germany, Japan, the United Kingdom, and the United States are not included in the sample. The chapter uses unconsolidated statements, but many U.S. and Japanese firms report only consolidated statements; therefore, too few observations are left after data cleaning to compute resource allocation efficiency measures. U.K. firms do not report materials use, which is needed to calculate TFP. After cleaning, firm data for Germany cover an insufficient share of gross output of the manufacturing sector to allow a meaningful analysis of misallocation. See Annex 2.2.

cient country. In panel 2, firm revenue productivities are scaled by the country-industry average. The figure reveals that dispersion of revenue productivities, within narrowly defined industries, is much tighter in the case of the more efficient country. This implies that the less efficient country would be able to reap substantial gains by moving resources from firms with lower revenue productivity (those on the left tail) to firms with higher revenue productivity (those on the right tail).

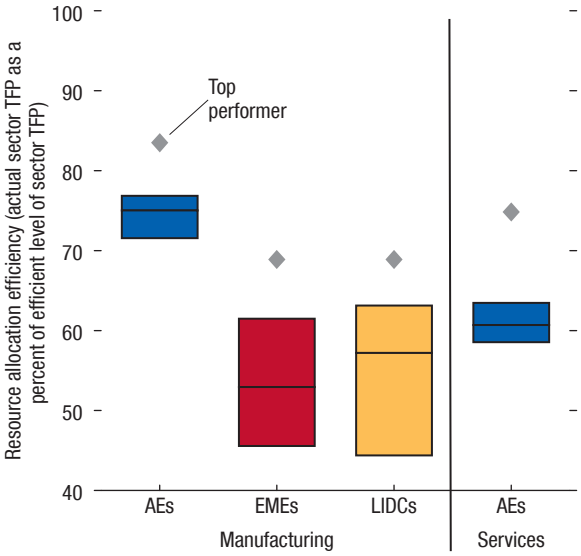
Figure 2.3 estimates resource allocation efficiency across country groups, aggregated at the sector level for manufacturing and services. In all cases, countries are well below 100 percent, indicating that there is ample room to increase efficiency, more so in the case of emerging markets and low-income developing countries.[13]

The potential TFP gains from removing distortions within sectors are substantial. Figure 2.4, panel 1, shows that all country groups could achieve quite substantial TFP gains by fully equalizing revenue productivity across firms. However, these numbers could overstate the potential efficiency gains because of measurement error and factors omitted from the model (for example adjustment costs and price markup variation). Therefore, to control for these factors that may bias the estimates, panel 2 measures the TFP gains that countries could achieve from moving to the efficiency level of a top performer within each sample (that is a country at the 90th percentile of the distribution of resource allocation efficiency). For manufacturing, TFP gains for advanced economies are estimated at 16 percent at the median. For emerging market economies, median TFP gains are estimated at 30 percent, but rise to 52 percent at the 75th percentile of the distribution. For low-income developing countries, median TFP gains amount to 20 percent, but rise to 58 percent at the 75th percentile of the distribution.[14] The potential TFP gains from eliminating distortions in the services sector are estimated to be somewhat larger: 23 percent at the median for advanced economies.[15]

Removing distortions offers potentially significant transitional real GDP growth effects. Assuming a transition path of 20 years, reducing resource misallocation (by moving to the efficiency level experienced by a top performer, as in Figure 2.4, panel 2) translates into a

Figure 2.3. Resource Allocation Efficiency
(Median and interquartile range across country groups)

There is ample room for countries to improve their allocation of resources.



Sources: ORBIS; World Bank, Enterprise Surveys (WBES); and IMF staff estimates.
Note: The middle line in each bar is the median. The interquartile range refers to the 25th to 75th percentile of the distribution. For emerging market economies (EMEs) and low-income developing countries (LIDCs), estimates use WBES data. The WBES also include a few advanced economies (AEs) in the sample. ORBIS data are used for AEs. Estimates of resource allocation efficiency follow Hsieh and Klenow (2009) (see Annexes 2.1 and 2.2). A top performer is defined as a country at the 90th percentile of the sample distribution of resource allocation efficiency, which is estimated separately for the WBES and ORBIS samples. In the case of the manufacturing sector, the top performer corresponds to Sweden in both the WBES and ORBIS samples. In the case of services, the top performer corresponds to Slovenia. The figure uses 2013 data in the case of AEs and the latest available data in the case of EMEs and LIDCs. TFP = total factor productivity.

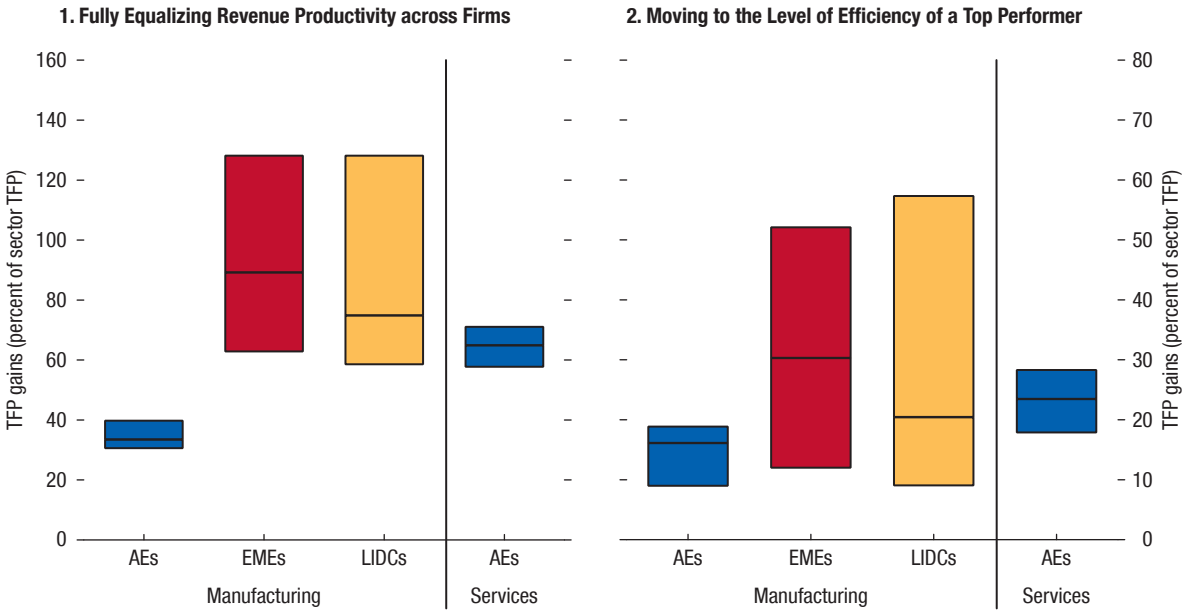
[13]Although the results suggest that emerging market economies have worse resource allocation efficiency than low-income developing countries, this point is under debate in the literature. For example, recent work by Cirera, Fattal Jaef, and Maemir (2017) uses rich census data for four low-income developing countries in sub-Saharan Africa to compute resource misallocation using the Hsieh and Klenow (2009) methodology and finds that the magnitude of misallocation is much larger than that computed using World Bank Enterprise Surveys data.

[14]These results are broadly in line with (and in some cases lower than) other findings in the literature on individual countries (Hsieh and Klenow 2009; Busso, Madrigal, and Pagés-Serra 2012; Crespo and Segura-Cayuela 2014; and Cirera, Fattal Jaef, and Maemir 2017).

[15]Though few studies exist that contrast the services sector with manufacturing, all have found higher resource misallocation in services than in manufacturing (Garcia-Santana and others 2016; Beņkovskis 2015; Dias, Robalo Marques, and Richmond 2016). Studies attribute higher misallocation in services to more sensitivity to regulations and tax structures (Arias-Ortiz and others 2014), higher price rigidities that result in greater adjustment costs when faced with a shock, and the larger presence of informal firms that benefit from implicit subsidies (Dias, Robalo Marques, and Richmond 2016).

Figure 2.4. Gains in Total Factor Productivity from Narrowing Dispersion of Firm Revenue Productivities within Industries
(Median and interquartile range across country groups)

Countries can reap substantial total factor productivity (TFP) gains by removing distortions.



Sources: ORBIS; World Bank, Enterprise Surveys (WBES); and IMF staff estimates.
Note: The middle line in each bar is the median. The interquartile range refers to the 25th to 75th percentile of the distribution. For emerging market economies (EMEs) and low-income developing countries (LIDCs), estimates use WBES data. The WBES also include a few advanced economies (AEs) in the sample. ORBIS data are used for AEs. Estimates of resource allocation efficiency follow Hsieh and Klenow (2009) (see Annexes 2.1 and 2.2). A top performer is defined as a country at the 90th percentile of the sample distribution of resource allocation efficiency, which is estimated separately for the WBES and ORBIS samples. In the case of the manufacturing sector, the top performer corresponds to Sweden in both the WBES and ORBIS samples. In the case of services, the top performer corresponds to Slovenia. The figure uses 2013 data in the case of AEs and the latest available data in the case of EMEs and LIDCs.

higher annual real GDP growth rate of 0.7 percent for advanced economies, 1.3 percent for emerging market economies, and 0.9 percent for low-income developing countries (Figure 2.5).[16]

Upgrading the Tax System Helps Chip Away at Resource Misallocation

What policies and market failures are behind these high levels of resource misallocation? There are many culprits. Restuccia and Rogerson (2013, 2016) survey the literature and point to (1) legislated provisions that vary by firm characteristics (for example tax incentives that depend on size or location, tariffs applied to particular goods, employment protection measures, and product market regulations that limit market access); (2) discretionary provisions made by the government that favor specific firms (for example, subsidies, selective tax enforcement, and preferential loans granted to specific firms because of corruption); and (3) market imperfections (for example, monopoly power and incomplete financial markets).

This chapter makes the case that both tax policy and tax administration are among the important factors that policymakers need to bear in mind when tackling the productivity challenge. This adds to the extensive existing literature on the effect of the level and composition of taxes on productivity and growth.[17] The

[16]These estimates are for the median country in each country group. Calculations are made under the assumption that the estimated TFP gains in the manufacturing sector could be similarly achieved across other sectors (which is reasonable, as there is broad consensus that resource misallocation is worse in services and agriculture) and that there are no adjustment costs. Also, these estimates are limited to the first-round effects because they do not consider that higher TFP will also result in greater aggregate investment, which would feed back into higher productivity.

[17]See, for example, IMF 2015b and Arnold and others 2011.

chapter examines a selection of tax policies to explore the channels through which they generate misallocation. The selection of policies is not exhaustive. Rather, it aims at giving concrete examples of how the specific design of tax policies can result in differentiated tax treatments across firms. This includes taxes that discriminate across capital asset types (leading to differentiated treatment of firms because of variation in their propensity to use the various asset types) or across firm characteristics such as their sources of financing (debt or equity), their degree of informality, or their size.[18]

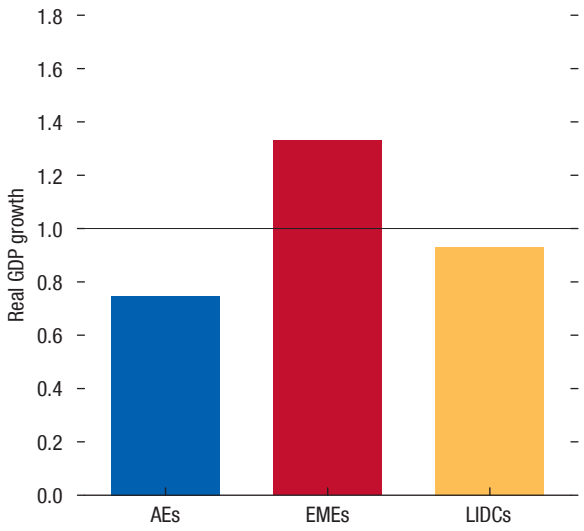
The analysis in the chapter relies on the fact that, even when subject to the same tax rules, heterogeneous firms within the same industry will face firm-specific tax rates if there are differences in taxation by asset type, source of financing, or firm characteristics. The effective marginal tax rate (EMTR) on capital income measures an investor's tax burden on the returns from an investment (see Box 2.1 and Annex 2.4 on EMTR definition and estimation). If EMTRs are the same across assets, financing, and firm characteristics, then all firms in a given industry face the same tax rate. However, when EMTRs are different, tax rates will vary considerably across firms even within narrowly defined industries as a result of firm-level differences in their asset composition, sources of financing, ownership structure, and profitability (whether the firm has incurred losses) (see Annex 2.1 for further discussion). For example, companies vary widely in how they combine machinery and buildings to produce the final output, even if total capital is the same.

This chapter tests whether resource allocation efficiency is lower in countries with higher tax distortions that result from differences in EMTRs across asset types, sources of financing, and firm characteristics. Firm-specific EMTRs are not readily available across a wide set of countries. Therefore, to test the hypothesis that tax distortions affect resource allocation efficiency, the analysis exploits the fact that firms in certain industries are more exposed to specific tax distortions that disfavor more productive firms and, therefore those industries would see greater resource misallocation (see Annex 2.1 for the model derivation). For example, a higher tax disparity favoring buildings over machinery—measured as the EMTR on machinery minus the EMTR on buildings—would disproportionately affect firms in industries that are more intensive in machinery (such as paper products) than firms in industries that are more intensive in buildings (such as food products). In this example, resource allocation efficiency in the paper industry would be lower in countries with a high tax disparity than in countries with a low tax disparity. The empirical strategy relies on a difference-in-differences approach as proposed by Rajan and Zingales (1998).[19]

[18]Annex 2.3 illustrates the way that taxes can affect the overall level of total factor productivity, using as an example a tax wedge that is positively correlated with productivity.

Figure 2.5. Estimated Annual Real GDP Growth Effects from Reducing Resource Misallocation

Potential total factor productivity (TFP) gains from reducing resource misallocation could lift the annual real GDP growth rate by roughly 1 percentage point, assuming a transition path of 20 years.

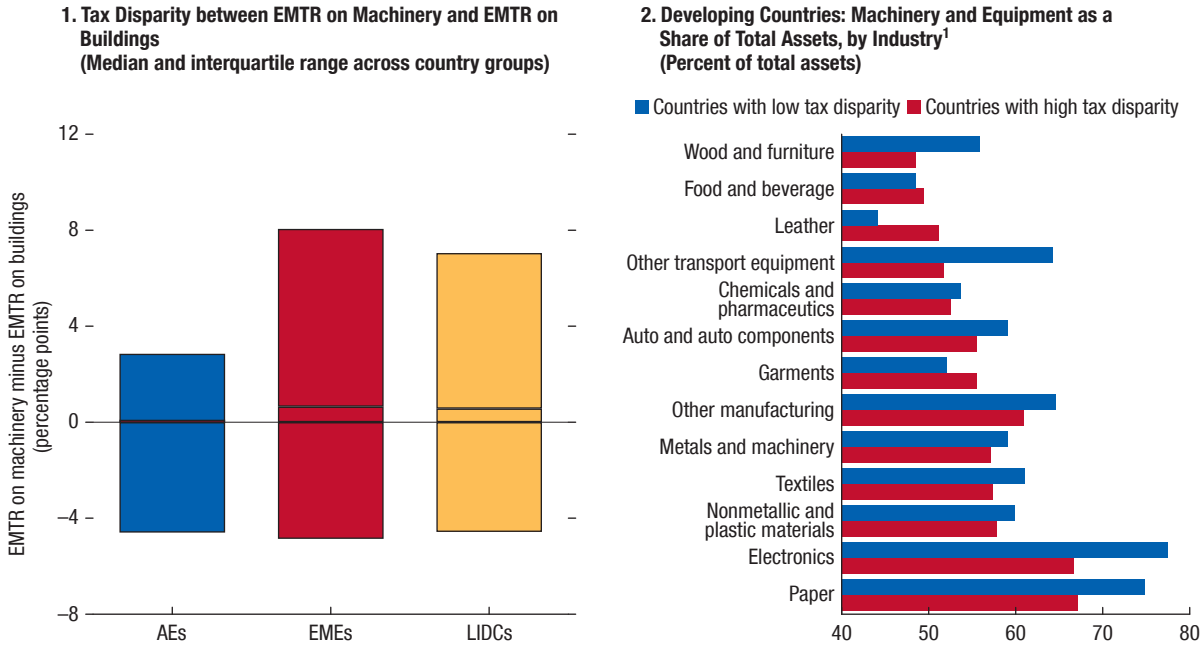


Sources: ORBIS; World Bank, Enterprise Surveys; and IMF staff estimates.
Note: The figure shows medians across country groups. Estimates are computed based on the assumption that the other sectors could achieve TFP gains similar to those estimated for the manufacturing sector and that there are no adjustment costs. AEs = advanced economies; EMEs = emerging market economies; LIDCs = low-income developing countries.

[19]The difference-in-differences approach is based on the assumption that certain industries and firms have an intrinsically high exposure to a given tax policy. Industry and firm exposure to particular tax policies is assumed not to vary across countries. For example, machinery-intensive industries are expected to be more affected by a higher tax disparity that weighs against machinery, while industries with a higher share of small firms are expected to be more affected by preferential tax treatment of small firms. The interaction between this exposure and the relevant tax distortion is then introduced in the empirical model as the main variable of interest to explain resource allocation efficiency at the industry level. A significant coefficient on the interaction term provides evidence that the tax channel identified is indeed valid. Because of data constraints, the specifications used to analyze

Figure 2.6. Tax Disparity and Investment in Machinery

A higher tax for machinery than for buildings affects firms' investment decisions.



Sources: Oxford University Center for Business Taxation; World Bank, Enterprise Surveys; and IMF staff estimates.
Note: The middle line in each bar is the median, and the interquartile range refers to the 25th to 75th percentile of the distribution. Data correspond to 2015. AEs = advanced economies; EMEs = emerging market economies; LIDCs = low-income developing countries.
[1]Tax disparity is the effective marginal tax rate (EMTR) on machinery minus the EMTR on buildings. Countries with high (low) EMTR disparity are those with EMTR differences above (below) the median across countries. Total assets are measured as the sum of machinery and buildings.

Reducing Distortions across Capital Asset Types

Disparities in EMTRs across capital asset types can increase resource misallocation when they steer investors toward lower return, tax-favored, investments. EMTRs vary across asset types because of differences between tax depreciation and economic depreciation.[20]

A wider disparity in EMTRs across asset types can result in over- or underinvestment in particular types of capital assets.[21] Figure 2.6, panel 1, shows that tax disparity—here measured as the EMTR on machinery minus the EMTR on buildings—is above zero in half the countries in the sample, regardless of country group, and is sizable for some emerging market economies and low-income developing countries. Panel 2 illustrates, for developing countries, that those with high tax disparity (meaning higher tax for machinery than for buildings) tend to have a lower share of machinery compared to countries with lower tax disparity. This suggests that taxes are affecting firms' investment decisions.

Empirical evidence shows that greater tax disparity across capital asset types is associated with higher misal-

the role of tax administration have as a dependent variable firm-level productivity rather than resource allocation efficiency at the industry level. In all the specifications, country and industry fixed effects are included. Depending on the data set used, time fixed effects, firm fixed effects, and other controls are added. It is worth noting that the difference-in-differences approach captures only the differential effect of a tax working through the interaction term. It does not capture the direct effect of taxation, which is captured by the fixed effects. This approach was also followed by Andrews and Cingano (2014), Gamberoni, Giordano, and Lopez-Garcia (2016), and Lashitew (2016) to analyze the effect of financial, product, and labor market regulations on resource misallocation.

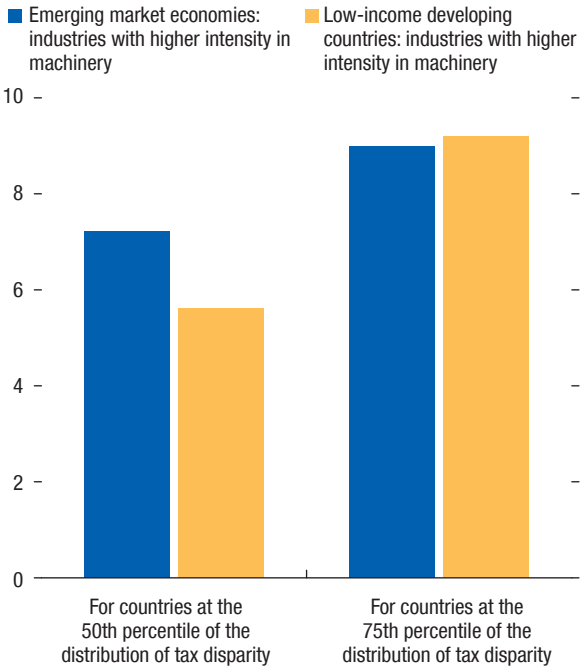
[20]While countries may try to match tax depreciation to economic depreciation, in the interest of simplicity they tend to offer only a limited choice of tax depreciation schemes. Also, some countries allow accelerated depreciation to encourage certain investments.

[21]The case of Mozambique illustrates how the dispersion in EMTRs can be further compounded in the presence of additional tax incentives (see Box 2.3).

location. The analysis looks at the effect of a higher tax disparity between machinery and buildings on resource allocation efficiency (as estimated earlier in the chapter) in manufacturing industries across 54 emerging market economies and low-income developing countries. It finds that machinery-intensive industries—which are more exposed to the tax disparity—have lower resource allocation efficiency in countries where the tax disparity is higher (Annex 2.5). The results suggest that by fully eliminating the tax disparity (that is, an EMTR on machinery equal to the EMTR on buildings), emerging market economies would raise the resource allocation efficiency of those highly exposed industries by 7¼ percentage points, and low-income developing countries would raise it by 5½ percentage points (Figure 2.7). For advanced economies, studies using a more detailed breakdown of asset types find that tax disparities affect investment choices, which corroborates the results for emerging market economies and low-income developing countries. For the United States, Liu (2011) shows that, compared with a uniform tax scheme, differences in EMTRs by asset type cause underinvestment in computing and electronic equipment by about 25 percent and overinvestment in machinery and transportation equipment by about 18 percent. Similarly, for 11 advanced economies, Fatica (2013) finds that differential taxation leads on average to underinvestment in capital related to information and communications technology and overinvestment in other machinery and equipment.

Figure 2.7. Developing Countries: Improvements in Resource Allocation Efficiency from Reducing Tax Disparity to Benchmark
(Percent of industry TFP)

Eliminating the tax disparity between machinery and buildings would significantly raise resource allocation efficiency in machinery-intensive industries.



Source: IMF staff estimates.
Note: Tax disparity is measured as the difference in the effective marginal tax rate (EMTR) on machinery minus the EMTR on buildings. The benchmark is set as the country at the 10th percentile of the distribution for tax disparity.

Reducing Distortions across Sources of Financing

Corporate debt bias can result in resource misallocation when it affects investment decisions that depend more on equity, as is the case with investment in research and development (R&D). Corporate debt bias occurs when firms are allowed to deduct interest expenses, but not returns to equity, in calculating corporate tax liability.[22] This raises the cost of equity financing compared with debt financing. Innovative firms—especially start-ups—tend to rely on equity rather than debt for R&D investments (which have risky, long-horizon payoffs) because there are no collateral requirements and investors share in upside returns (Stiglitz 1985; Hall 2002; Brown, Fazzari, and Petersen 2009).[23] Therefore, not only does debt bias distort the financing choice, but it can also create resource misallocation by imposing a higher marginal tax on R&D investment compared with other capital spending.[24]

Empirical results for nine advanced economies show that corporate debt bias has a significant impact on resource misallocation (Annex 2.5). Debt bias is measured as the EMTR on equity minus the EMTR on debt. While corporate debt bias remains high

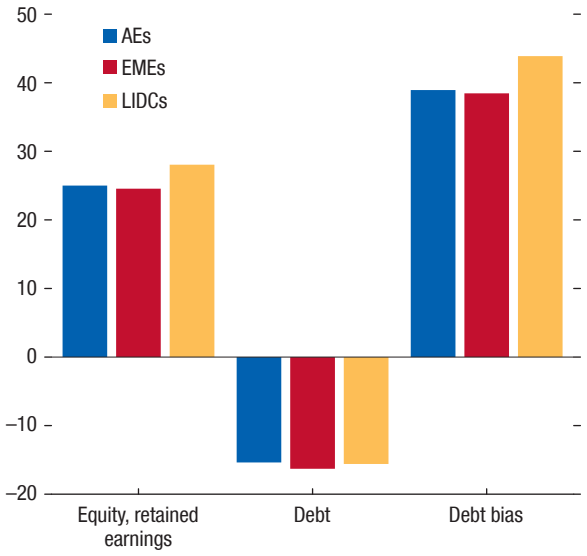
[22]The rationale for allowing deduction for interest expenses is that they are seen as a cost of doing business while equity payments are seen as business income. In economic terms, however, both are a return on capital and there is no a priori reason to tax them differently (De Mooij 2012).

[23]The negative relationship between R&D investment and debt financing is well documented (Aghion and others 2004; Carpenter and Petersen 2002).

[24]Debt bias also poses a stability risk by contributing to excessive private sector leverage (IMF 2016b).

Figure 2.8. Effective Marginal Tax Rates by Source of Financing
(Percent)

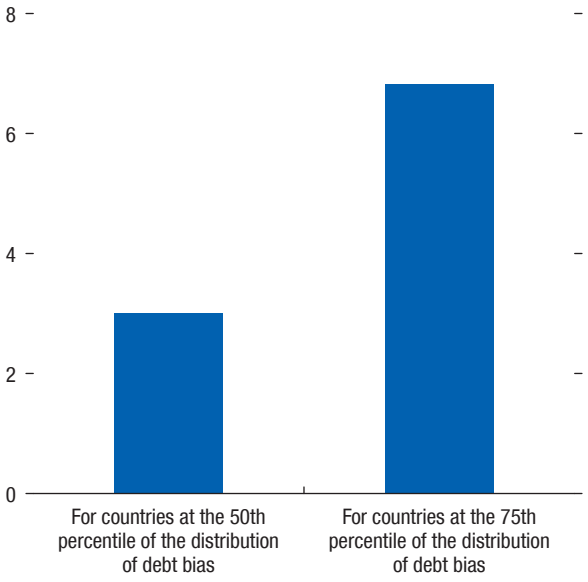
Corporate debt bias remains high across countries.



Sources: Oxford University Center for Business Taxation; and IMF staff estimates.
Note: The figure shows the median across country groups for 2015. Debt bias is measured as the effective marginal tax rate (EMTR) on equity minus the EMTR on debt. Note that in the case of debt-financed investment, the combination of interest deductions and accelerated depreciation can exceed taxes paid on the associated income, resulting in negative EMTRs. EMTR calculations do not take into account personal taxes on capital income. AEs = advanced economies; EMEs = emerging market economies; LIDCs = low-income developing countries.

Figure 2.9. Advanced Economies: Improvements in Resource Allocation Efficiency in R&D-Intensive Industries from Reducing Debt Bias to Benchmark
(Percent of industry total factor productivity)

Reducing debt bias could significantly raise resource allocation efficiency in more research and development (R&D)–intensive industries.



Source: IMF staff estimates.
Note: Debt bias is measured as the effective marginal tax rate (EMTR) on equity-financed investment minus the EMTR on debt-financed investment. The benchmark is set as the country at the 10th percentile of the distribution for debt bias.

across country groups (Figure 2.8), it is more relevant for advanced economies, where access to financing (both debt and equity) is less constrained than in developing countries. The empirical results show that R&D-intensive industries, which are more exposed to debt bias, have lower resource allocation efficiency in countries where debt bias is higher. If the median advanced economy were to reduce its debt bias to the level observed in the 10th percentile of the sample distribution, it could raise the resource allocation efficiency of more R&D intensive industries by 3 percentage points (Figure 2.9).[25] The effects on overall productivity from reducing debt bias would go well beyond these estimates, as higher R&D would also help expand the technology frontier.

[25]This is in line with other findings that link taxation by financing type and R&D investment (Brown and Martinsson 2016).

Several options are available to eliminate the distortions arising from corporate debt bias and from tax disparities across capital asset types, including the allowance for corporate equity system and a cash flow tax.

- *Allowance for corporate equity system.* In an ACE system, investments that earn a "normal" return are exempt from taxation through a deduction for an imputed return on equity. By allowing a deduction for both interest and the normal rate of return on equity, the ACE charges no tax on projects with a return that matches the cost of capital. As such, it is a tax on economic rents (the firm's revenue in excess of the opportunity costs of all its inputs, including financing costs). As a result, an ACE tax system does not distort the choice between debt and equity as sources of finance. The ACE system also removes distortions induced by differences between economic depreciation and tax depreciation. In particular,

accelerated tax depreciation reduces the book value of assets, thereby reducing the ACE in later years, exactly offsetting the benefits from earlier depreciation in present-value terms. ACE systems have been effectively applied in a number of countries, including Belgium, Cyprus, Italy, and Turkey. They require careful design to mitigate potential revenue loss due to a narrowing of the corporate tax base (IMF 2016b).

- *Cash flow tax (CFT).* In the simplest sense, a CFT is a tax levied on the money entering the business less the money leaving the business.[26] A CFT entails immediate expensing of all investment expenditures (that is, 100 percent first-year depreciation allowances) and no deductibility of either interest payments or dividends. Therefore, if it is well designed and implemented, a CFT does not affect the decision to invest or the scale of investment, and it does not discriminate across sources of financing. So far, no country has adopted a comprehensive business cash flow tax, which likely reflects in part the complexities inherent in the transition.[27] The United States is currently considering a destination-based form of a cash flow tax (see Box 1.1), which raises a variety of distinct issues, including the possibility of adverse cross-country spillovers if it were to be implemented by only a subset of countries (Auerbach, Devereux, and Simpson 2010; Auerbach and others 2017).

Reducing Distortions across Formal and Informal Firms

Informality is a problem not only for revenue collection, but also for productivity.[28] Recognizing that there are many reasons why a firm or individual might not pay taxes (Kanbur and Keen 2014), this chapter treats as informal firms all those that fail to pay the full amount of tax due. Noncompliance with taxes reduces productivity by interfering with the process of creative destruction through firm entry and exit. Through tax evasion and circumvention of regulations, informal firms enjoy a relative cost advantage over their tax-compliant competitors. This amounts to a potentially large subsidy that allows informal firms to stay in business despite low productivity, increasing their weight in the economy at the expense of more productive firms (Fajnzylber 2007; Levy 2008; Pagés 2010; Busso, Fazio, and Levy 2012). As a result, informal businesses gain market share even if they are less productive, reducing the market share of more productive, tax compliant businesses.

A view across several measures of informality shows that informal firms are typically less productive than formal firms. Figure 2.10 illustrates this difference in productivity, no matter which of four different indicators is used to proxy informality: self-employment, noncontributors to a retirement pension scheme, the share of unregistered firms, or the prevalence of "cheats." Cheats—borrowing the nomenclature of Kanbur and Keen (2015)— are firms that are registered with the tax authority but underreport their sales for tax purposes.[29] Empirical analysis using firm-level data for manufacturing in emerging market economies and low-income developing countries confirms that cheats are indeed less productive than tax compliant firms (Annex 2.6). The results suggest that cheats that report only 30 percent of their sales (firms at the 25th percentile of the distribution of cheats) have a 4 percent lower TFP than tax-compliant firms in both emerging market economies and low-income developing countries.[30] This finding is in line with those of other studies that use alternative measures of productivity

[26]CFTs occur in several forms, commonly divided into three main classes: CFT on real business activity, CFT on real and financial transactions, and CFT on distribution of dividends (European Commission 2015).

[27]CFTs have been more common in special fiscal regimes for the extractive industries (IMF 2012) and for small and medium-sized enterprises (European Commission 2015).

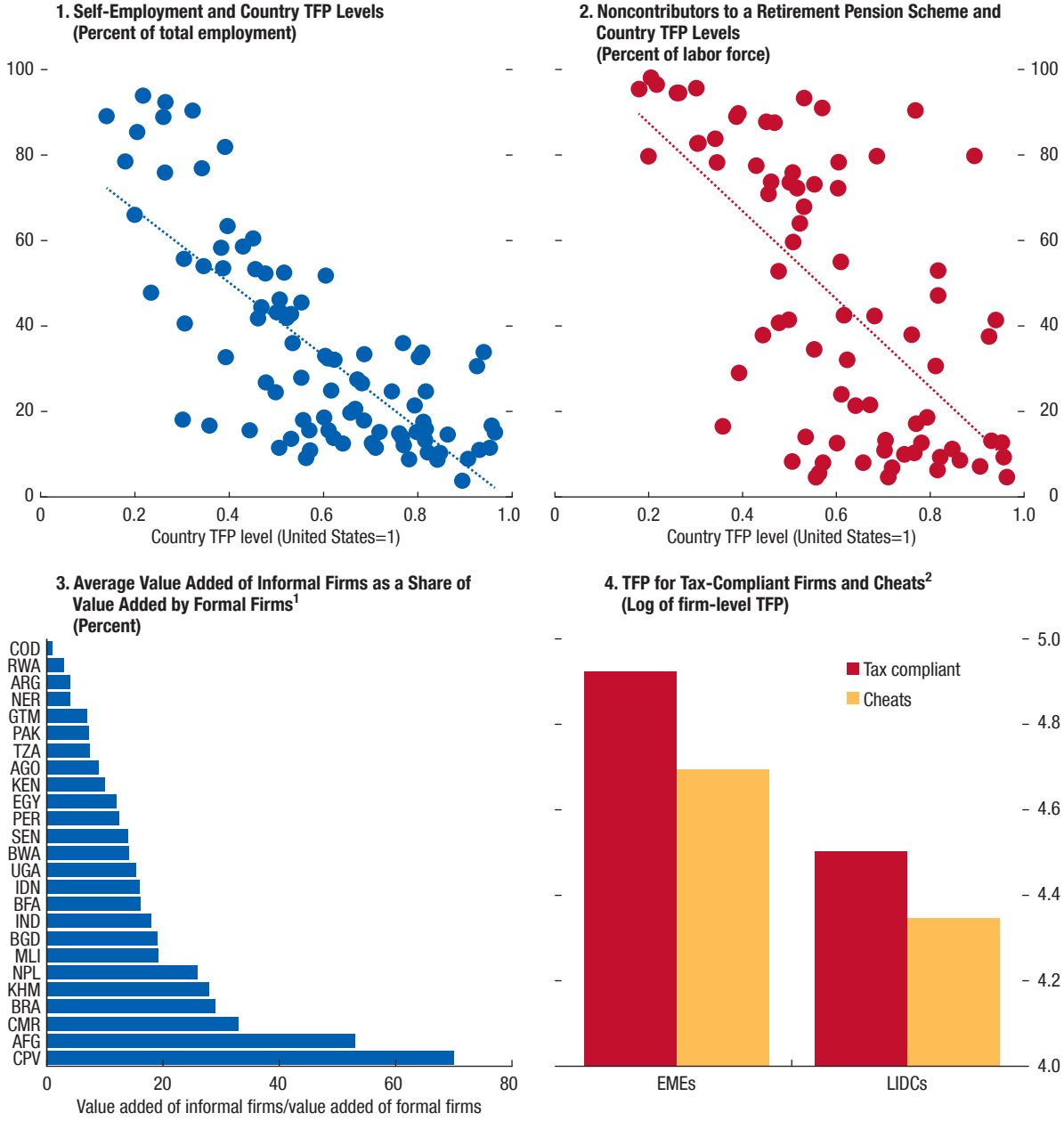
[28]This chapter focuses on the detrimental effect of informality on productivity, although it is important to note that informal firms can contribute to economic activity and employment, especially in developing countries (Dessy and Pallage 2003).

[29]Cheats are defined here as registered firms associated with reporting less than 100 percent of their sales for tax purposes, using firm responses to the question: "What percentage of total annual sales would you estimate the typical firm in your area of business reports for tax purposes?" from the World Bank Enterprise Surveys. Although firms may be reluctant to reveal the extent of their underreporting, survey respondents will presumably tend to answer questions based on their own experiences. Therefore, responses to this question are interpreted as indicating firms' behavior. This proxy for informality has previously been used by La Porta and Shleifer (2008, 2014), Dabla-Norris and Inchauste (2008), and Fajnzylber (2007). The proxy is found to be correlated with a number of other measures of informality, such as self-employment and the fraction of the labor force that does not contribute to a retirement pension scheme. The empirical analysis assumes that survey respondents answer other questions in the survey accurately.

[30]Similar results were found when using alternative country-level measures of informality (see Annex 2.6).

Figure 2.10. Developing Countries: Productivity of Informal Firms

Informal firms are typically less productive than formal firms; therefore, the higher the prevalence of informal firms in an economy, the lower will be the country's productivity.



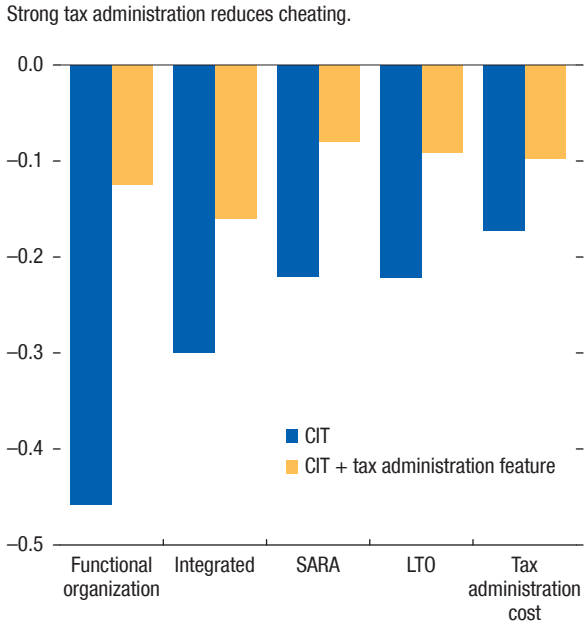
Sources: Feenstra, Inklaar, and Timmer 2015; La Porta and Shleifer 2014; World Bank, Enterprise Surveys; World Bank, Human Development Network Social Protection pensions database; World Bank, World Development Indicators; and IMF staff estimates.
Note: EMEs = emerging market economies; LIDCs = low-income developing countries. Country labels in panel 3 use International Organization for Standardization (ISO) abbreviations; see "Country Abbreviations" in the Methodological and Statistical Appendix for definitions.
[1]Informality in this panel is defined as a firm's being unregistered, from La Porta and Shleifer 2014.
[2]The figure shows the median across groups. Cheats are defined as firms that declare less than 100 percent of their sales for tax purposes. Total factor productivity (TFP) is calculated at the firm level, using the Levinsohn and Petrin (2003) method.

and informality (La Porta and Shleifer 2014; Loayza 2016).

Several studies have shown that tax policy and tax administration affect the prevalence of informality and thus productivity. Colombia provides an interesting case study on the effect of taxation on informality. A 2012 tax reform that reduced payroll taxes was found to incentivize a shift of Colombian workers out of informal into formal employment (Box 2.2). Leal Ordóñez (2014) finds that taxes and regulations play an important role in explaining informality in Mexico. For Brazil, Fajnzylber, Maloney, and Montes-Rojas (2011) show that tax reductions and simplification led to a significant increase in formal firms with higher levels of revenue and profits.[31]

While a higher tax burden contributes to the prevalence of informality, new empirical evidence finds that a strong tax administration can mitigate this effect, thereby supporting higher aggregate productivity. For 130 developing countries, a higher corporate tax rate is found to increase the prevalence of cheats among small manufacturing firms, lowering the share of sales reported for tax purposes. However, the results also show that an effective and efficient revenue administration diminishes this effect (see Annex 2.6).[32] Figure 2.11 shows that the negative effect of the corporate income tax rate on sales reported for tax purposes by small manufacturing firms is considerably lower when tax administrations are stronger.[33] These findings suggest that, as tax administration improves and the prevalence of cheats declines, less productive firms will exit the market, allowing more productive, tax-compliant firms to gain market share and absorb more labor and capital.

Figure 2.11. Developing Countries: Effect of Corporate Income Tax and Tax Administration Features on the Share of Sales Reported for Tax Purposes by Small Firms
(Percent)



Source: IMF staff estimates.
Note: The figure shows the effect for every percentage point of corporate income tax (CIT). The tax administration cost is expressed as a percentage of total revenue. The median tax administration cost across the sample is 1 percent of revenue. Integrated = integrated tax and customs agencies; LTO = large taxpayer office; SARA = semiautonomous revenue agency.

A number of measures can be adopted to strengthen tax administrations and therefore contribute to reducing the unfair cost advantage enjoyed by informal, less productive firms. The first step is to ensure that taxpayers are registered, that they are knowledgeable regarding their tax obligations, and that reporting is accurate. Taxpayer segmentation, primarily by size, can help tailor the provision of taxpayer services and enforcement actions—large, medium-sized, small, and micro taxpayers offer very different revenue possibilities and compliance risks. Audit plays a key role in promoting accurate reporting, including by encouraging higher declarations from firms that are not audited. However, audit is most effective when it is risk based (Khwaja, Awasthi, and Loeprick 2011) and when auditors are well trained. Integrating the tax and customs agencies strengthens enforcement capacity when the agencies work together to identify risks

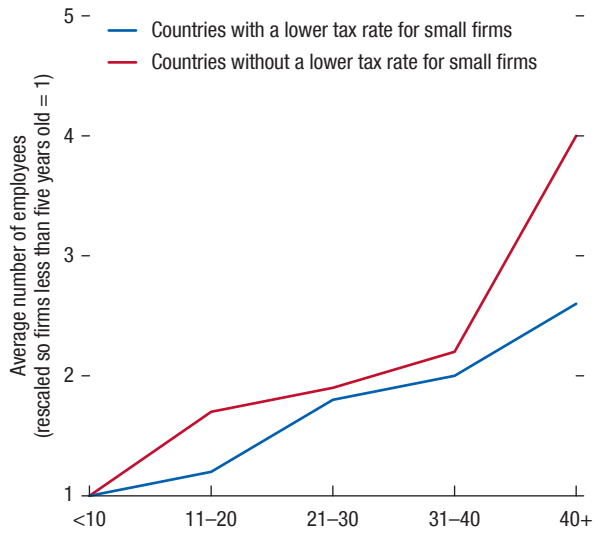
[31]A number of other studies have also found a significant link between the tax system and informality (Johnson, Kaufmann, and Zoido-Lobatón 1998; Loayza 1996; Schneider and Enste 2000; Savić and others 2015).

[32]Proxies used for tax administration in the regression analysis are imperfect (see Annex 2.6). A more comprehensive measure of tax enforcement capacity is the tax gap for the major taxes. The tax gap is the difference between potential and actual tax collections. However, the tax gap measure is currently available only for a limited set of countries and mainly for value-added taxes. The IMF Fiscal Affairs Department's Revenue Administration Gap Analysis Program (RA-GAP) aims to help countries identify and address tax gaps. The program has initially focused on value-added tax gap estimation and is being extended to other taxes. RA-GAP reports for 22 countries have been completed so far.

[33]Similar results are found when the fraction of the labor force that does not contribute to a retirement pension scheme is used as the proxy for informality. See Annex 2.6.

Figure 2.12. Developing Countries: Employment by Firm Age

Firms tend to grow less as they age in countries that offer lower tax rates for small firms than in those that do not.



Sources: KPMG; World Bank, Enterprise Surveys; and IMF staff estimates.
Note: Lines represent the median for each group.

and develop response strategies (IMF 2011). While a semiautonomous revenue agency can be helpful in improving tax enforcement, international experience has so far been mixed (Crandall 2010). The IMF (2015a) discusses these and other options to improve tax compliance in detail.

Reducing Distortions across Small and Large Firms

Preferential tax treatment based on size affects productivity by stunting firm growth. Some governments support small businesses to encourage employment and entrepreneurship, with the justification that small firms are harmed by specific constraints, such as lack of access to credit or disproportionate tax compliance costs. A number of countries therefore offer tax incentives in the form of a lower corporate income tax rate for firms below a certain size—measured by level of profits, turnover, or number of employees (OECD 2015). However, tax differences across firm size can result in misallocation if more productive firms choose to stay small to remain below the eligibility threshold, preventing them from taking advantage of economies of scale and scope (Pagés 2010; Bobbio 2016). This "small business trap" affects aggregate productivity because a larger share of output ends up being produced by smaller, less efficient firms. To illustrate that preferential tax regimes can create a disincentive for small firms to grow, Figure 2.12 shows that older firms are much smaller in countries with lower tax rates for small firms than in countries without a preferential regime. Mozambique exemplifies the "bunching" effect that preferential regimes can create: a very high density of firms with income just below the level at which the size-based tax preference is removed (Box 2.3; Figure 2.3.1).[34]

Empirical analysis for 54 emerging market economies and low-income developing countries finds that preferential tax treatment for small firms is associated with lower productivity (Figure 2.13). Among industries with a high share of small firms, resource allocation efficiency is found to be lower by 1½ percentage points in those countries that provide lower tax rates for small firms (see Annex 2.5). In a similar vein, Benedek and others (forthcoming) find that, among a selection of European countries, firms that receive more size-related tax incentives experience lower TFP growth. These authors' results suggest that the potential TFP gains for small and medium-sized enterprises from eliminating size-related tax incentives range between 0.8 percent and 2.9 percent when weighted by firm employment.

If aimed at compensating for specific constraints, preferential tax treatment should be targeted to new firms rather than small firms.[35] Once a firm is well established, presumably some of these constraints would lessen. Such an approach would provide support to young firms as they start, while setting the right incentives for them to grow and become more productive. Providing support to new firms would nonetheless require rules that limit potential abuse—such as new legal entities created just to renew the tax preference on a continuing activity—and strong enforcement.

Alleviating tax compliance costs can also encourage higher productivity among small firms. These costs represent the burden imposed on firms to comply

[34]This pattern partly reflects underreporting of income, but it may also reflect changes in real activity, such as reducing investment or inefficiently fragmenting the business. Examples of other countries showing evidence of bunching include Armenia (Asatryan and Peichl 2016) and Costa Rica (Brockmeyer and Hernandez 2016).

[35]The April 2016 *Fiscal Monitor* also emphasizes these types of policies to promote greater innovation.

with the tax code over and above the direct financial tax liability; for example, the opportunity cost of the time that employees spend dealing with tax issues or the cost of professional tax advice. Compliance costs include substantial fixed components (for example, filing a value-added tax return costs the same regardless of the net amount remitted) and so are a disproportionate burden on small businesses (Slemrod and Venkatesh 2002; Coolidge 2012; IMF 2015a). Dabla-Norris and others (forthcoming) provide evidence that small and young firms perform better in countries with lower tax compliance costs, using data from 21 emerging markets and developing countries over 2013–15. They compile a novel Tax Administration Quality Index (TAQI) drawing on the Tax Administration Diagnostic Assessment Tool (TADAT).[36] The index captures efforts by tax administrations to improve the quality and flow of information to taxpayers, simplify the structure of tax systems, and streamline reporting requirements and procedures that have a bearing on tax compliance costs for firms (see Annex 2.7 for details). Their results show that countries with a high TAQI score (that is, lower tax compliance costs) see higher labor productivity among small firms (Figure 2.14, panel 1) and young firms (Figure 2.14, panel 2). They also obtain similar results for a wider set of countries and years, using electronic filing available from the Revenue Administration Fiscal Information Tool (RA-FIT) as a proxy of tax compliance costs.[37]

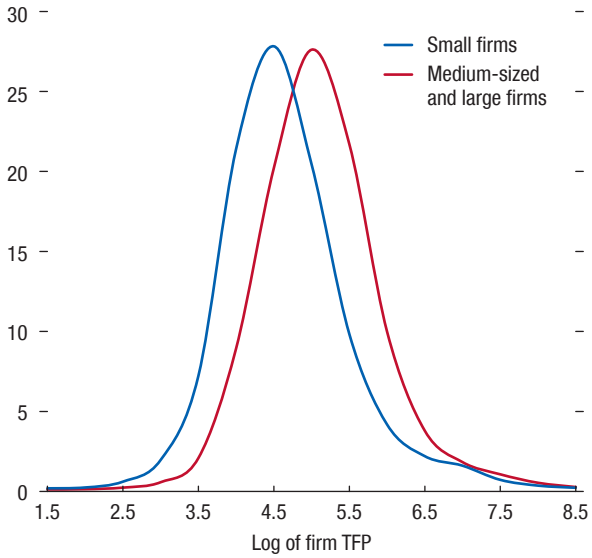
Limitations and Extensions

The Hsieh and Klenow (2009) framework has some well-known caveats. It quantifies misallocation only within sectors, not across sectors. However, reducing misallocation across broad economic sectors can also raise aggregate productivity. For example, Dabla-Norris and others (2015) show that TFP gains from improving factor allocation across sectors average about 9 percent for selected advanced economies. Another limitation of the approach is that it may overestimate the gains from reallocation because of measurement error or model misspecification. Hsieh and Klenow argue that estimating misallocation relative to a top performer, as this chapter does, can mitigate this limitation. And finally, the framework is static, as it does not capture possible shifts in the distribution of firm productivities and available productive resources over time, including those resulting from entry and exit of firms. A growing body of recent research (Bento and Restuccia 2016; Haltiwanger 2016; Decker and others 2016) explores the dynamic implications of misallocation, which is not considered in the chapter owing to data constraints.

It is important to note that the estimates of TFP gains from reducing resource misallocation do not take into account adjustment costs. Improving the

Figure 2.13. Firm-Level Total Factor Productivity by Size
(Percent of firms)

Small firms are typically less productive than medium-sized and large firms.



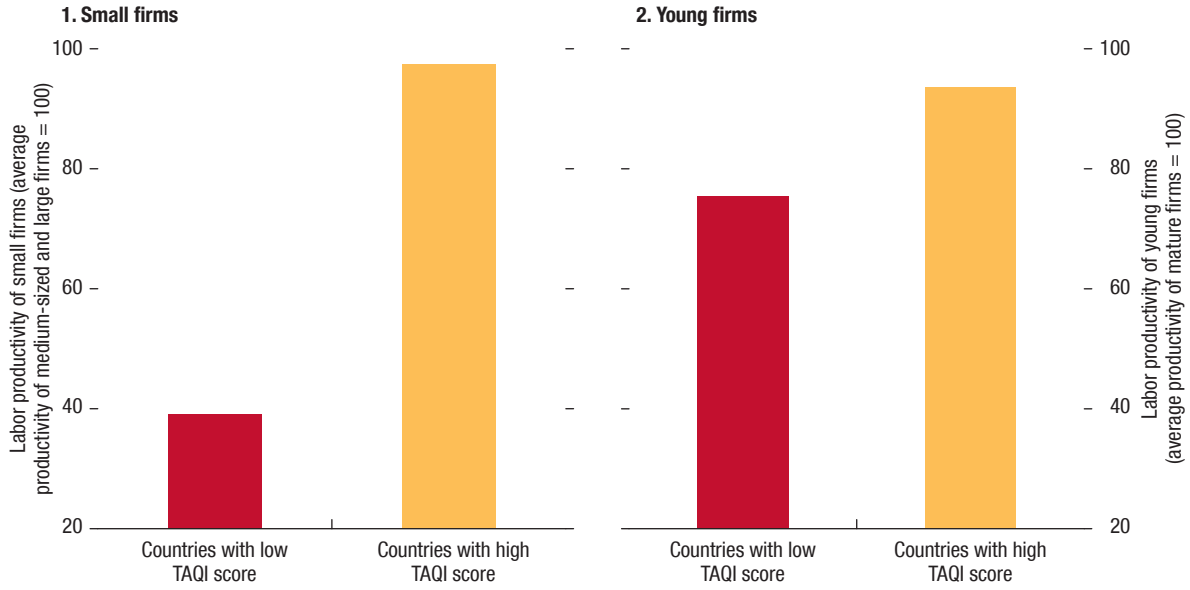
Sources: World Bank, Enterprise Surveys; and IMF staff estimates.
Note: Firm total factor productivity (TFP) is estimated using the Levinsohn and Petrin (2003) method.

[36]TADAT assessments provide an evidence-based and scored assessment of key performance outcome areas that cover most tax administration functions, processes, and institutions. See http://www.tadat.org/.

[37]RA-FIT is an initiative of the IMF Fiscal Affairs Department that compiles a rich, standardized data set of self-reported tax administration performance indicators. The electronic filing rate is currently available across 42 countries over the 2011–13 period. Filing is an important element of firms' tax compliance burden (McCaherty 2014). Albeit imperfect, the electronic filing rate can serve as a proxy because it is driven by initiatives of a country's tax administration to make filing easier for firms and may reflect other associated elements that reduce tax compliance burdens—for example, a "client focus" in a country's tax administration, well-established taxpayer services, and in some cases the provision of prepopulated tax return forms.

Figure 2.14. Developing Countries: Tax Administration Quality Index and Labor Productivity of Small and Young Firms

Small and young firms enjoy higher labor productivity in countries with a higher Tax Administration Quality Index (TAQI) score.



Source: Dabla-Norris and others, forthcoming.
Note: Labor productivity refers to sales divided by the number of employees. Small firms have fewer than 20 employees; young firms are less than seven years old. A higher score on the TAQI implies lower tax compliance costs. Countries with a low (high) TAQI score are those at the 25th (75th) percentile of the sample distribution. The TAQI uses country-specific information on different dimensions of tax administration that are likely to matter for tax compliance costs faced by firms, from the IMF's Tax Administration Diagnostic Assessment Tool (TADAT). Medium-sized and large firms are those with 20 or more employees. Mature firms are those seven or more years old.

allocation of resources will necessarily have an impact on the mix of firms in an economy as well as workers caught up in the process (Haltiwanger 2011; Andrews and Saia 2016). There will be winners and losers; therefore, any such transition needs to be carefully managed.

In the context of international taxation, the productivity impact of narrowing the difference in tax treatment across domestic and multinational companies is not clear-cut. In many cases, such companies enjoy a lower tax burden than their domestic counterparts, thanks to aggressive tax planning to shift profits to low-tax jurisdictions.[38] For example, Finke (2013) finds that in 2007 German multinational companies paid 27 percent less in taxes than a control group of domestic firms. Several countries have implemented policies to limit such companies' ability to shift profits (for example, transfer-pricing regulations or thin-capitalization rules) with the objective of raising domestic revenue collection and curbing unfair competition that affects the profitability and growth of domestic firms competing with these lower-taxed companies (OECD 2013; Fuest and others 2013). However, multinational companies are often at the global productivity frontier (Andrews, Criscuolo, and Gal 2015), providing positive externalities for other firms in the local economy, which is especially relevant in the case of developing countries (Figure 2.15). Because such companies are more mobile than domestic firms, the potential benefits of antiavoidance legislation could be undone if they respond by cutting their investment and reducing their presence in the local economy. Indeed, new empirical analysis from De Mooij and Liu (forthcoming) for 27 advanced economies finds that following the introduction of transfer-pricing regulations, multinational affiliates reduce their investment as a share of fixed assets by 1 to

[38]Transfer prices are the prices used for related-party transactions among multinational company affiliates. By undervaluing goods or services passed from a high-tax affiliate to a low-tax affiliate or overvaluing goods or services passed from a low-tax affiliate to a high-tax affiliate, a multinational company can shift profits to lower-tax firms and minimize its overall tax liability.

3 percentage points (Annex 2.8). The negative impact is mainly concentrated in large, more complex multinationals, and is smaller for multinationals with a higher share of intangible assets that might facilitate profit shifting via royalty payments. Though moderate, these estimates underscore the importance of international coordination in the implementation of antiavoidance legislation and of using part of the revenues generated by antiavoidance measures to support productivity, including by strengthening institutions, human capital, and infrastructure.

It is also important to acknowledge that there are some exceptional cases in which it might be desirable for tax policy to influence resource allocation. This is the case when markets, by themselves, would not result in optimal outcomes; for example, underinvestment in research or excessive carbon emissions. In these cases, firms do not take into account their externalities. Tax policy measures can therefore be used to help correct such externalities.

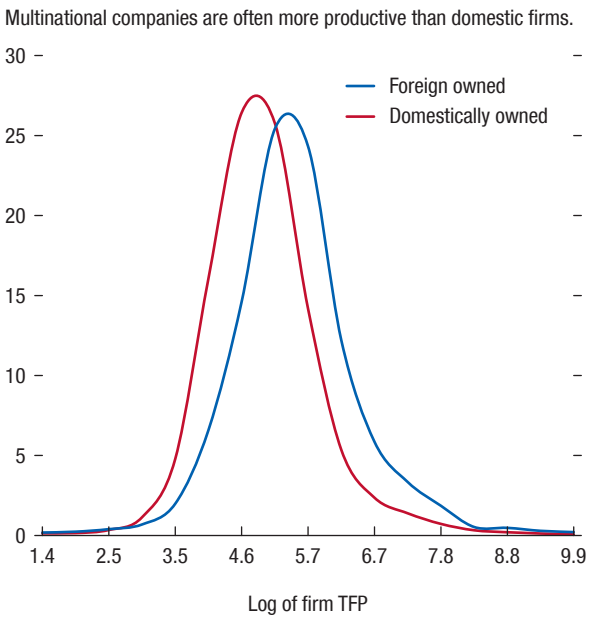
Finally, tax reform priorities for each country will need to take into account not only their impact on productivity.[39] Reforms may have implications for other government objectives, including better income distribution and revenue mobilization needs.[40] Other reforms to reduce misallocation will also be needed, such as reducing credit market distortions, or easing labor and product market regulatory burdens.[41] Governments will therefore need to tailor their reform strategies in a way that balances their various objectives and needs.

Conclusions

Resource misallocation implies that countries experience lower productivity because they are making poor use of their existing labor and capital. It manifests itself in a wide dispersion in productivity levels across firms, even within narrowly defined industries. This dispersion reveals that some businesses in each country have managed to achieve high levels of efficiency, possibly close to those of the world frontier in their particular industry, which in turn implies that existing conditions within the country can be compatible with higher levels of productivity. Therefore, countries can reap substantial TFP gains from reducing resource misallocation, allowing other firms to catch up with the high productivity firms in their own economies. In some cases, however, the least productive businesses will have to exit the market, allowing the more productive ones to gain market share.

TFP gains from reducing resource misallocation could add roughly 1 percentage point to annual real GDP growth, based on estimates for a sample of 54 developing countries and 9 advanced economies. Payoffs would be higher for emerging market economies and low-income developing countries than

Figure 2.15. Developing Countries: Firm-Level Total Factor Productivity by Ownership
(Percent of firms)



Sources: World Bank, Enterprise Surveys; and IMF staff estimates.
Note: Firm-level total factor productivity (TFP) is calculated using the Levinsohn and Petrin (2003) method. Foreign-owned firms are firms in which more than 50 percent of shares are held by foreign investors. Domestically owned firms are those in which more than 50 percent of shares are held by domestic investors.

[39]A central result in public economics is that tax systems should maintain full production efficiency even in second-best environments (Diamond and Mirrlees 1971). However, in more recent literature, Emran and Stiglitz (2005), Gordon and Li (2009), and Best and others (2015) explore the trade-off between production efficiency and revenue efficiency in the choice of tax instruments when allowing for tax evasion.

[40]For a discussion of fiscal policies to enhance revenue mobilization and to address income inequality, see IMF 2015b and Clements and others 2015.

[41]Results in this chapter are not directly comparable with those of other studies because of differences in the definitions of resource misallocation, methodologies used, and countries covered. However, in their literature survey, Restuccia and Rogerson (2013) indicate that any one particular factor typically has small effects on TFP relative to the overall scale of resource misallocation.

in advanced economies, with considerable variation across countries. Reforms to improve the allocation of resources will nonetheless have winners and losers, requiring a carefully managed transition.

Misallocation arises from a number of distortions, created by poorly designed economic policies and market failures, that prevent the expansion of efficient firms and promote the survival of inefficient ones. Countries can chip away at resource misallocation by upgrading the design of their tax systems to ensure that firms' decisions are made for business reasons and not tax reasons. This chapter provides evidence that countries that address tax treatments that discriminate by asset type, sources of financing, or firm characteristics such as formality and size can achieve significant TFP gains.

Governments should seek to minimize differentiated tax treatment across assets and financing in order to tilt firms' investment decisions toward assets that are more productive, rather than more tax-favored. If it is well designed, an ACE system or a cash flow tax can address both of these distortions.

Governments should also seek to level the playing field across firms to encourage growth of productive firms. Lower compliance costs and stronger tax enforcement can help reduce the unfair cost advantages informal firms enjoy, which will make room for more productive, tax-compliant firms to increase their market share. Measures include reducing compliance costs (for example, through easy filing) and promoting compliance by ensuring that taxpayers are registered, that they are knowledgeable regarding their tax obligations, and that reporting is accurate. Tax administration should follow a risk-based approach that includes strong audit capacity and taxpayer segmentation. To encourage growth and productivity among small and young firms, tax compliance costs should be reduced. To avoid the "small business trap," tax relief would be more effective if it were targeted to new rather than small firms.

Box 2.1. What Is the Effective Marginal Tax Rate?

Effective marginal tax rates (EMTRs) are most useful as a consolidated indicator of the various tax factors affecting investors who might be weighing new marginal investments. The EMTR summarizes the tax burden applied to before-tax capital income realized over an investment's lifetime, as implied by major provisions of a country's corporate tax code. These major provisions include statutory federal tax rates, surcharges, local tax rates, depreciation rates and accelerated depreciation, treatment of inventories, and interest deductibility.

The significant variation in EMTRs for various capital asset types arises from differences between the rates at which a country's tax code allows businesses to deduct the cost of assets (known as tax depreciation) and the rates at which those assets actually wear out or become obsolete (economic depreciation). The greater the acceleration in tax depreciation relative to economic depreciation, the lower the EMTR.

Variation in EMTRs across sources of financing arise when there are differences in the deductibility of interest expenses and returns to equity from firms' tax liability.

The estimations of EMTRs used in this chapter, unless otherwise stated, have been provided by the Oxford University Center for Business Taxation, following the approach developed in Devereux and Griffith 1998 (see Annex 2.4). EMTRs are calculated across capital asset types (machinery, buildings, intangibles, and inventories) and across sources of financing (debt, equity, and retained earnings), for each country-year in the data set.

Box 2.2. Colombia: Labor Tax Reform and the Shift from Informal to Formal Employment

In 2012, the Colombian government introduced a series of changes in the country's tax code with the aim of increasing labor formality. The reform entailed a significant reduction in nonwage labor costs and a partial shift of the tax base from labor to corporate income in order to finance social programs. Four years later, the informality rate in the 13 main metropolitan areas had fallen by 6½ percentage points, to 51 percent, and part of the decrease has been attributed to the effects of the reform.

The Colombian case is interesting for two reasons. First, nonwage labor costs in the country are very high: before the 2012 reform, they accounted for 60.3 percent of the average wage rate. Second, the share of informal workers is also high, ranging from 50 to 60 percent depending on the definition (Figure 2.2.1).[1]

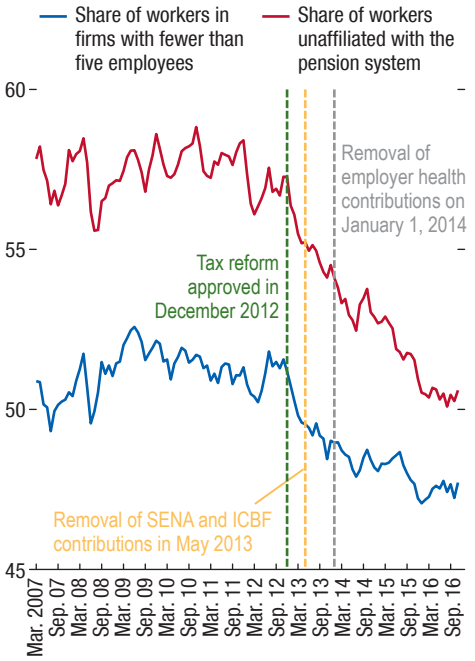
Under the reform, payroll taxes were reduced by 13.5 percentage points for workers earning up to 10 times the minimum wage. In particular, employer contributions for training (2 percentage points), in-kind transfers for low-income households (3 percentage points), and health (8.5 percentage points) were eliminated (Table 2.2.1). This implied a fall of 22.4 percent in the payroll tax. To compensate for the revenue loss, a new tax paid by firms called Contribución Empresarial para la Equidad (CREE) was created. For practical purposes, the CREE is equivalent to a corporate income tax of 8 percent (temporarily set at 9 percent for 2013–15), although with fewer tax deductions so that the tax base is slightly larger. To avoid increasing firms' tax burden, the corporate income tax was simultaneously decreased from 33 to 25 percent. Overall, the reform partially shifted the tax base from labor to corporate income while leaving the total tax rate on corporate income largely unchanged.[2]

Several studies have found that the tax reform had a positive effect on employment and was associated with a shift of workers out of informal into formal employment. By making formal salaried labor cheaper, the reform increased the demand for salaried workers at the expense of informal salaried and own-account workers.

- A series of studies commissioned by the Inter-American Development Bank (Steiner and Forero 2015; Kugler and Kugler 2015; Bernal, Eslava, and Meléndez 2015) found that the reform increased the number of formal jobs by between 3.1 and 3.4 percent and increased wages by between 1.9 and 4.4 percent, with most of the impact among small and medium-sized enterprises. The IMF (2015c) also finds that the reduction in payroll taxes had a positive effect on employment, investment, and GDP.
- Based on general equilibrium models, Steiner and Forero (2015), Anton (2014), and Hernández (2012) find that the tax reform increased formal

Figure 2.2.1. Informal Employment, 2007–16
(Percent of total workforce)

The share of informal workers declined following the 2012 reform.



Source: Departamento Administrativo Nacional De Estadística (DANE), Colombia.
Note: ICBF = Instituto Colombiano de Bienestar Familiar; SENA = Servicio Nacional de Aprendizaje.

[1]The Colombian National Statistics Department (DANE) provides two measures of informality: (1) workers who do not make contributions to either health or pension schemes and (2) workers employed in firms with no more than five employees; unpaid family helpers or housekeepers; self-employed persons with the exception of independent professionals and technicians; and owners of firms with no more than five workers.

[2]An alternative minimum personal income tax and changes in the value-added tax also helped to compensate for revenue losses.

Box 2.2 *(continued)*

Table 2.2.1. Payroll Taxes
(Percent of wage rate)

The 2012 reform reduced payroll taxes by 13.5 percentage points.

Contribution for	Prereform	Postreform
Pensions	16.0	16.0
Employer	12.0	12.0
Employee	4.0	4.0
Health Care	12.5	4.0
Employer	8.5	. . .
Employee	4.0	4.0
Professional Risks	2.0	2.0
Other Payroll Contributions	9.0	4.0
Training (SENA)	2.0	. . .
In-Kind Transfers (ICBF)	3.0	. . .
Compensation Funds	4.0	4.0
Paid Vacations	4.2	4.2
Severance Pay	8.3	8.3
Mandatory Bonuses	8.3	8.3
Total	60.3	46.8
Employer	52.3	38.8
Employee	8.0	8.0

Source: Antón 2014.
Note: ICBF = Instituto Colombiano de Bienestar Familiar; SENA = Servicio Nacional de Aprendizaje.

employment by between 3.4 and 7.4 percent of total employment and lowered informality by between 1.4 and 4.2 percent. Fernández and Villar (2016), using a matching difference-in-differences approach, find that the tax reform reduced the informality rate of the workers affected by the reform in the country's 13 main metropolitan areas by between 4.3 and 6.8 percentage points, which translates to a reduction in the national informality rate of between 2.0 and 3.1 percentage points, given that only 45 percent of the working population was affected by the reform.

Box 2.3. Mozambique: Differential Tax Treatment across Firms

Tax systems in most countries include features that result in differentiated treatment across firms, which can create resource misallocation. The tax system in Mozambique illustrates two mechanisms through which such distortions take effect: (1) tax incentives for investment that vary substantially across capital assets types, sectors, and location, which can distort firm decisions on allocation of resources or production and (2) preferential tax treatment for small taxpayers, which can become a disincentive to firm growth.

Mozambique provides an illustration of the extent to which tax incentives affect effective marginal tax rates (EMTRs) and the extent to which small firms respond to preferential tax treatment by remaining below the eligibility threshold.

Based on an IMF Fiscal Affairs Department technical assistance mission to Mozambique. See Swistak, Liu, and Varsano, forthcoming.

Difference in Effective Marginal Tax Rates across Capital Asset Types, Sectors, and Location

Generous investment incentives result in very low EMTRs, which differ substantially across asset types and across sectors (Table 2.3.1). EMTRs by major capital asset type under general investment incentives (section B of the table) range from 13 percent to 27 percent, well below the EMTRs without incentives (section A). When general incentives and sector-specific incentives are combined, EMTRs fall further and even become negative in the case of agriculture (section C).

Preferential Tax Treatment of Small Firms

Since 2009, Mozambique has offered a simplified tax on gross turnover for small taxpayers (*imposto simplificado para pequenos contribuintes,* or ISPC, regime) that replaces the corporate income tax, personal income tax, and value-added tax (Law 5/2009).

Table 2.3.1. Mozambique: Effective Marginal Tax Rate under Different Investment Incentives

The dispersion in effective marginal tax rates (EMTRs) is compounded in the presence of numerous tax incentives.

		B. With General Investment Incentives				C. With Sector-Specific Investment Incentives	
		Depreciation Rate Increased by 50 percent	Investment Tax Credit, First Five Years				
			5 Percent in Maputo	10 Percent outside Maputo	Incentives Combined	Agriculture and Fisheries	Hotels and Tourism
Asset Type	A. No Incentives	A	B	C	D = A + B	D + Sector Incentive	D + Sector Incentive
Machinery and Equipment	30	24	25	21	16	–2	13
Commercial and Industrial Building	32	. . .	27	22	22	–4	19
Residential Building	20	. . .	16	13	13	–2	11
Intangible: Patents	29	. . .	24	19	19	–3	17

Sources: Code of Fiscal Benefits (Law 4/2009); and Swistak, Liu, and Varsano, forthcoming.

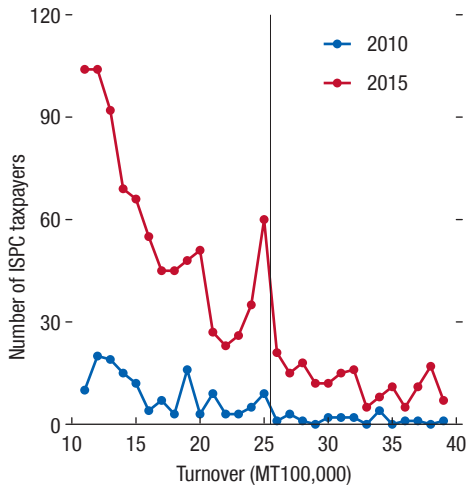
Note: Assumptions: real interest rate = 0.05; economic depreciation rate for machinery = 0.175; economic depreciation rate for commercial building = 0.031; economic depreciation rate for intangible assets = 0.154. Key tax parameters are valued according to Decree 72/2013 of December 23, 2013; statutory corporate tax rate = 32 percent; depreciation of the above assets follows a straight line at a rate of 10 percent for machinery, 2 percent for commercial and industrial building, 10 percent for residential building, and 10 percent for intangible assets (patents).

Box 2.3 *(continued)*

Taxpayers with an annual business volume below Mt2,500,000 can qualify for a flat tax rate of 3 percent on their annual business volume. Taxpayers with an annual business volume lower than 36 times the minimum wage are exempt from tax. The eligibility threshold has remained unchanged despite relatively high inflation in recent years. This has resulted in significant bunching of taxpayers below the eligibility threshold, which has increased dramatically since the introduction of the regime (Figure 2.3.1).

Figure 2.3.1. Distribution of ISPC Taxpayers, 2015 Compared with 2010

The preferential tax regime for small firms creates a "bunching" effect just below the eligibility threshold.



Source: Swistak, Liu, and Varsano, forthcoming.
Note: The horizontal axis shows the distribution of *imposto simplificado para pequenos contribuintes* (ISPC) taxpayers by turnover bins of MT100,000. There are a small number of ISPC taxpayers above the threshold, possibly because the registration requirement is applied to turnover in the previous year instead.

Annex 2.1. Conceptual Framework

Resource Misallocation and Total Factor Productivity

This annex discusses the conceptual framework for the link between resource misallocation and total factor productivity (TFP) developed by Hsieh and Klenow (2009). Consider an industry s with a large number N_s of monopolistically competitive firms. Total industry output is given by a constant elasticity of substitution production function:

$$Y_s = \left[\sum_{i=1}^{N_s} (y_{is})^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}}, \quad \text{(A2.1.1)}$$

in which y_{is} denotes firm i's real output, and σ denotes the elasticity of substitution between output variety i. p_{is} is the price of variety i and P_s the price of industry output Y_s. Firms face an isoelastic demand for their output given by $y_{is} = (p_{is}/P_s)^{-\sigma} Y_s$.

Firms' output is given by a Cobb-Douglas production function:

$$y_{is} = A_{is} k_{is}^{\alpha} l_{is}^{1-\alpha}, \quad \text{(A2.1.2)}$$

in which k_{is} is capital, l_{is} is labor, A_{is} is physical productivity, and α is the elasticity of output with respect to capital.

Firms choose their price, capital, and labor to maximize their profits:

$$\max \Pi_{is} = (1-\tau_{is}^{y}) p_{is} y_{is} - (1+\tau_{is}^{k})(r+\delta_s) k_{is} - \omega l_{is}, \quad \text{(A2.1.3)}$$

in which ω denotes the wage rate, r denotes the real interest rate, δ denotes the economic depreciation rate, τ_{is}^{y} denotes a firm-specific wedge that distorts output decisions, and τ_{is}^{k} denotes a firm-specific wedge that distorts capital relative to labor decisions. The first-order conditions with respect to labor and capital are given by

$$MRP\ L_{is} = \left(\frac{1-\alpha}{\mu}\right)\left(\frac{p_{is} y_{is}}{l_{is}}\right) = \left(\frac{1}{1-\tau_{is}^{y}}\right)\omega, \quad \text{(A2.1.4)}$$

$$MRP\ K_{is} = \left(\frac{\alpha}{\mu}\right)\left(\frac{p_{is} y_{is}}{k_{is}}\right) = \left(\frac{1+\tau_{is}^{k}}{1-\tau_{is}^{y}}\right)\left(r+\delta_s\right), \quad \text{(A2.1.5)}$$

in which $\mu = \sigma/(\sigma-1)$ denotes the constant markup of price over marginal cost. Equation (A2.1.4) states that firms set the marginal revenue product of labor (*MRP L*) equal to the wage rate grossed up to compensate for the tax on output. Similarly, equation (A2.1.5) states that firms equate the marginal revenue product of capital (*MRP K*) equal to the cost of capital times the wedge $(1+\tau_{is}^{k})/(1-\tau_{is}^{y})$. It is easy to see that the higher the τ_{is}^{k}, the higher *MRP* K_{is} needs to be to equate the after-tax return across firms, and the lower the equilibrium level of K is.

Following Hsieh and Klenow (2009), revenue productivity (*TFPR*) is defined at the firm level as the product of price p_{is} and physical productivity A_{is}:

$$TFPR_{is} = p_{is} A_{is} = \left(\frac{p_{is} y_{is}}{k_{is}^{\alpha} l_{is}^{1-\alpha}}\right) = \mu\left(\frac{MPRK_{is}}{\alpha}\right)^{\alpha}\left(\frac{MPRL_{is}}{1-\alpha}\right)^{1-\alpha}. \quad \text{(A2.1.6)}$$

Firms with higher output distortion τ_{is}^{y} or higher capital distortion τ_{is}^{k} have higher marginal revenue products and, as equation (A2.1.6) shows, a higher $TFPR_i$. It is also easy to see that the higher capital distortion $\tau_{is}^{k}$is, the lower the equilibrium level of K_{is} and equilibrium level of y_{is} are.

Resources are allocated optimally when all firms face the same (or no) distortions in output ($\tau_{is}^{y} = \tau_{s}^{y}$) and capital markets ($\tau_{is}^{k} = \tau_{s}^{k}$). In this case, more factors are allocated to firms with higher productivity A_{is}, but there is no dispersion of the returns to factors across firms. In other words, *MRPK* and *MRPL* are equalized across firms. The presence of idiosyncratic distortions τ_{is}^{y} and τ_{is}^{k} leads to dispersion of marginal revenue products and revenue productivity. Industry-level TFP is defined as

$$TFPs = \left[\sum_{i=1}^{N}\left(A_{si} \cdot \frac{\overline{TFPR}_s}{TFPR_{is}}\right)^{\sigma-1}\right]^{\frac{1}{\sigma-1}} \quad \text{(A2.1.7)}$$

in which $\overline{TFPR}_{is} = \mu\left(\frac{MRPK_s}{\alpha}\right)^{\alpha}\left(\frac{MRPL_s}{1-\alpha}\right)^{1-\alpha}$ is a geometric average of the average marginal revenue productivity of capital and labor in the industry. When marginal products are equalized across plants, $TFP_s = \left(\sum_{i=1}^{N} A_{si}^{\sigma-1}\right)^{\frac{1}{\sigma-1}}$ and is larger than TFP_s in the presence of output or capital distortions.

Implication for Empirical Analysis

Under this framework, the extent of resource misallocation is estimated by following a series of steps.

1. *Firm-level revenue productivity (TFPR).* First, for each firm-year, the following three measures are computed:

$$1+\tau_{is}^{K} = \frac{\alpha_s}{1-\alpha_s}\frac{w l_{is}}{r K_{is}}, \quad \text{(A2.1.8)}$$

$$1-\tau_{is}^{Y} = \frac{\sigma}{\sigma-1}\frac{w l_{is}}{(1-\alpha_s) p_{is} y_{is}}, \quad \text{(A2.1.9)}$$

$$A_{is} = \left(\frac{(p_{is} y_{is})^{\frac{\sigma}{\sigma - 1}}}{k_{is}^{\alpha} l_{is}^{1-\alpha}} \right), \quad \text{(A2.1.10)}$$

in which A_{is} denotes physical productivity. Equations (A2.1.4) and (A2.1.5) are used to compute $MRP\ L_{is}$ and $MRP\ K_{is}$, and equation (A2.1.6) is employed to estimate firm-level $TFPR_{is}$ for each firm-year observation.

2. *Within-industry TFPR dispersion.* In the second step, equation (A2.1.7) is used to compute industry-level TFP *(*TFP_s*)*.
3. *Sector-level resource allocation efficiency.* In the third step, aggregating industries within the same sector yields the measure of resource allocation efficiency (RAE) at the sector level:

$$(RAE) = \left(\frac{Y}{Y_{efficient}} \right) = \prod_{s=1}^{S} \left[\sum_{i=1}^{M_s} \left(\frac{A_{si}}{\overline{A}_s} \frac{\overline{TFPR}_s}{TFPR_{si}} \right)^{\sigma - 1} \right]^{\theta_s/(\sigma - 1)}. \quad \text{(A2.1.11)}$$

The TFP gains from eliminating resource misallocation at the sector level can be expressed as

$$TFPgain = 100\left(Y_{efficient}/Y - 1 \right). \quad \text{(A2.1.12)}$$

Tax Dispersion and Resource Misallocation

This annex extends the Hsieh and Klenow (2009) framework to show that industries that rely more on a particular asset (for example, machinery) should see greater resource misallocation as a result of tax dispersion across firms.

For illustration purposes, a Lucas' span of control model of a manager in industry j that must choose how much to invest in machinery (M) and buildings (B) to maximize profits using a decreasing-returns-to-scale technology in a competitive environment is considered. Hsieh and Klenow (2009, Appendix A) show that this model is equivalent to the more complex monopolistic competition model in their analysis, but it is more useful for purposes here.

Machinery and buildings pay the same rental rate (r), but machinery is also subject to a firm-specific tax T_i.[42]

The problem of entrepreneur i (entrepreneurs differ in their managerial ability A_i) in industry j is

$$\max_{M,B} A_i M_i^{\alpha_j} B_i^{\gamma_j} - r(1 + T_i) M_i - r B_i.$$

The first-order conditions of this problem are

$$M: \alpha_j A_i M_i^{\alpha_j - 1} B_i^{\gamma_j} = r\left(1 + T_i\right),$$

$$B: \gamma_j A_i M_i^{\alpha_j} B_i^{\gamma_j - 1} = r.$$

Hence,

$$\frac{B_i}{M_i} = \left(1 + T_i\right) \frac{\gamma_j}{\alpha_j}$$

or

$$B_i = (1 + T_i) \frac{\gamma_j}{\alpha_j} M_i.$$

Simple algebra yields the following input demands as a function of taxes, the capital rental rate, and other parameters:

$$M_i = \left[\frac{\alpha A_i \left(\frac{\gamma_j}{\alpha_j} \right)^{\gamma_j} (1 + T_i)^{\gamma_j - 1}}{r} \right]^{\frac{1}{1 - \alpha_j - \gamma_j}},$$

$$B_i = \frac{\gamma_j}{\alpha_j} \left(1 + T_i \right) \left[\frac{\alpha A_i \left(\frac{\gamma_j}{\alpha_j} \right)^{\gamma_j} (1 + T_i)^{\gamma_j - 1}}{r} \right]^{\frac{1}{1 - \alpha_j - \gamma_j}}.$$

Plugging input demands into the production function gives

$$Y_i = A_i M_i^{\alpha_j} B_i^{\gamma_j} = \left(1 + T_i \right)^{\frac{-\alpha_j}{1 - \alpha_j - \gamma_j}} A_i^{\frac{1}{1 - \alpha_j - \gamma_j}} \left(\frac{\gamma_j}{\alpha_j} \right)^{\frac{\gamma_j}{1 - \alpha_j - \gamma_j}} \left(\frac{1}{r} \right)^{\frac{\alpha_j + \gamma_j}{1 - \alpha_j - \gamma_j}}.$$

To keep the analysis as simple as possible, consider an economy in which each industry has two managers, and even the dispersion of taxes is the same across industries. The output produced by firm 1 relative to firm 2 is

$$\frac{Y_1}{Y_2} = \left(\frac{A_1}{A_2} \right)^{\frac{1}{1 - \alpha_j - \gamma_j}} \left(\frac{1 + T_2}{1 + T_1} \right)^{\frac{\alpha_j}{1 - \alpha_j - \gamma_j}}$$

The model provides the following results:

1. Holding other factors constant, the higher the productivity of manager 1 relative to that of manager 2, the higher will be the output produced by manager 1. Clearly, Y_1/Y_2 is increasing in A_1.
2. If taxes are the same for managers 1 and 2 in each industry, there is no misallocation in the sense of Hsieh and Klenow. The fraction of output produced

[42]The model could be written with different taxes and rental rates on machinery and buildings; the only thing that matters for allocation is the ratio of the two.

by firms is entirely determined by their total factor productivity A_i. This can be seen as $\left(\frac{1 + T_2}{1 + T_1}\right) = 1$ if taxes are the same across firms.

3. With other factors held constant, the higher the tax rate on machinery on firm 1, the more distorted the allocation, and the lower the fraction of output produced by manager 1. This can be seen as Y_1/Y_2 is decreasing in T_1.
4. The higher the intensity of machinery in a given industry (which in the model translates to a higher $\propto_j$), the larger the distortion on output, when there is dispersion in taxes across firms. Notice that even if productivity disparities and tax disparities are the same across industries, the reduction in the fraction of output produced by the more productive manager is increasing in $\propto_j$.

For the empirical work in the chapter, results 3 and 4 are tested. The model suggests that industries that rely more on machinery should see larger misallocation as a result of tax dispersion across firms.

Tax Dispersion across Firms under the Same Tax Rules

This annex provides an explanation of why, even when subject to the same tax rules, heterogeneous firms in the same industry will face firm-specific tax rates if there are differences in taxation by asset type, source of financing, or firm characteristics. This is a well-established finding in the tax literature (see, for example, Egger and others 2009; Graham, Lemmon, and Schallheim 2002; Dwenger and Walch, 2014; and Devereux, Maffini, and Xing 2015). If effective marginal tax rates (EMTRs) are the same across assets, financing, and firm characteristics, then all firms in a given industry will face the same tax rate, and there is no misallocation—the fraction of output produced by firms is solely determined by the firm's individual total factor productivity However, when EMTRs are different across assets, financing, and firm characteristics, tax rates will vary considerably across firms within narrowly defined industries because of firm-level differences in their asset composition, sources of financing, ownership structure, and profitability (whether the firm has incurred losses). For instance:

- Companies vary widely in the way they combine different capital inputs to produce the final output, even within a narrowly defined industry and at the same level of aggregate capital (Pindyck 1979). Given that different types of capital assets have different tax depreciation schedules and that these do not necessarily match the assets' true economic depreciation, differences in firms' asset composition will result in different firm-level EMTRs. For example, the EMTR for machinery will play a more important role in affecting investment by firms with a higher share of machinery in their total capital inputs.
- Companies rely on different sources of financing for their investment, including retained earnings, new equity, or external debt. It can be shown that the cost of capital is different under alternative sources of financing when debt, equity, and retained earnings are subject to different tax treatment (see Annex 2.4). In this case too, firm-level heterogeneity will result in differences in firm-level EMTRs.
- In addition, companies differ widely in the extent to which they incur losses. The marginal tax rate for loss-making companies is the statutory rate discounted by the number of years they expect to remain in a loss-making position, and it can vary anywhere between zero and the statutory tax rate. This is another important source of heterogeneity in firm-level effective marginal tax rates. For example, Dwenger and Walch (2014) find that owing to the asymmetric treatment of tax losses and profits, the taxable status of a firm is extremely important in determining the firm-specific marginal tax rate and user cost of capital.

Annex 2.2. Calculation of Resource Allocation Efficiency Using Firm-Level Data

Resource allocation efficiency is a country-industry-specific variable that is constructed from firm-level data. Firm-level data for developing countries in this chapter are from the World Bank Enterprise Surveys (WBES), while firm-level data for advanced economies in this chapter are from ORBIS, provided by Bureau van Dijk. The WBES is survey-based, and is the highest quality source of representative firm-level data available for many developing countries. The information in ORBIS data comes from financial statements of firms that are subject to official reporting requirements. The version used here includes information that is not consolidated for parents and

subsidiaries. Compared to WBES data, ORBIS data includes many more observations, has a much more consistent panel dimension, and employs a much more detailed industry classification (namely, at the four-digit level). These differences imply that the two data sets cannot be combined, and empirical analysis for developing economies and advanced economies is carried out separately.

A careful cleaning methodology is followed:

WBES data. The cleaning procedure is mostly based on Inklaar, Lashitew, and Timmer 2016. It entails the removal of observations with negative sales, capital, labor, and value added and implausibly high values of sales per worker and the removal of the bottom 2.5 and top 97.5 percentiles of the computed output wedges, capital wedges, and total factor productivity. To ensure that the final sample is not too different from the original (representative) sample, all firms in industries for particular countries and years are excluded if they have fewer than five observations or if less than half of the original number of observations remain in the sample. Along the same lines, all firms in countries for particular years are dropped if fewer than 40 observations remain in total across all industries or if fewer than 40 percent of the original number of observations in total across all industries remain. The resulting sample encompasses a strongly unbalanced panel of 30 emerging market economies, 24 low-income developing countries, and 3 advanced economies that spans the 2002–16 period.[43]

ORBIS data. The data are first subjected to a standard cleaning procedure that follows Kalemli-Ozcan and others (2015). The sample encompasses nine countries over the 2006–13 period. Countries are included only if at least 50 percent of the observations in the manufacturing sector were retained after omitting negative, missing, and extreme values of key variables required for the computation of the resource misallocation measure or if, according to Kalemli-Ozcan and others (2015), the TFP sample accounts for at least roughly 70 percent of the manufacturing sector. In addition, countries with large idiosyncratic year-to-year fluctuations in the number of firms are omitted. The countries selected are Belgium, the Czech Republic, France, Italy, Portugal, the Slovak Republic, Slovenia, Spain, and Sweden.[44] In addition, ORBIS data are cleaned in line with the recent literature on misallocation in advanced economies, including Crespo and Segura-Cayuela 2014; Dias, Robalo Marques, and Richmond 2016; and García-Santana and others 2016. In addition to removing the top and bottom percentiles of the wedges and TFP, the 1 percent tails of the firm-level to industry-level total factor (revenue) productivity ratios are removed. Finally, all firms in industries in particular countries and years with fewer than 10 observations are removed, firms with fewer than 10 employees are dropped, and firms that had fewer than 20 employees in the first year they appear in the sample are dropped as well. This ensures that the resource efficiency estimates are not upwardly biased and that the results are comparable to those found in the literature.

Resource allocation efficiency is estimated following Hsieh and Klenow (2009) (see Annex 2.1). Calculations are undertaken for the manufacturing sector at the two-digit International Standard Industrial Classification (ISIC) industry level for the WBES sample and at the four-digit North American Industry Classification System (NAICS) industry level for the ORBIS sample. Resource allocation efficiency is also calculated for the services sector in the case of advanced economies, but not for developing countries because of data constraints. Annex Table 2.2.1 provides the number of observations in each case.

The choice of parameter values used in the estimations follows Hsieh and Klenow (2009) and Inklaar, Lashitew, and Timmer (2016). The output elasticities of labor and capital for each industry are approxi-

[43]The countries in the sample are Angola, Argentina, Azerbaijan, Bangladesh, Botswana, Brazil, Bulgaria, Burundi, Cambodia, Chile, China, Colombia, Croatia, the Democratic Republic of the Congo, the Dominican Republic, Ecuador, Egypt, El Salvador, Estonia, Ethiopia, Ghana, Guatemala, Guinea, Honduras, India, Indonesia, Iraq, Jamaica, Jordan, Kenya, the Lao People's Democratic Republic, Mali, Mauritania, Mexico, Moldova, Mongolia, Mozambique, Namibia, Nepal, Nigeria, Pakistan, Peru, the Philippines, Senegal, Serbia, Slovenia, South Africa, Sri Lanka, Sweden, Tanzania, Thailand, Tunisia, Uganda, Uzbekistan, Vietnam, Zambia, and Zimbabwe.

[44]Owing to data constraints, Germany, Japan, the United Kingdom, and the United States are not included in the sample. This chapter uses unconsolidated statements, but many Japanese, U.K., and U.S. firms report only consolidated statements, and in many cases, there is no information provided on whether a particular firm is a stand-alone firm. As a result, there are too few observations left after data cleaning to compute resource allocation efficiency measures. Coverage of other potential data sources such as Compustat is also insufficient, because only listed firms are included. The use of country-specific sources of firm-level data (such as official business census data) is beyond the scope of this chapter and would raise issues related to international comparability of different data sources used.

Annex Table 2.2.1. Number of Observations

	Manufacturing Sector		Services Sector
	World Bank, Enterprise Surveys	ORBIS	ORBIS
Coverage			
Number of Countries	30 EMEs, 24 LIDCs, 3 AEs	9 AEs	9 AEs
Number of Industries	18	73	76
Number of Years	1 year for most countries	8 years, 2006–13	8 years, 2006–13
Revenue Productivity: Firm-Level Observations			
Total	26,649	364,357	306,908
Sector-Country-Year Average	45	96	115
Country-Year Average	375	5,061	4,263
Resource Allocation Efficiency: Country-Industry Observations	590	3,784	2,930

Source: IMF staff compilations.
Note: AEs = advanced economies; EMEs = emerging market economies; LIDCs = low-income developing countries.

mated by their cost shares in the United States from the Bureau of Economic Analysis. The elasticity of substitution between output of different firms is set to 3. The rental price of capital is set to 0.1, assuming a real interest rate of 5 percent and a depreciation rate of 5 percent. The cost of labor is used to measure employment at the firm level to account for differences in hours worked and human capital (implying that no assumption with respect to the wage rate needs to be made).

Annex 2.3. A Simple Example of Distortive Taxes and Resource Misallocation

This annex illustrates how taxes can affect the fraction of capital and labor employed by firms with different productivity levels and, as a result, aggregate total factor productivity (TFP). It departs from the standard model of span of control by Lucas (1978), in which managers differ in their ability to manage existing productive resources. The production technology relating output to labor is the same across managers (with decreasing returns to scale), but TFP is given by managerial talent. Without distortive taxes and with efficient financial markets, input demands will be such that the value of marginal products equals factor prices and thus the value of marginal products is equated across all firms. The most productive firms will also employ the largest share of labor and capital available in the economy. Under distortive taxes, however, less productive firms could in principle employ more productive factors than they would without such frictions. This would translate into more value added produced by lower-productivity firms and thus lower economy-wide TFP.

Setup

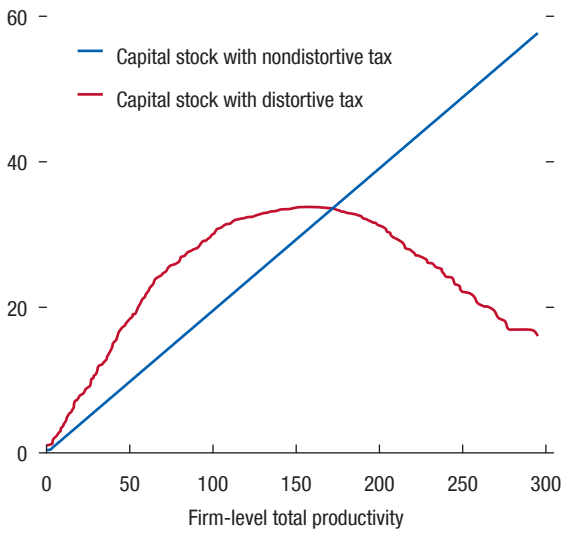
For illustration, it is assumed managerial productivity (A^i) is drawn from a Pareto density (as is common in the literature, to match firm size distribution).

In the presence of a nondistortionary tax, where $\tau_s^K = 0.35$, $\tau_s^Y = 0.4$, for all firms in the industry, the distribution of capital by firm productivity is shown in Annex Figure 2.3.1. In this case, the amount of capital input is perfectly correlated with firm-level productivity. Taxes that affect all firms equally do not change the fact that more productive firms are larger and employ more capital and labor than less productive firms.

One key distortion emphasized by the literature is the impact of taxes that are correlated with productivity (or size). For illustration purposes, consider that taxes are given by $1 + \tau_{is}^K = a + b(A^i)$, and $1 - \tau_{is}^Y = c - d(A^i)$, with $b > 0$ and $d > 0$, so that taxes penalize more productive firms. A representative distribution of K under the distortive taxes is illustrated by the solid green line in Annex Figure 2.3.1, where more capital is allocated to less productive firms. Annex Figure 2.3.2 further compares the amount of capital allocated to firms of different productivity ranges relative to the total amount of capital in the economy, with and without the distortive tax. Again, compared with a nondistortionary tax, the distortive taxes allocate more capital to less productive firms.

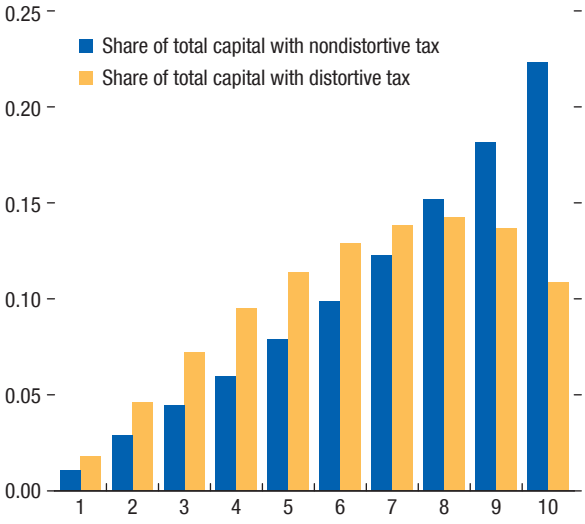
Note that in this example, the specific shape of the distribution of the capital is an artifact of the tax function, which increases linearly in the level of firm-level productivity. However, the general message carries beyond this simple example; that is, distortive tax policy results in resource misallocation and loss in aggregate TFP.

Annex Figure 2.3.1. Capital Allocation with Distortive Taxes



Source: IMF staff estimates.

Annex Figure 2.3.2. Share of Total Capital: Distortive versus Nondistortive Taxes



Source: IMF staff estimates.

Annex 2.4. Estimates of the Effective Marginal Tax Rate

Estimates of effective marginal tax rates (EMTRs) used in this chapter, unless otherwise noted, were provided by the Oxford University Center for Business Taxation.[45]

The calculation of EMTRs follows the approach developed by Devereux and Griffith (1998), which starts with the Hall and Jorgenson (1967) user cost of capital. The user cost of capital ($\tilde{p}$) is the real before-tax rate of return that a marginal investment must earn to recover the cost of the investment, pay taxes on business income, cover the economic depreciation, and pay an expected after-tax rate of return on marginal saving:

$$\tilde{p} = \frac{(1 - A)}{(1 - \tau)(1 + \pi)}\{\rho + \delta(1 + \pi) - \pi\} - \frac{F_t(1 + \rho)}{\gamma(1 - \tau)(1 + \pi)} - \delta,$$

in which τ is the statutory corporate tax rate; π is the expected inflation rate; δ is the economic rate of depreciation; $A = \tau\phi(1 + \rho)/(\rho + \phi)$ is the net present value of the depreciation allowance, in which ϕ is the rate at which capital expenditure can be offset against tax; $\rho = (1 - m^i)i/(1 - z)$ is the shareholders' nominal discount rate, with m^i the personal tax rate on interest income, i the nominal interest rate, and z the accruals-equivalent capital gains tax rate.

Moreover, $\gamma = \left(1 - m^d\right)/\left(1 - c\right)\left(1 - z\right)$ is a term measuring the tax discrimination between new equity and distributions, with m^d the personal tax rate on dividend income and c the rate of tax credit available on dividends paid. To capture the impact of financing cost, F_t is a term capturing the additional cost of raising external finance, defined as[46]

$$\text{Retained earnings: } F_t = 0, \tag{A2.4.1}$$

$$\text{New equity: } F_t = \frac{-\rho(1 - \gamma)}{(1 + \rho)}\left(1 - \phi\tau\right), \tag{A2.4.2}$$

$$\text{Debt: } F_t = \frac{\gamma(1 - \phi\tau)}{(1 + \rho)}\left\{\rho - i(1 - \tau)\right\}. \tag{A2.4.3}$$

[45]For more details on methodology, underlying data sources, and parameter values used by the center, see http://www.sbs.ox.ac.uk/sites/default/files/Business_Taxation/Docs/Publications/Reports/cbt-tax-ranking-2012.pdf. Estimates do not include investment tax credits or individual-level taxes. They take into account the Italian allowance for corporate equity and the U.K. patent box, but not the U.K. annual investment allowance.

[46]To illustrate the exact formula for the user cost of capital, consider the case in which $m^i = z = 0$ and hence $\rho = i$, the nominal interest rate. The cost of capital for investment financed with retained earnings is therefore

$$\tilde{p}^{RE} = \frac{(1 - A)}{(1 - \tau)}\{r + \delta\} - \delta$$

in which r is defined as the real interest rate: $(1 + r)(1 + \pi) = 1 + i$.

The EMTR is therefore defined as the expected pretax rate of return ($\tilde{p}$) minus the expected after-tax rate of return (r), divided by the pretax rate of return. Thus, for new investment:

$$EMTR = \frac{\tilde{p} - r}{\tilde{p}}.$$

There are some limitations to the standard EMTR calculation. It is important to note that EMTRs are quite sensitive to the underlying assumptions, for example, those regarding the interest rate or inflation. They are usually computed under uniform and constant parameters, which might not reflect actual country data. The effective tax rate model may omit features of the corporate tax code that may influence incentives to save and invest. For example, EMTR calculations generally ignore special credits, deductions, rates, and other tax provisions intended to encourage investment in specific assets or industries, which are prevalent in developing countries. They assume that firms use all available deductions and credits when such deductions and credits are likely to be of little use to a firm in a loss position or with a stock of unused tax losses and credit carryforwards. Standard EMTR calculations also assume that all investors are subject to corporate tax, ignoring the fact that various tax avoidance opportunities may lead to a lower statutory tax rate on marginal investment. This means that lower federal corporate income tax rates and other tax measures intended to reduce marginal effective tax rates on new investment may have less influence in an economy that is open to international capital flows.

Annex 2.5. Taxation and Resource Allocation Efficiency within Industries

This annex summarizes the econometric approaches used to estimate the effect of tax distortions on resource allocation efficiency within industries, following a difference-in-differences (DID) approach, following Rajan and Zingales (1998). Because of data constraints, analyses are conducted separately for advanced and developing economies.

Emerging Market and Low-Income Developing Countries: Disparities in Effective Marginal Tax Rates Across Asset Types and Industry-Level Resource Allocation Efficiency

Disparities in effective marginal tax rates (EMTRs) across asset types can increase resource misallocation when they result in over- or underinvestment in particular types of assets. This section of the annex explores the effect that disparity in EMTRs across capital asset types can have on resource allocation efficiency within industries.

Empirical Strategy

Tax disparity in this analysis is defined as the difference between the EMTR on machinery and the EMTR on buildings. A DID approach is used, exploiting the fact that industries with a higher share of firms that are more capital intensive in machinery will be more affected than other industries by a higher tax disparity.

Denoting industry by j and country by k, the following equation is estimated:

$$\begin{aligned} RAE_{j,k} = {} & \alpha + \delta_j + \gamma_k \\ & + \beta_1 \left(tax\ disparity_k * machinery\ share_j \right) \\ & + B_x X_{j,k} + \varepsilon_{j,k}, \end{aligned} \tag{A2.5.1}$$

in which *RAE* denotes resource allocation efficiency and is a country-industry-specific variable, constructed from firm-level data as discussed in Annex 2.1 and 2.2; *tax disparity* denotes the country-level EMTR on machinery minus the EMTR on buildings (in absolute terms). Machinery share is the industry-specific capital intensity in machinery, as a share of total capital. To control for endogeneity, *machinery share* is measured using the asset share in industry capital income of the United States, under the assumption that the United States faces the least distortions.[47] The terms δ_j and γ_k are the industry and country fixed effects, respectively, included to isolate the impact of taxes from that of other unobserved policies or underlying structural characteristics that might be important in generating resource misallocation. The term $X_{j,k}$ is a vector of additional country-industry-specific control variables that includes the share of small firms in that industry, the share of young firms in that industry, the share of exporting firms in that industry, and the log of capital intensity in that industry. The regression also includes a proxy for the level of competition within each industry—measured as the share of firms with two or more competitors—to control for the possible effect of monopolistic power on the dispersion of revenue productivities. Moreover, the regression also controls for financing constraints using

[47]This is the approach followed by Rajan and Zingales (1998) to address potential endogeneity issues.

the self-reported perception of access to finance as an obstacle to business (average for the industry). The term α is a constant, and $\varepsilon_{j,k}$ denotes an error term disturbance satisfying standard assumptions.

The coefficient β_1 represents the DID estimate of the effect of tax disparity on resource allocation efficiency within industries that are more capital intensive in machinery. It is expected to be negative if a higher tax disparity reduces resource allocation efficiency in those industries.

Data

Country-industry-specific variables are constructed from firm-level data from the World Bank Enterprise Surveys. Country-level data on EMTRs are from the Oxford University Center for Business Taxation. Data on asset shares in industry capital income of the United States are from the Bureau of Labor Statistics.

The data set contains a maximum of 573 observations across 18 industries for 30 emerging market and 24 low-income developing countries.

Results

Annex Table 2.5.1 presents the main regression results. Column (1) presents those for equation (A2.5.1), including only the controls for the share of firms with more than two competitors and financing constraints; columns (2) and (3) add additional country-industry-specific controls. Columns (3) to (6) are based on similar specifications, with a term added for the interaction between the share of small firms in the industry and the perception of financing constraints in the industry.

The results in column (1) show that a 1 percentage point reduction in tax disparity is associated with a 1–1.5 percentage point increase in resource allocation efficiency in the industries that are more capital intensive in machinery. By reducing the tax disparity to the that observed at the 10th percentile of the distribution (zero tax disparity), the median emerging market economy would be able to increase its resource allocation efficiency by 7¼ percentage points in those industries that are more capital intensive in machinery and by 5½ percent in the case of the median low-income developing country.

Advanced Economies: Corporate Debt Bias and Industry-Level Resource Allocation Efficiency

Corporate debt bias can result in resource misallocation when it affects investment decisions that are more dependent on equity, as is the case for investment in research and development (R&D). Corporate debt bias occurs when firms are allowed to deduct interest expenses, but not returns to equity, in calculating corporate tax liability, raising the cost of equity financing compared to debt financing. Innovative firms, particularly startups, tend to rely on equity rather than debt for R&D investments (which have risky, long-horizon payoffs) because there are no collateral requirements and shareholders share in upside returns (Stiglitz 1985; Hall 2002; Brown, Fazzari, and Petersen 2009). Therefore, debt bias not only distorts the financing choice but can also create resource misallocation by imposing a higher marginal tax on R&D investment compared to other capital spending. This section of the annex explores the effect corporate debt bias can have on resource allocation efficiency within industries.

Empirical Strategy

The empirical approach estimates the relationship between corporate debt bias and resource allocation efficiency. It uses a DID approach exploiting the fact that industries with a higher R&D intensity will be more affected than other industries by a higher debt bias.

The following DID estimation is tested:

$$RAE_{j,k,t} = \alpha + \delta_j + \gamma_k + \chi_t + \beta_1 \left(debtbias_{kt} * R\&Dintensity_j \right) + \varepsilon_{j,k,t}, \quad \text{(A2.5.2)}$$

in which the subindices *j, k,* and *t* refer to the industry, country, and time, respectively; *RAE* denotes resource allocation efficiency and is a country-industry-specific variable, constructed from firm-level data as discussed in Annex 2.1 and 2.2; *debtbias* denotes the country-level EMTR on equity-financed investment minus the EMTR on debt-financed investment; And *R&D intensity* is the industry-specific R&D intensity (measured using the average of industrial R&D expenditures normalized by value added across member countries of the Organisation for Economic Co-operation and Development, to control for endogeneity). *External equity dependence* is also used as an alternative interaction variable with *debtbias*. The terms δ_j, γ_k, and χ_t are the industry, country, and time fixed effects, respectively (included to isolate the impact of taxes from that of other unobserved policies or underlying structural characteristics that may be important in generating resource

Annex Table 2.5.1. Developing Countries: Resource Allocation Efficiency and Disparity in Effective Marginal Tax Rates across Asset Types

Dependent Variable: Resource Allocation Efficiency at Industry Level in Manufacturing	(1)	(2)	(3)	(4)	(5)	(6)
Disparity in EMTRs$_k$ × Machinery as Share of Total Assets$_j$	−1.172*	−1.267*	−1.678***	−1.144*	−1.263*	−1.663***
	(−0.642)	(−0.617)	(−0.518)	(−0.631)	(−0.622)	(−0.526)
Firm Capital Intensity$_{j,k}$		0.039	0.035		0.037	0.033
		(−0.023)	(−0.024)		(−0.021)	(−0.022)
Share of Young Firms$_{j,k}$		−0.044	0.023		0.008	0.076
		(−0.103)	(−0.106)		(−0.119)	(−0.117)
Share of Small Firms$_{j,k}$		−0.027	0.025		−0.226	−0.138
		(−0.234)	(−0.245)		(−0.547)	(−0.534)
Share of Exporting Firms$_{j,k}$			0.004***			0.004***
			(−0.001)			(−0.001)
Share of Firms with 2+ Competitors$_{j,k}$	−0.017	−0.013	0.006	−0.021	−0.013	0.005
	(−0.085)	(−0.081)	(−0.08)	(−0.086)	(−0.083)	(−0.082)
Median Perception of Access to Finance as an Obstacle$_{j,k}$	0.025	0.028	0.031			
	(−0.024)	(−0.024)	(−0.023)			
Share of Small Firms$_{j,k}$ × Perception of Access to Finance as an Obstacle$_{j,k}$				0.029	0.155	0.127
				(−0.112)	(−0.287)	(−0.278)
Number of Observations	286	286	286	286	286	286
R^2	0.513	0.525	0.552	0.51	0.521	0.547
Country Fixed Effects	Y	Y	Y	Y	Y	Y
Industry Fixed Effects	Y	Y	Y	Y	Y	Y

Source: IMF staff calculations.
Note: The disparity in effective marginal tax rates (EMTRs) is the EMTR on machinery minus the EMTR on buildings. Standard errors are in parentheses and are clustered by industry.
*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

misallocation); α is a constant; and $\varepsilon_{j,k,t}$ denotes an error term disturbance satisfying standard assumptions.

The coefficient β_1 represents the difference-in-differences estimate of the effect of debt bias on resource allocation efficiency within R&D-intensive industries. It is expected to be negative if a higher debt bias reduces resource allocation efficiency in those industries.

Data

Country-level data on EMTRs are from the Oxford University Center for Business Taxation. Data on R&D intensity (the average of industrial R&D expenditures normalized by value added across member countries of the Organisation for Economic Co-operation and Development) and external equity dependence (the ratio of net external equity issues to total assets for the median U.S. firm in each industry in the 1980s) are from Brown and Martinsson 2016.

The main estimation sample is an unbalanced panel of 3,784 observations, across nine advanced economies, over the period 2006–13.

Results

Annex Table 2.5.2 presents the main regression results. Column (1) shows the results for equation (A2.5.2), including country, industry, and time fixed effects; column (2) uses country-time and industry-time fixed effects; and column (3) uses country-industry and time fixed effects. Columns (4) to (6) employ similar specifications, using equity dependence as the interaction variable with debt bias.

The results in column (3) show that a 1 percentage point reduction in debt bias is associated with a 0.01 percentage point increase in resource allocation efficiency in those industries that are more intensive in R&D. By reducing the debt bias to that observed at the 10th percentile of the distribution (29 percentage points), the median advanced economy would be able to increase resource allocation efficiency in those industries that are more R&D intensive by 3 percentage points. The median debt bias reduction would be 13 percentage points.

Similar results are obtained when equity dependence is used as the interaction term instead of R&D intensity. The results in column (6) show that a 1 percent point reduction in debt bias is associated with a 0.02 percentage point increase in resource allocation efficiency in those industries that are more dependent on equity. By reducing the debt bias to that observed at the 10th percentile of the distribution, the median advanced economy would be able

Annex Table 2.5.2. Advanced Economies: Resource Allocation Efficiency and Corporate Debt Bias

Dependent Variable: Resource Allocation Efficiency at Industry Level in Manufacturing						
	(1)	(2)	(3)	(4)	(5)	(6)
Debt Bias$_k$ × R&D Intensity$_j$	–0.00781***	–0.00815***	–0.00900***			
	(0.00120)	(0.00126)	(0.00163)			
Debt Bias$_k$ × Equity Dependence$_j$				–0.0198***	–0.0204***	–0.0231***
				(0.00307)	(0.00322)	(0.00422)
Number of Observations	3,784	3,784	3,784	3,784	3,784	3,784
R^2	0.301	0.318	0.411	0.301	0.318	0.411
Country Fixed Effects	Y	N	N	Y	N	N
Industry Fixed Effects	Y	N	N	Y	N	N
Time Fixed Effects	Y	N	Y	Y	N	Y
Country × Time Fixed Effects	N	Y	N	N	Y	N
Industry × Time Fixed Effects	N	Y	N	N	Y	N
Country-Industry Fixed Effects	N	N	Y	N	N	Y

Source: IMF staff calculations
Note: Robust standard errors are in parentheses and are clustered by country and industry.
*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

to increase resource allocation efficiency in those industries that are more equity dependent by 3 percentage points.

Emerging Markets and Low-Income Developing Economies: Preferential Tax Regime for Small Firms and Industry-Level Resource Allocation Efficiency

Preferential tax treatment based on size affects productivity by stunting firm growth. Tax differences across firm size can result in misallocation if more productive firms choose to stay small to remain below the eligibility threshold for preferential tax treatment, preventing them from taking advantage of economies of scale and scope (Pagés 2010; Bobbio 2016). This also implies that a larger share of output at the aggregate level ends up being produced by smaller, less efficient firms.

Empirical Strategy

The empirical approach explores the relationship between preferential tax regimes for small firms and resource allocation efficiency. It uses a DID approach, exploiting the fact that industries with a higher share of small firms will be more affected than other industries by a preferential treatment of small firms.

The following equation is estimated for country k and industry j:

$$RAE_{j,k} = \alpha + \delta_j + \gamma_k + \beta_1 \left(preferential_treatment_k * share_small_{j,k}\right) + \beta_x X_{j,k} + \varepsilon_{j,k}, \quad \text{(A2.5.3)}$$

in which RAE denotes resource allocation efficiency and is a country-industry-specific variable, constructed from firm-level data as discussed in Annex 2.1 and 2.2; *preferential_treatment* is a dummy variable equal to 1 if the country offers lower tax rates for small firms; $share_small_{j,k}$ is the country-industry-specific share of small firms in each industry; and $X_{j,k}$ is a vector of additional country-industry-specific control variables that includes the share of small firms in that industry, the share of young firms in that industry, the share of exporting firms in that industry, and the log of capital intensity in that industry. The regression also includes a proxy for the level of competition within each industry—measured as the share of firms with two or more competitors—to control for the possible effect of monopolistic power on the dispersion of revenue productivities. Moreover, the regression controls for financing constraints using the self-reported perception of access to finance as an obstacle to business (average for the industry). These are included to isolate the impact of taxes from that of other unobserved policies or underlying structural characteristics that may be important in generating resource misallocation. The term α is a constant, and $\varepsilon_{j,k}$ denotes an error term disturbance satisfying standard assumptions.

The coefficient β_1 represents the DID estimate of the effect of having a preferential regime for small firms on resource allocation efficiency within industries that have a larger share of small firms. It is expected to be negative if the preferential regime for small firms reduces resource allocation efficiency in those industries.

Data

Country-industry-specific variables are constructed from firm-level data from the World Bank Enterprise

Annex Table 2.5.3. Developing Countries: Resource Allocation Efficiency and Preferential Taxes for Small Firms

Dependent Variable: Revenue Allocation Efficiency at Industry Level in Manufacturing	(1)	(2)
Lower Tax for Small Firms Dummy$_k$ × Share of Small Firms$_j$	−1.193** (−0.477)	−1.587** (−0.63)
Capital Intensity$_{jk}$		0.014*** (−0.004)
Share of Young Firms$_{jk}$		−0.051 (−0.066)
Share of Small Firms$_{jk}$		0.055 (−0.336)
Share of Exporting Firms$_{jk}$		0.001* (−0.001)
Share of Firms with 2+ Competitors$_{jk}$		−0.092*** (−0.018)
Median Perception of Access to Finance as an Obstacle$_{jk}$		0.011 (−0.013)
Number of Observations	501	484
R^2	0.079	0.127
Country Fixed Effects	Y	Y
Industry Fixed Effects	Y	Y

Source: IMF staff calculations.
Note: Standard errors are in parentheses and are clustered by industry.
*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

Surveys. Data on countries that provide lower tax rates for small firms are drawn from the KPMG database.

The data set contains a maximum of 501 observations (determined by the KPMG variable) across 18 industries in 30 emerging market economies and 24 low-income developing countries.

Results

Annex Table 2.5.3 presents the main regression results. Column (1) estimates equation (A2.5.3) with country and industry fixed effects. Column (2) includes additional country-industry-specific control variables.

The results show that emerging market and low-income developing countries that provide lower tax rates for small firms face lower resource allocation efficiency. More specifically, for industries with a larger share of small firms, resource allocation efficiency is lower by between 1.2 and 1.6 percentage points, respectively, in countries that offer lower tax rates for small firms compared with countries that do not have such tax scheme.

Annex 2.6. Firm-Level Productivity, Informality, and the Tax System

A country's tax system can affect productivity when it contributes to the prevalence of informality in the country's economy. Informal firms are those that fail to pay the full amount of tax due. Weak tax enforcement reduces productivity when it gives informal firms a relative cost advantage over their tax-compliant competitors through tax evasion. This amounts to a potentially large subsidy that allows informal firms to stay in business despite their low productivity, increasing their weight in the economy at the expense of more productive firms (Fajnzylber 2007; Levy 2008; Pagés 2010; Busso, Fazio, and Levy 2012). As a result, informal businesses gain market share even if they are less productive, reducing the market share of more productive, tax-compliant businesses. This annex explores the link between productivity and informality, proxied by the prevalence of cheats, and the effect tax policy and tax administration can have on the prevalence of cheating among small firms.

Empirical Strategy

Two empirical specifications are implemented. The first explores whether firm-level total factor productivity (TFP) is lower for cheats—registered firms that underreport their sales to the tax authority (equation A2.6.1). The second empirical specification uses a difference-in-differences (DID) approach to analyze whether the corporate income tax (CIT) rate and features of the tax administration increase the prevalence of cheating among small firms (equation A2.6.2).

$$TFP_{i,j,k} = \gamma_k + \delta_j + \beta_1 salesreported_{i,j,k} + \beta_2 Z_{i,j,k} + \varepsilon_{i,j,k}, \quad \text{(A2.6.1)}$$

$$salesreported_{i,j,k} = \gamma_k + \delta_j + \beta_1 \left(small_{i,j,k} \times CIT_k\right) + \beta_2 \left(small_{i,j,k} \times CIT_k \times taxadmin_k\right) + \beta_3 Z_{i,j,k} + \varepsilon_{i,j,k}. \quad \text{(A2.6.2)}$$

The subindices *i, j,* and *k* in the two equations refer to the firm, industry, and country, respectively.

In equation (A2.6.1), *TFP* is the firm-level TFP, calculated following Levinsohn and Petrin (2003), and *sales reported* is the explanatory variable of interest, here defined as the share of sales reported to the tax authorities. The baseline specification controls for country (γ_k) and industry (δ_j) fixed effects that capture all other unobserved country- and industry-specific characteristics. The variable Z_i includes standard firm-level control variables, in particular, age, export share,

whether the firm is domestically owned, whether the firm is small (fewer than 20 workers), and whether the firm perceives access to financing as a major constraint for its business. The variable $\varepsilon_{i,j,k}$ is the error term. The coefficient of interest is β_1 and reflects the effect of underreporting sales to the tax authority (cheating) on firm-level productivity. It is expected to be negative if underreporting of sales reduces firm TFP.

In equation (A2.6.2), the dependent variable *sales reported* is the same as that used in equation (A2.6.1). For the DID approach, it is assumed that small firms tend to face higher tax compliance costs than larger firms and therefore have a greater incentive to cheat. *CIT* is the country-level statutory corporate income tax rate, and *tax admin* is a dummy variable equal to 1 when the country exhibits certain tax administration characteristics associated with a stronger tax enforcement capacity and lower compliance costs. Tax administration characteristics include whether the country has an integrated tax and customs agency, a functionally organized tax administration, a semi-autonomous revenue agency (SARA), and a large taxpayer office (LTO).[48] The coefficient β_1 represents the DID estimate of the effect of the CIT rate on reporting of sales for tax purposes. It is expected to be negative if a higher rate contributes to a reluctance of small firms to accurately report to the tax authorities. The coefficient β_2 represents the DID estimate of the effect of the tax administration characteristic in offsetting the negative effect of the CIT rate on reporting by small firms. This coefficient is expected to be positive if stronger tax enforcement deters firms from cheating.

To corroborate the findings from firm-level regressions, country-level regressions are also implemented, using as a proxy for informality the fraction of the labor force that does not contribute to a retirement pension scheme. The following equations are specified:

$$TFP_k = \alpha + \lambda Z_k + \beta_1 \, noncontributors_k + \varepsilon_k, \quad \text{(A2.6.3)}$$

$$noncontributors_k = \alpha + \lambda Z_k + \beta_1 \, CIT_k + \beta_2 (CIT_k \times taxadmin_k) + \varepsilon_{k.} \quad \text{(A2.6.4)}$$

In equation (A2.6.3), TFP_k is TFP at the country level, from the Penn World Tables. The main explanatory variable, $noncontributors_k$, is a proxy for informality, measured as the fraction of the labor force that does not contribute to a retirement pension scheme. Self-employment as a percentage of total employment is used as an alternative measure of informality. The coefficient β_1 is expected to be negative and statistically significant, showing that a high prevalence of informal activities is associated with lower TFP. Country-specific characteristics (Z_k) such the GDP level and population size are controlled for; α is a constant, and ε_k is the error term. To correct for potential reverse-causality bias, a two-stage least-squares instrumental-variables methodology is used. Following Loayza, Servén, and Sugawara (2009), three instrumental variables are used for the endogenous measures of informality: secondary enrollment rate, intellectual property protection, and the independence of the judiciary system. Diagnosis statistics (under- and weak identification tests and Hansen's overidentification test) show that the three instrumental variables used are valid instruments.

In equation (A2.6.4), the dependent variable is *noncontributors* as defined above. Among the explanatory variables, the focus is on the coefficients β_1 and β_2, which capture the effect on informality of tax policy (CIT_k) and tax administration ($CIT_k \times taxadmin_k$), respectively. While the coefficient β_1 is expected to be positive and statistically significant (showing that a higher tax policy burden increases informality through a higher share of noncontributors to pension schemes), the coefficient β_2 is expected to be negative. This indicates that an efficient tax administration with better tax enforcement and lower compliance costs can help mitigate the effect of the tax rate on informality. Country-specific characteristics (Z_k) such as GDP level and population size are controlled for; α is a constant, and ε_k is the error term.

Data

Firm-level data used in equations (A2.6.1) and (A2.6.2) are from the World Bank Enterprise Surveys and cover 130 countries.

Firm-level data on reporting of sales to the tax authority are based on firm responses to the question "What percentage of total annual sales would you esti-

[48]The characteristics used in the regression analysis are imperfect proxies. A more comprehensive measure of tax enforcement capacity is the tax gap for major taxes. However, the tax gap measure is currently available only for a limited set of countries and mainly for value-added taxes. The IMF Fiscal Affairs Department's Revenue Administration Gap Analysis Program (RA-GAP) aims to help countries identify and address compliance gaps. The program initially focused on value-added tax gap estimation but is being extended to other taxes. RA-GAP reports for 22 countries have been completed so far.

Annex Table 2.6.1. Firm-Level Productivity and Informality

Dependent Variable: Firm-Level Total Factor Productivity			
	All Countries		
	(1)	(2)	(3)
Age_i	0.0065***	0.0063***	0.0065***
	(0.001)	(0.001)	(0.001)
$Corruption_i$	–0.001	–0.004	0.001
	(0.008)	(0.008)	(0.009)
$Sales\ Reported_i$	0.0016***	0.0018***	0.0018***
	(0.000)	(0.000)	(0.000)
Number of Observations	11,499	11,499	10,604
R^2	0.421	0.432	0.446
Industry Fixed Effects	Y	Y	Y
Country Fixed Effects	Y	Y	Y

Source: IMF staff calculations.
Note: Standard errors are in parentheses and are clustered by country and industry.
*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

mate the typical firm in your area of business reports for tax purposes?" from the World Bank Enterprise Surveys. Although firms may be reluctant to reveal the extent of their underreporting, survey respondents will presumably tend to answer questions based on their own experiences. Therefore, responses to this question are interpreted as indicating firms' own behavior. This proxy for informality has been previously used by La Porta and Shleifer (2008, 2014), Dabla-Norris and Inchauste (2008), and Fajnzylber (2007). It is found to be correlated with a number of other measures of informality, such as self-employment as a share of total employment and the fraction of the labor force that does not contribute to a retirement pension scheme. For the empirical analysis, it is assumed that survey respondents answer other questions in the survey accurately. Data on sales reported for tax purposes are available for the period 2002–10.

The data on characteristics of the tax administration are from the U.S. Agency for International Development Tax Database for 2007–12. These include (1) tax administration costs as a percentage of total revenue, suggesting that a higher number of tax staff per taxpayer can provide greater audit capacity; (2) whether a particular country has an integrated tax and customs agency, which can enable a more complete view of each taxpayer; (3) whether a particular country has a functionally organized tax administration that standardizes common work across taxes and tax-type organizations and simplifies the relationship between the tax administration and the taxpayer; (4) whether the country has a semiautonomous revenue agency (SARA), which helps protect against political interference and provides independence in operations and human resource management; and (5) whether the country has a large taxpayer office (LTO), which can enable a better allocation of administrative resources and facilitate risk-management approaches to compliance.

Data on the statutory CIT rate are from the IMF's Tax Policy Database.

For the country-level regression in equation (A2.5.3), TFP is from the Penn World Table 9.0 database. The fraction of the labor force that does not contribute to a retirement pension scheme is from the World Bank Human Development Network Social Protection pensions database. Data are available for 116 countries over the period 2000–15. Data on self-employment as a share of total employment are from the World Bank's *World Development Indicators*.

Estimation Results

Annex Table 2.6.1 provides the results linking firm-level TFP and the percentage of sales reported for tax purposes, based on equation (A2.6.1). Column (1) reports the baseline result and includes country and industry fixed effects. Column (2) includes year fixed effects, and column (3) retains only the latest available data for firms surveyed twice or more.

The firm-level regressions confirm that lower informality is associated with higher productivity. Results in column (1) show that a 1 percentage point increase in sales reported is associated with a 0.001 percentage point increase in firm-level TFP. The results suggest that cheats that report only 30 percent of their sales (equivalent to the firm at the 25th percentile of the distribution of cheats) have a 4 percent lower TFP than tax-compliant firms.

Annex Table 2.6.2 presents the country-level regression results, following equation (A2.6.3). Each column uses an alternative proxy for the prevalence of informality: noncontributors to the pension scheme (column 1) and the share of self-employment (column 2). The country-level results confirm firm-level results that lower informality is associated with higher productivity.

Annex Table 2.6.3 provides the results linking sales reported, the CIT tax rate, and characteristics of the tax administration, using the DID approach of equation (A2.6.2). Each column provides the results

for an alternative characteristic of the tax administration: tax administration costs as a percentage of total revenue (column 1); whether a particular country has a functionally organized tax administration (column 2); whether a particular country has an integrated tax and customs agency (column 3); whether the country has a SARA (column 4); and whether the country has an LTO (column 5). Overall, the firm-level DID regressions show that a stronger tax administration can help offset the effect of a higher tax rate on the percentage of sales reported by small firms.

Annex Table A2.6.4 provides the country-level results linking the tax system and informality—as proxied by the fraction of the labor force that does not contribute to a retirement pension (equation A2.6.4). As in Annex Table A2.6.3, each column provides the results for an alternative characteristics of the tax administration. The results reiterate the firm-level

Annex Table 2.6.2. Aggregate Total Factor Productivity and Informality

Dependent Variable: Log Total Factor Productivity at Country Level		
	(1)	(2)
GDP (log)	0.058	0.0419
	(–0.05)	(–0.048)
Population size (log)	–0.0443	–0.0141
	(–0.075)	(–0.07)
Noncontributors to pensions (log)	–0.540*	
	(–0.281)	
Self-employment (log)		–0.419**
		(–0.161)
Number of Countries	101	103
Underidentification (*p*-value)	0.001	0.002
Weak-identification (KP *F*-stat)	5.883	12.774
Weak-instrument (SW *S*-stat)	0.068	0.155
Hansen (*p*-value)	0.153	0.326

Source: IMF staff calculations.
Note: Standard errors are in parentheses. The underidentification and weak-identification hypotheses are rejected. The instruments employed also pass the Hansen overidentification test. KP *F*-stat = Kleibergen-Paap *F*-statistics; SW *S*-stat = Stock-Wright *S*-statistics.
*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

Annex Table 2.6.3. Firm-Level Informality, Tax Rates, and Tax Administration

Dependent Variable: Percent of Total Sales Reported for Tax Purposes					
	(1)	(2)	(3)	(4)	(5)
Age_i	0.0338	0.0599***	0.0525**	0.0511**	0.0537**
	(0.023)	(0.022)	(0.021)	(0.021)	(0.021)
Export Share $(log)_i$	0.0263	–0.0069	–0.0082	–0.0083	–0.0024
	(0.027)	(0.021)	(0.021)	(0.021)	(0.020)
Domestic $Ownership_i$	1.379	–0.529	–1.084	–0.763	–1.177
	(1.431)	(1.259)	(1.220)	(1.205)	(1.249)
Licensing/Permit $Constraints_i$	–1.640***	–0.904**	–1.116**	–1.079**	–1.176**
	(0.543)	(0.454)	(0.453)	(0.449)	(0.473)
Perception of Access to Financing as a $Constraint_i$	–0.429	–0.481	–0.428	-0.440	–0.277
	(0.612)	(0.593)	(0.575)	(0.569)	(0.595)
Perception of Corruption as a $Constraint_i$	–0.292	–0.852**	–0.753**	–0.775**	–0.734**
	(0.409)	(0.363)	(0.349)	(0.349)	(0.354)
Informal $Competition_i$	0.355	–0.324	–0.212	–0.260	–0.182
	(0.307)	(0.288)	(0.280)	(0.281)	(0.286)
Small $Firm_i$	1.259	-0.880	2.824	–0.214	0.00677
	(3.631)	(3.290)	(3.573)	(3.224)	(3.356)
$CIT_k \times$ Small $Firm_i$	–0.172	–0.458***	–0.316**	–0.227*	–0.221
	(0.119)	(0.167)	(0.138)	(0.116)	(0.160)
$CIT_k \times$ Tax Administration $Cost_k \times$ Small $Firm_i$	0.0714***				
	(0.027)				
$CIT_k \times$ Functional $Organization_k \times$ Small $Firm_i$		0.333**			
		(0.135)			
$CIT_k \times$ Integrated Tax and Customs $Agency_k \times$ Small $Firm_i$			0.0913		
			(0.056)		
$CIT_k \times$ Semi-Autonomous Revenue $Agency_k \times$ Small $Firm_i$				0.102*	
				(0.053)	
$CIT_k \times$ Large Taxpayer $Office_k \times$ Small $Firm_i$					0.0574
					(0.126)
Number of Observations	4,695	8,993	9,573	9,675	9,278
R^2	0.099	0.167	0.174	0.175	0.159
Industry Fixed Effects	Y	Y	Y	Y	Y
Country Fixed Effects	Y	Y	Y	Y	Y

Source: IMF staff calculations.
Note: Standard errors are in parentheses and are clustered by country and industry. CIT = corporate income tax.
*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

Annex Table 2.6.4. Country-Level Informality, Tax Rates, and Tax Administration

Dependent Variable: Noncontributors to Pensions at Country Level (log)

	(1)	(2)	(3)	(4)	(5)
GDP (log)	–0.120***	–0.114***	–0.0935***	–0.0958***	–0.103***
	(0.035)	(0.022)	(0.016)	(0.019)	(0.018)
Population Size (log)	0.225***	0.178***	0.149***	0.155***	0.159***
	(0.059)	(0.035)	(0.030)	(0.034)	(0.027)
Log_CIT	0.103	0.231	0.127	0.0195	0.266
	(0.212)	(0.167)	(0.124)	(0.111)	(0.415)
Tax Administration Cost	–0.821				
	(0.751)				
Log_CIT × Tax Administration Cost	0.257				
	(0.233)				
Functional Organization		0.393			
		(0.523)			
Log_CIT × Functional Organization		–0.101			
		(0.166)			
Integrated Tax and Customs Agency			–1.579**		
			(0.758)		
Log_CIT × Integrated Tax and Customs Agency			0.456**		
			(0.221)		
Semiautonomous Revenue Agency				–1.355**	
				(0.535)	
Log_CIT × Semiautonomous Revenue Agency				0.421***	
				(0.160)	
Large Taxpayer Office					0.569
					(1.410)
Log_CIT × Large Taxpayer Office					–0.111
					(0.421)
Number of Countries	47	89	100	102	93
R^2	0.486	0.442	0.46	0.453	0.545

Source: IMF staff calculations.
Note: Standard errors are in parentheses and are clustered by country and industry. CIT = corporate income tax.
*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

results that a stronger tax administration can help reduce the incidence of informality.

Annex 2.7. Tax Compliance Costs and Firm Productivity

Tax compliance costs refer to the resources spent by firms to comply with taxation in addition to the tax liability, such as employee time dealing with tax issues and the cost of professional advice. Tax compliance costs are commonly found to be especially burdensome for small firms and young businesses (Slemrod and Venkatesh 2002; Coolidge 2012). However, the more resources small firms spend to file their taxes, the fewer resources are available for more productive activities.

This annex, based on Dabla-Norris and others, forthcoming, provides evidence that small and young firms have higher labor productivity in countries with lower tax compliance costs. Dabla-Norris and her colleagues construct a novel Tax Administration Quality Index (TAQI). This index is comprehensive in the sense that it reflects the quality of all aspects of tax administration that matter for tax compliance costs, comparable across countries, and abstracts from any effects of tax policy on compliance costs. The index is based on country-specific information from the Tax Administration Diagnostic Assessment Tool (TADAT), a comprehensive standardized framework for evaluating the performance of tax administration systems. The index uses TADAT data for 33 dimensions of tax administration grouped into four broad categories that matter for tax compliance costs: (1) supporting taxpayer information, (2) filing and payment, (3) postfiling processes, and (4) accountability and transparency on the part of the tax authorities. The TAQI is measured on a scale of 0 to 4, with a higher score implying lower compliance costs.

Empirical Strategy

To assess whether tax compliance costs take a toll on labor productivity of small and young firms, the analysis uses the TAQI to captures the strength of

those areas of tax administration that matter for firms' tax compliance costs.

To address potential endogeneity, the analysis focuses on the differential impact the TAQI can have on productivity of small and young firms using a difference-in-differences approach. Given the regressive nature of tax compliance costs, the identifying assumption is that small and young firms are likely to benefit more than large and more mature firms from improvements in tax administration that alleviate the tax compliance burden.

Two alternative specifications are estimated:

$$PROD_{i,j,k} = \alpha + \gamma_k + \delta_j + \beta_0 small_{i,j,k} + \beta_1 \left(small_{i,j,k} \times TAQI_k\right) + \beta_2 Z_{i,j,k} + \varepsilon_{i,j,k}, \quad \text{(A2.7.1)}$$

$$PROD_{i,j,k} = \alpha + \gamma_k + \delta_j + \beta_0 young_{i,j,k} + \beta_1 \left(young_{i,j,k} \times TAQI_k\right) + \beta_2 Z_{i,j,k} + \varepsilon_{i,j,k}. \quad \text{(A2.7.2)}$$

In the specifications, the subindices *i, j,* and *k* refer to firm, industry, and country, respectively. The analysis is based on cross-section data in the sense that there is only one observation for each country and firm. *PROD* is labor productivity (in logs) as a measure of firm performance. The variable *small* is a dummy that reflects firm size, equal to 1 if a particular firm has fewer than 20 employees; *young* is a dummy that reflects firm age, equal to 1 if a particular firm is younger than seven years old (which corresponds to the 25th percentile of the age distribution in the sample); Z_i includes standard firm-level control variables, in particular, whether a particular firm is partially government owned, an exporter, or partially foreign owned, and whether it perceives tax administration as a major constraint for its business; *TAQI* is the Tax Administration Quality Index (measured on a scale from 0 to 4); α is a constant; and $\varepsilon_{i,j,k,t}$ is the error term. The coefficient β_1 represents the difference-in-differences estimate of the effect of the electronic filing rate on labor productivity in small and young firms; it is expected to be positive if electronic filing is associated with higher productivity in these firms. The baseline specification controls for unobserved country (γ_k) and industry (δ_j) fixed effects. The results reported in the chapter text control for combined country-industry fixed effects. The results are unlikely to be affected by reverse causality, as the country-wide TAQI can be seen as exogenous to any individual firm. In addition, given that cross-section data are used, country fixed effects will capture all other aspects of tax policy and tax administration that are common across firms and other unobserved country-specific characteristics such as regulation that may be correlated with the quality of tax administration. In alternative specifications, the robustness of the definition of small and young firms is tested.

Data

Firm-level data are from the World Bank Enterprise Surveys. The tax administration index is constructed using data from TADAT, and there are 21 country-year combinations for which observations for both data sources are available. While World Bank Enterprise Surveys provide data for many countries, most countries covered are surveyed only once.

Results

Annex Table 2.7.1 summarizes the main estimation results. Column (1) reports the baseline result based on equation (A2.7.1) for small firms, which includes country and industry fixed effects. Column (2) includes country-industry effects instead of the country and industry fixed effects separately. Columns (4) and (5) provide results for similar specifications for young firms, following equation (A2.7.2). In specifications (3) and (6), the robustness to the exact definition of small and young firms is tested. In specification (3), the *small* dummy refers to firms with fewer than 100 employees. In specification (6), the *young2* dummy refers to firms that are younger than five years old. The results are also robust to including in the regressions terms capturing the interaction of the *small* dummy with indicators of governance and regulatory quality.

On average, a higher TAQI score is found to be associated with higher productivity in small and young firms. Based on specifications (2) and (5), for every one unit increase in the TAQI, labor productivity is 51 percent higher in the case of small firms and 16 percent higher in the case of young firms.

Specification (2) implies that in countries with a low TAQI score (at the 25th percentile of the sample distribution), the productivity of small firms is about 40 percent of the productivity of larger firms. In countries with a high TAQI score (at the 75th percentile of

Annex Table 2.7.1. Developing Countries: Tax Compliance Costs and Labor Productivity

Dependent Variable: Firm-Level Labor Productivity

	(1)	(2)	(3)	(4)	(5)	(6)
$Small_i$	–1.230***	–1.143***		–0.224***	–0.231***	–0.230***
	(0.163)	(0.174)		(0.048)	(0.050)	(0.048)
$Young_i$	–0.163***	–0.134***	–0.199***	–0.498***	–0.412***	
	(0.041)	(0.041)	(0.042)	(0.121)	(0.119)	
$Government\ Owned_i$	–0.104	–0.067	–0.061	–0.108	–0.071	–0.107
	(0.177)	(0.190)	(0.186)	(0.175)	(0.187)	(0.175)
$Exporter_i$	0.330***	0.307***	0.374***	0.323***	0.305***	0.324***
	(0.059)	(0.062)	(0.060)	(0.060)	(0.062)	(0.060)
$Foreign_i$	0.308***	0.326***	0.365***	0.310***	0.323***	0.312***
	(0.081)	(0.082)	(0.082)	(0.083)	(0.084)	(0.083)
Perception That Tax Administration Is a Major Constraint$_i$	–0.039	–0.036	–0.043	–0.029	–0.029	–0.030
	(0.030)	(0.029)	(0.030)	(0.030)	(0.029)	(0.029)
$Small_i \times TAQI_k$	0.563***	0.508***				
	(0.088)	(0.094)				
Small and Medium-Sized Enterprises$_i$			–1.271***			
			(0.224)			
Small and Medium-Sized Enterprises$_i \times TAQI_k$			0.690***			
			(0.118)			
$Young_i \times TAQI_k$				0.190***	0.158**	
				(0.065)	(0.064)	
$Young2_i$						–0.375**
						(0.156)
$Young2_i \times TAQI_k$						0.123
						(0.086)
Number of Observations	11,354	11,354	11,354	11,354	11,354	11,354
R^2	0.584	0.598	0.581	0.58	0.594	0.579
Number of Countries	21	21	21	21	21	21
Number of Industries	23	23	23	23	23	23
Country Fixed Effects	Yes	No	Yes	Yes	No	Yes
Industry Fixed Effects	Yes	No	Yes	Yes	No	Yes
Country × Industry	No	Yes	No	No	Yes	No

Source: IMF staff calculations.
Note: Standard errors are in parentheses and are clustered by country and industry. TAQI = Tax Administration Quality Index.
*$p < 0.1$; **$p < 0.05$; ***$p < 0.001$.

the sample distribution), the productivity differences between small and larger firms are much smaller. The results from specification (5) also show that productivity of young firms is only 75 percent of the productivity of mature firms in countries with a low TAQI score. The productivity differences are again only a few percentage points in the case of countries with a higher TAQI score.

Annex 2.8. Antiavoidance Legislation and Investment by Multinational Firms

Many countries are contemplating taking steps to level the playing field across multinational and domestic firms by narrowing the gap between their effective tax rates through antiavoidance legislation to restrict profit shifting. These policy initiatives would increase the effective tax rate on multinational companies. However, because such companies are more mobile than domestic firms, unilateral action by a domestic government to address profit shifting can create distortions in real activity by reducing company's investment and employment. In turn, this can reduce domestic tax revenue in the long term and have adverse effects on national welfare. This annex, based on De Mooij and Liu, forthcoming, tests whether the implementation of antiavoidance legislation, in particular, transfer-pricing regulations, has had an impact on investment by multinational firms.

Empirical Strategy

To assess whether policy restrictions on the ability to shift profits indeed has an impact on multinational companies' investment decisions, the analysis focuses on transfer-pricing regulations (TPRs) that

were recently introduced in 27 countries (Annex Figure 2.8.1).

The analysis uses a difference-in-differences (DID) method. It exploits plausibly exogenous time-series variation in the effective cost of capital following introduction of TPRs in many countries. If TPRs have increased the effective cost of capital on multinational investment, a reduction in multinational investment relative to investment by domestic company groups would be expected. To explicitly control for variation in the investment owing to nontax factors, a control group is used, consisting of domestic company groups in the same host country that are exposed to aggregate shocks similar to those experienced by multinational companies.

Formally, the investment response is tested in the standard DID specification:

$$Investment_{i,k,t} = \varphi_i + \chi_t + \beta_{tpr}(MNC_i * TPR_{k,t}) + \beta_X X_{i,k,t} + \beta_Z Z_{k,t} + \varepsilon_{i,k,t}, \quad \text{(A2.8.1)}$$

in which i indexes firms, k indexes host countries, and t indexes time. The dependent variable $Investment_{i,k,t}$ denotes gross investment scaled by book value of fixed capital assets in (at the end of) year $t-1$. Net investment (investment net of depreciation) is also used as an alternative dependent variable. The key variable of interest is an interaction term between two indicators: an indicator equal to 1 for multinational affiliates and 0 otherwise (MNC_i) and an indicator equal to 1 following the introduction of some TPR and 0 otherwise (TPR_{kt}).

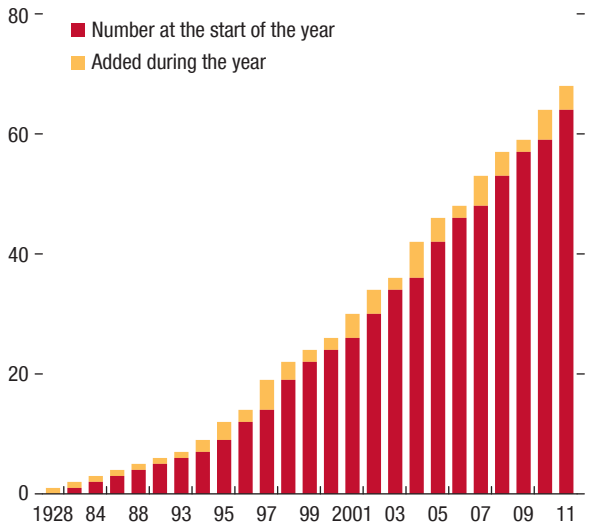
The coefficient β_{tpr} represents the DID estimate of the effect of TPR on investment by multinational affiliates; it is expected to be negative if introduction of the regulation is associated with a reduction in multinational companies.

Firm fixed effects (φ_i) are included to control for unobserved firm-specific productivity differences and the unobserved time-invariant characteristics of the parent company. Firm fixed effects further subsume host country fixed effects (given that affiliates do not change their location), which control for time-invariant differences across host countries that may affect the location choice of multinationals, for example, perceived average quality of governance during the sample period, common language or former colonial ties with the home country, and geographical distance between the home and host country. Time dummies (χ_t) are also included to capture the effect of aggregate macroeconomic shocks, including the effect of the global financial crisis, that are common to all multinational affiliates in the same host country. The term $X_{i,k,t}$ denotes a vector of firm-level controls—such as firm sales, cash flow per dollar of fixed assets, profitability, and sales growth (lagged one period), and $\varepsilon_{i,k,t}$ is the error term. Time-varying country characteristics ($Z_{k,t}$) for host countries (such as GDP per capita, population size, unemployment rate, and indices of governance quality and financial institution stability) are also included to capture the effect of time-varying local productivity, market size, and demand characteristics on investment.

Most specifications include the statutory corporate income tax (CIT) rate in the host country or country-year fixed effects to control for the confounding effects of concurrent tax reforms in the host countries. They also include a full set of industry-by-year interactions and country-by-year interactions to control for industry- and country-specific macroeconomic factors that might affect private investment and would otherwise be captured by the DID estimates. Sensitivity analysis is conducted to confirm the robustness of the findings (not reported here for the sake of brevity).

Alternative specifications are also implemented to test the effect of TPRs on complex multinational companies and whether the effect of TPRs is mitigated

Annex Figure 2.8.1. Countries with Transfer-Pricing Regulations



Sources: Mescall 2011; Saunders-Scott 2013; and IMF staff estimates.

Annex Table 2.8.1.Transfer-Pricing Regulations and Multinational Investments

Dependent Variable: Investment per Dollar of Fixed Assets

	(1)	(2)	(3)	(4)	(5)	(6)
$MNC_i \times TPR_{kt}$	–0.027***	–0.024***	–0.011***	–0.010***	–0.010***	
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	
$MNC_i \times TPR_{kt} \times CIT_{kt}$						–0.021***
						(0.004)
$Log(Sales_{t-1})$	–0.094***	–0.096***	–0.088***	–0.088***	–0.088***	
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	
Cash Flow per Dollar of Fixed Assets	0.018***	0.018***	0.018***	0.018***	0.018***	0.019***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$Profitability_{t-1}$	0.076**	0.072**	0.065**	0.064**	0.064**	0.016**
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.008)
$Sales\ Growth\ Rate_{t-1}$	0.031***	0.029***	0.027***	0.027***	0.027***	–0.013***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Number of Observations	679,555	679,555	679,555	679,554	679,554	492,087
R^2	0.317	0.318	0.324	0.325	0.325	0.359
Firm Fixed Effects	Y	Y	Y	Y	Y	Y
Year Fixed Effects	Y	Y	Y	Y	Y	Y
Country-Year Fixed Effects	N	N	Y	Y	Y	Y
Industry-Year Fixed Effects	N	N	N	Y	Y	Y
Country-Industry Fixed Effects	N	N	N	N	Y	Y

Source: IMF staff calculations.
Note: Standard errors are in parentheses and are clustered by country and industry. CIT = corporate income tax; MNC = multinational company; TPR = transfer-pricing regulation.
*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

when multinational companies have a high share of intangible assets. $MNC_{complex}$ is a dummy variable equal to 1 if the number of countries (or companies) in which a particular multinational company's group operates is above the median number of countries (companies) in the sample. The share of intangible assets is defined as the average share of intangible fixed assets relative to total fixed assets for each firm.

Data

The primary data set for empirical analysis is an unbalanced panel of 130,062 companies in 27 countries for the years 2006–14. It is constructed by using unconsolidated financial statements of affiliates of domestic and multinational company groups in the ORBIS database provided by Bureau van Dijk. A company is defined as a multinational affiliate if it has an ultimate parent company that owns at least 50 percent of its shares and is located in a foreign country. A company is defined as a domestic affiliate if it has an ultimate parent company that owns at least 50 percent of its shares and is located in the same country, and all the other affiliates of its parent company are located in the same country.

Results

Annex Table 2.8.1 summarizes the main estimation results. Column (1) reports the baseline result based on equation (A2.8.1), which includes firm-level non-tax determinants of investment and firm fixed effects and year fixed effects. Column (2) adds country-level macroeconomic characteristics. Columns (3) through (5) check the robustness of the results by subsequently adding country-year fixed effects (3), industry-year fixed effects (4), and country-industry fixed effects (5). Column (6) further interacts the variable of interest (*MNC* and *TPR*) with the statutory tax rate in the host country to capture the extent of the increase in the cost of capital following the introduction of TPRs.

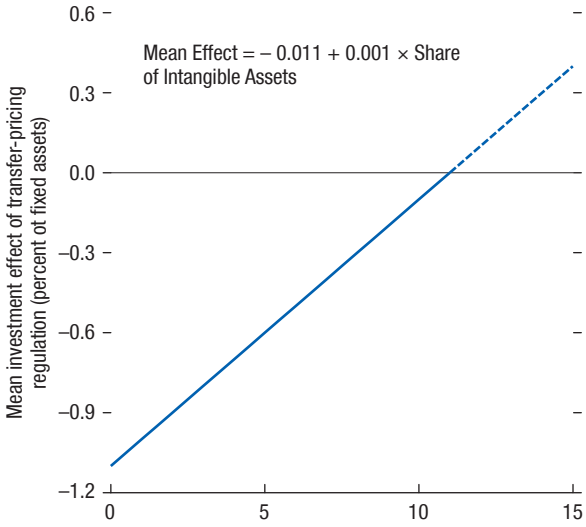
On average, introduction of transfer-pricing regulations would decrease investment as a percentage of fixed assets among multinational affiliates by 1–3 percentage points. Given that multinational affiliates invest about

Annex Table 2.8.2. Transfer-Pricing Regulations and Investments in the Case of Complex Multinational Companies

Dependent Variable: Investment per Dollar of Fixed Assets	Number of Companies (1)	Number of Countries (2)
$MNC_{it} \times TPR_{Kt}$	–0.005	–0.006
	(0.009)	(0.008)
$MNC_{it} \times TPR_{Kt} \times MNC_{Complex,it}$	–0.016*	–0.017**
	(0.008)	(0.008)
Number of Observations	605,908	605,908
R^2	0.273	0.273
Firm Fixed Effects	Y	Y
Year Fixed Effects	Y	Y
Country-Year Fixed Effects	Y	Y
Industry-Year Fixed Effects	Y	Y
Country-Industry Fixed Effects	Y	Y

Source: IMF staff calculations.
Note: Standard errors are in parentheses and are clustered by country and industry. MNC = multinational company; TPF = transfer-pricing regulation.
*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

Annex Figure 2.8.2. Estimated Effect of Transfer-Pricing Regulations on Investment, Taking into Account Intangible Assets



Source: De Mooij and Liu, forthcoming.

30 cents per dollar of their fixed assets, this implies a reduction of 3–5 percent in multinational investment in response to the introduction of TPRs. The negative impact of TPRs on investment is mainly concentrated in large, more complex multinationals (Annex Table 2.8.2) and is smaller for multinationals with a higher share of intangible assets, which facilitates profit shifting via royalty payment (Annex Figure 2.8.2). Overall the findings suggest that TPRs have a moderate effect on multinational investment; this should be taken into account when evaluating the overall impact of antiavoidance provisions on tax revenues and national welfare.

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