The Missing Middle Managers: Labor Costs, Firm Structure, and Development*†

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Abstract

This paper shows that large, multi-establishment business enterprises face a high cost of middle management in poor countries and that this cost inhibits the growth of the modern sector. We provide new empirical evidence using a database covering compensation for 300,000 middle managers working at modern firms in 146 countries. We estimate that the elasticity of real management costs with respect to real GDP per worker is 0.1. We quantify the importance of this finding using a calibrated appropriate technology model where firms choose whether to adopt the management-intensive modern business structure. Lower management costs in developing countries would increase the revenue share of the modern sector by 10–20 percentage points.

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1 Introduction

A key characteristic of modern economic growth is the systematic transformation of the organization of production (Kuznets, 1973). In developing countries, it is organized along traditional lines: the majority of workers are self-employed or employed in small, slow-growing single-establishment firms whose owners also manage the enterprise on a day-to-day basis.[1] By contrast, most workers in developed countries are employed in modern business enterprises: large, multi-establishment firms with a separation of ownership and management.

This shift in firm organization requires the formation of a class of professional, salaried managers who set strategy, allocate resources, and monitor and coordinate production (Chandler, 1977). In this paper, we document that the real cost of middle management for modern firms varies little with development, which implies that its relative cost is much higher in developing countries. We establish that this high relative cost deters the adoption and spread of modern business enterprises. We also provide new suggestive evidence as to why management is expensive in developing countries.

We start with the data. An important challenge is that modern business enterprises are uncommon in developing countries, which makes it difficult to obtain data on these firms and their costs. Yet doing so is important to the extent that modern firms face different labor costs, for example if they hire higher-quality managers or pay efficiency wages.[2] Our approach is to use a proprietary database collected and maintained by a global compensation consulting company (the "Company"). The Company specializes in informing large, modern businesses operating in developing and emerging economies – including many prominent multinational firms – how their salaries and compensation packages compare to the typical rate in the local labor market. The Company measures the typical rate using data on what past clients pay similar workers. Its database is a cumulative record of actual compensation by modern firms to over 300,000 workers. The database covers mostly middle managers in 146 countries worldwide.

[1] See Gollin (2008) on the prevalence of self-employment, Bento & Restuccia (2017), Poschke (2018), and Bento & Restuccia (2021) for facts about firm and establishment size, and Hsieh & Klenow (2014) for facts about establishment growth, all relative to development.

[2] Bloom *et al.* (2014) show that management quality is lower in poor countries among domestic firms but not among establishments of foreign multinational firms.

The database has two features that make it particularly useful for comparing the cost of management across countries. First, the Company devotes substantial labor resources to standardizing jobs across firms and countries to a common, detailed scheme so that it can provide clients with "apples-to-apples" comparisons of pay. Second, some clients hire the Company to benchmark pay for establishments in multiple countries in the same year. We can use these clients' data to estimate cross-country variation in pay within a fixed firm and job.

Our main empirical finding is that the real cost of middle management varies little with development. The elasticity of the average compensation of middle managers in the Company's database with respect to GDP per worker, both adjusted to 2017 international dollars, is just 0.16.[3] Controlling for standardized job fixed effects or firm-job-year interactions cuts this estimate in half. We explore the heterogeneity of our results by firm type and worker skill level. We validate these findings using alternative data sources that cover the market for managers among modern firms in developing countries. We compare these compensation figures to earnings of managers in nationally representative data sets.

Our next step is to establish that the high cost of management deters the adoption and spread of modern business enterprises. Here, our paper intersects with a large literature that proposes explanations for the relationship between firm size and development, including financial frictions, differences in sectoral composition, or access to reliable electricity (Buera *et al.* , 2011; Buera & Kaboski, 2012; Fried & Lagakos, forthcoming). We propose an additional, complementary factor, which is the high relative cost of management. We conduct a quantitative evaluation of a model of endogenous firm structure to isolate the importance of this factor.

The model builds on an appropriate technology adoption framework (Basu & Weil, 1998; Acemoglu & Zilibotti, 2001; Caselli & Coleman, 2006). Inspired by Chandler (1977), we model the relevant technology choice as the organization of the firm and the scale of production. Under the traditional structure the owner manages the firm, which limits its size to a single, small establishment. Alternatively, firms can choose the modern structure, in which case they can grow to have

[3] Brinatti *et al.* (2022) document a similarly low pay elasticity for workers engaging in freelance work on a popular website. This finding is also related to work on the large firm wage premium or the foreign firm wage premium, although we are the first to show that it holds even within-firm across-country. See Oi & Idson (1999) for a review of early work and Alfaro-Urena *et al.* (2021) for more recent findings.

a large establishment or multiple establishments and benefit from economies of scale.[4] However, modern firms need middle managers to monitor and coordinate production. The share and size of modern firms depends on the cost of middle management as well as the relative productivity of the two technologies and other factors proposed in the literature, which we capture in a generic wedge.

We calibrate the model and use it to assess how much high management costs inhibit the modern sector in developing countries. An important target for the calibration is the effect of log relative management costs on log aggregate compensation of managers relative to non-managers. We estimate this elasticity using cross-country data on employment shares from the International Labour Organization and management costs from the Company database. The ordinary least squares (OLS) estimate is roughly -0.5. This estimate suffers from an endogeneity bias, but the sign of the bias is unclear in our context. We use the extent of hiring by non-profit firms in the Company database – a group that we otherwise exclude throughout the paper – as a plausibly exogenous shifter of management costs in developing countries to explore further. The elasticity of management costs among for-profits with respect to the number of non-profit competitors in the same local labor market is a precisely estimated 0.08.[5] Our instrumental variable (IV) estimate is roughly -1, suggesting that the OLS may underestimate the elasticity

We combine both the OLS and IV estimates of this target with other, more standard parameters to quantify the importance of the relative cost of management. Specifically, we show that if developing countries faced the same relative cost as developed countries, the revenue share of the modern sector would rise by 10 percentage points under the OLS estimate of the elasticity of 20 percentage points under the IV estimate. Aggregate output would rise by 25 percent in either case. A decomposition following Basu & Fernald (2002) shows that the output gains stem primarily from reallocating labor from the traditional to the modern sector. Our calibration procedure implies a wedge to the adoption of the modern firm structure in developing countries; reallocating labor in the face of this wedge has

[4]We focus on economies of scale, but there are other important aspects of firm structure. Becker & Murphy (1992) emphasize specialization, while Garicano & Rossi-Hansberg (2006b) and Garicano & Rossi-Hansberg (2006a) emphasize the organization of the firm into a management hierarchy as a way to economize on knowledge.

[5]This finding is related to previous work that shows that non-profits pay higher wages and attract skilled workers from the local government (Godfrey *et al.* , 2002; Deserranno *et al.* , 2020). We provide evidence that it also affects the private sector.

a first-order effect on output as in Baqaee & Farhi (2020).

Finally, we examine why management is relatively expensive in developing countries. We consider two broad theories and provide evidence for each. First, modern firms may hire high-quality workers, who are likely scarce given the low education quality and emigration of skilled workers (brain drain). Second, labor market frictions and poor contract enforcement may imply that firms need or find it optimal to pay high wages or efficiency wages to attract workers and ensure that their incentives are aligned with those of distant ownership.

Our work is most closely tied to the new literature demonstrating the importance of management (Bloom *et al.* , 2014). Our findings on relative costs help rationalize why firms choose low-quality management, including the widespread use of family members as managers, instead of hiring professional management (Bloom *et al.* , 2013). The quantitative results are related to recent work that uses quasi-experimental evidence to show that management and firm structure respond to distance and labor supply within a country (Gumpert *et al.* , 2022; Feng & Valero, 2020). Finally, we provide some suggestive results on why managers are scarce in developing countries that connects with existing work on their education and high-skill labor markets (Bloom *et al.* , 2013; Guner *et al.* , 2018; Esfahani, 2022).

We also contribute to the literature on appropriate technology adoption. Whereas most recent work emphasizes the importance of the skill intensity of technology, our emphasis on firm structure is more in the spirit of Stewart (1977). We show that this has the potential to generate large quantitative results because the relative cost of middle management varies much more across countries than does the relative cost of capital or educated labor. Finally, our work relates to the literature on cross-country differences in human capital (Caselli, 2005; Hendricks & Schoellman, 2018). Rather than focusing on conventional measures such as years of schooling, we show that there is a high cost for a particular set of skills that is an important complement to the productive technologies and economies of scale that modern production makes possible.

2 Data

Our empirical analysis makes use of a proprietary database collected and maintained by a global compensation consulting company (the "Company"). Compen-

sation consultants provide clients with information on how the compensation of their employees compares with that of similar workers in the local labor market. Relative to its competitors, the Company's niche is compensation in developing and emerging markets.

As we discuss further below, the typical client for the Company is a modern, multi-establishment organization. Clients that hire the Company thus begin by selecting which establishment or establishments will participate in the market comparison. For each establishment, human resources personnel report the positions that are present and the average compensation by position.

The Company's central business proposition is to return to the client select moments of the distribution of compensation for each position in the local market. For these figures to be meaningful, it is essential that the Company provide "apples-to-apples" comparisons. To this end, the Company does not take the position titles reported by the client at face value. Instead, it employs professional jobs analysts who conduct interviews to learn about the tasks, responsibilities, and skills associated with each position. They use this information to translate each position into their own internal, globally standardized job classification scheme. This step ensures that workers the Company analysts deem "accountants" in any firm or country perform similar tasks and have similar responsibilities and so makes the compensation comparisons meaningful. This work is invaluable for our purposes because it means that the data on compensation for the same job across countries is much more comparable than that produced by the standard method, which involves economists or national accountants applying crosswalks to data that include workers' self-reported occupations.

The Company's database only records the harmonized job title, not the original title provided by the client. However, we have access to select reports the Company has provided to clients for establishments in developing countries that list both the original position title and the standardized job title. These reports indicate that Company analysts systematically downgrade job titles in developing countries. For example, the client may have a position that it calls senior accountant, but after interviews the Company analysts would deem it to be equivalent only to accountant or junior accountant by global standards.

After providing the market comparison to the client, the Company adds the client's data to its database for future use. Thus, the Company's definition of mar-

ket compensation is based on the compensation actually paid by previous clients in the same labor market; the market compensation data provided to future clients in the same labor market will be based in part on the current client's pay. The Company defines a labor market at the city level. However, there are only data for one city per country (generally the capital city, sometimes the business hub if that is different) and so we use country and city interchangeably. The Company's standardized job classification scheme includes more than 200 titles and includes both a horizontal and vertical dimension (accounting versus human resources; junior accountant versus senior accountant).

We have access to the database as of late 2015, which in turn reflects compensation reported by clients spanning the years 2000–2015. Each observation reports the firm name, city/country, year, standardized job classification, the average compensation of workers in the position in the establishment, and in many cases also the total number of such workers. All observations pertain to local workers; expatriates are reserved to a separate database, which unfortunately we cannot access.

While there is no other information in the database, we use the firm name to merge on the firm's industry, profit/non-profit status, and headquarters location. For our analysis of the trends in compensation, we restrict attention to for-profit firms and exclude charities and governmental organizations. The remaining firms come from a wide variety of sectors, including banking, consulting, health care, mining and other natural resources, technology, telecommunications, and transport. We have data on pay for more than 300,000 workers from 1,219 firms in 146 countries.

Table 1 provides statistics on how our sample is distributed across countries and firms. For Panel A we aggregate the sample to the country level and merge on GDP per worker, measured in 2017 international dollars from World Bank (2022). This panel shows that we cover a wide range of the income distribution, with a 90-10 ratio of more than a factor of 16. It also shows that the database covers hundreds or thousands of workers in most countries.

For Panel B we aggregate the sample to the (parent) firm level. We have 1,219 firms in the database. The first row shows that the majority of firms contribute observations for a single country. However, about twenty percent of firms appear in the database for multiple countries. The top ten percent of firms appear in three or more countries; the top firm contributes observations for 81 different countries.

TABLE 1: SAMPLE DISTRIBUTION

	Percentiles				
	10th	25th	50th	75th	90th
Panel A: Countries (146)					
GDP p.w., 2017 intl $	4,774	12,231	28,742	51,014	79,499
Workers	280	921	1,504	2,762	4,146
Panel B: Firms (1,219)					
Countries	1	1	1	1	3
Unique Jobs	9	13	18	31	45
Workers	12	24	62	145	375

Table shows the distribution of the sample when aggregated to the level of the country or firm. Percentiles are computed separately for each moment, so the country with the median GDP per worker is different from that with median number of workers. All statistics refer to the final sample of 172,582 country-year-firm-job observations representing 316,452 total workers after imposing sample restrictions discussed in the text.

The remaining rows show that the median firm contributes 18 different jobs and provides data on pay for 62 workers.

We emphasize again that these firms are not representative employers in their labor markets. Indeed, given the prevalence of small, traditional firms in poor countries, a representative sample of firms would be of little use in characterizing the cost of management for modern firms. Instead, our sample consists almost entirely of modern business enterprises. The firms that hire the Company tend to be large, multi-establishment firms; three-fourths of our earnings observations come from foreign affiliates of multinational firms. The multinational firms are based primarily in North America (predominantly the United States), followed by Africa and Europe. Many firms in the database are large, well-known, publicly listed companies. To this point, the publicly listed U.S. firms in the database account for 32 percent of all revenue and 44 percent of all R&D investment in Compustat North America.

The database consists primarily of workers in middle management roles, with some associated support workers (cleaners, guards, and the like).[6] There are few

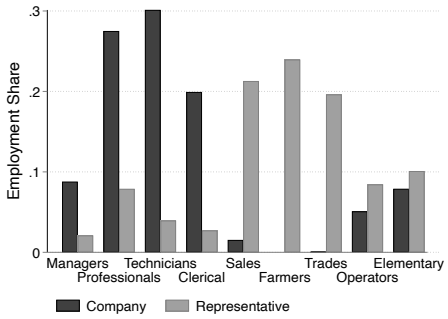
[6]We conjecture that this selection represents the firms and establishments with the greatest demand for the Company's services: foreign-owned firms who are uncertain about the market for specialized, uncommon, highly compensated workers.

production workers. To help visualize the occupational distribution in our database, we construct a crosswalk to match every job in the Company database to the closest 1-digit International Standard Classification of Occupation, 2008 (ISCO-08) occupation group. We then compute the distribution of employment across these ten bins in the Company database among countries with GDP per worker less than or equal to Bolivia (roughly $18,500 in 2017 international dollars).

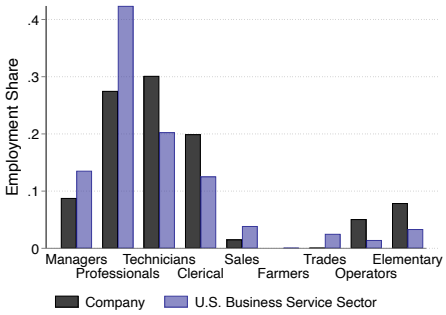
We compare this distribution to one constructed from nationally representative data sets for countries below the same GDP per worker threshold. Details of the data sets are available in Appendix A.1. Figure 1a shows that the two distributions are quite different. Representative data show that the typical worker in developing countries is engaged in sales, farming, trades work, or elementary occupations. By contrast, the workers in developing countries in the Company's database are focused in management, as well as the business subsets of professional, technical, and clerical occupations.

FIGURE 1: OCCUPATIONAL DISTRIBUTION OF COMPANY DATA (DEVELOPING COUNTRIES)

(a) Representative Data, Developing Countries



(b) U.S. Business Service Sector



This occupational distribution is quite similar to the one that prevails among workers employed in the business service sector in the United States, as shown in Figure 1b. The high degree of similarity leads us to infer that the establishments in the Company's database are primarily local headquarters that coordinate production, sales, or marketing for large firms from the country's capital city or business hub. We have verified that many firms also have production or sales establishments in the same country, but these establishments are not in the database.

The database reports gross and net compensation for all positions in three categories: base wage, bonus, and other income. Our preferred measure of compensation is total gross pay, which is the sum of gross wage, gross bonus, and other gross income. All amounts are reported to us in contemporaneous U.S. dollars; original data were either reported in U.S. dollars or were converted to dollars using market exchange rates. We make several adjustments to make sure that these amounts can be averaged and compared across countries and years, which is complicated by the fact that some emerging markets grow rapidly and hence experience rapid wage increases.

Our approach is to first convert all earnings back into local currency units using contemporaneous market exchange rates. We then adjust all amounts to year 2017 local currency units by adjusting for the average rate of nominal wage growth between year t and year 2017, inferred from the growth rate of nominal GDP per worker. This adjustment makes salaries comparable over time by assuming that each occupation would have experienced the aggregate average wage growth; it misses any occupation-specific wage growth. Finally, we convert year 2017 wages in local currency units to year 2017 international dollars using the PPP exchange rate.[7] We trim the bottom and top 0.5 percent of the real earnings distribution, which eliminates some outliers that look to be the result of miscoding. Our next goal is to study how the real compensation of middle managers varies across countries.

3 Empirical Results

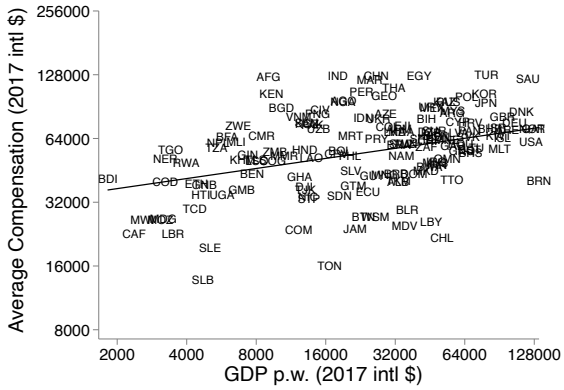
Now that we understand the nature of the database, we use it to address our main question of interest: how does the cost of middle management for modern firms vary with development? We estimate regressions of the form

$$\log(w_{c,t,f,j}) = \gamma + \eta \log(y_c) + \beta X_{c,t,f,j} + \varepsilon_{c,t,f,j}, \tag{1}$$

where $w_{c,t,f,j}$ is the total real gross compensation for workers in country c and year t working for firm f in standardized job j, y_c is the GDP per worker in country c,

[7] All data for the adjustments from World Bank (2022). PPP exchange rate inferred from the ratio of GDP per capita reported in local currency units and international dollars in year 2017.

FIGURE 2: MIDDLE MANAGER COMPENSATION AND DEVELOPMENT



and X is a vector of controls. The main parameter of interest is η, the elasticity of real compensation with respect to GDP per worker.

This compensation elasticity captures how much the the cost of middle management for modern firms varies with development. Two simple benchmarks can help build intuition. The first is a standard neoclassical growth model with homogeneous labor. A representative firm in each country takes input costs as given and produces output using a Cobb-Douglas production function with country-specific total factor productivity. In this model, compensation per employee is the labor share times GDP per worker, which implies that the compensation elasticity is one. The second benchmark is a simple application of the law of one price with heterogeneous labor. If a given type of worker earns the same compensation in all countries, then the compensation elasticity is zero.

Table 2 shows the results from estimating equation (1). Recall that each observation in our database includes the number of workers and average compensation per country-year-firm-job; we weight the regression by the number of workers and report robust standard errors. Column (1) shows the simplest specification, which includes no controls at all. In this case, the estimated elasticity is 0.16. Figure 2 plots average real compensation by country against GDP per worker. The estimated trend line shows that real compensation is more than $32,000 per year even in the poorest countries.

The remaining columns include controls to adjust for time effects as well as possible cross-country differences in the mix of jobs in the Company database. In

column (2) and (3) we add job and year fixed effects and then job-year interactions. Including these controls cuts the estimated compensation elasticity to 0.11. In columns (4) and (5) we add the identity of the firm as a control, either as a fixed effect (column (4)) or interacted with year and job (column (5)). Doing so reduces the estimated compensation elasticity further, to 0.08–0.09. These results help alleviate any residual concern about the comparability of jobs.

TABLE 2: ESTIMATED COMPENSATION ELASTICITY W.R.T. GDP PER WORKER

	(1)	(2)	(3)	(4)	(5)
Log GDP p.w.	0.158***	0.114***	0.113***	0.0883***	0.0848***
	(0.0384)	(0.00735)	(0.00657)	(0.00461)	(0.00418)
Fixed Effects	None	Year + Job	Year × Job	Year + Job + Firm	Year × Job × Firm
R-squared	0.021	0.718	0.727	0.842	0.853
N	160,681	160,656	160,455	160,653	85,062

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

We investigate the heterogeneity of this result along two dimensions. First, we consider whether it differs much between foreign affiliates of multinational firms and domestic establishments, inferred from whether an establishment is in the same country as the firm's headquarters. The results are shown in Table 3. We cannot include firm fixed effects when investigating domestic establishments, so we control for job-year interactions as in column 3 of Table 2. The first column repeats those results for comparison.

TABLE 3: ESTIMATED COMPENSATION ELASTICITY BY ESTABLISHMENT TYPE

	All	By Firm Type	
		Foreign	Domestic
Log GDP p.w.	0.113***	0.111***	0.110***
	(0.00657)	(0.00631)	(0.0142)
Fixed Effects	Year × Job	Year × Job	Year × Job
R-squared	0.727	0.732	0.727
N	160,455	126,039	34,161

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The remaining two columns show the results for foreign affiliates and domestic establishments. Note again that the majority of our sample is foreign affiliates (here, 126,039/160,455 $\approx$ 79 percent). However, the estimated compensation elasticity for the two groups is almost identical. This implies that our findings are not particular to affiliates of multinational firms.

We also investigate how our results vary by skill level. Like most compensation consulting firms, the Company's job classification scheme includes a measure of skill that crosses occupation borders, so that some human resource officers and some accountants can be deemed to be at the same skill level. We aggregate skill levels into four broad groups to avoid disclosing the Company's business information. The bottom skill level includes workers who are not in middle management roles. These are cleaners, guards, drivers, and so on. The remaining groups capture different skill levels of middle managers. The low skill level includes workers with clerical jobs, such as secretaries. The medium skill level includes workers with business associate and business professional jobs, such as accountant. The high skill level includes those with upper management role, such as senior executive.

TABLE 4: ESTIMATED ELASTICITY OF COMPENSATION BY SKILL LEVEL

	All	By Skill Level			
		Non-Management	Low	Medium	High
Log GDP p.w.	0.113***	0.205***	0.145***	0.0690***	0.0119*
	(0.00657)	(0.0193)	(0.0126)	(0.00494)	(0.00485)
Fixed Effects	Year × Job	Year × Job	Year × Job	Year × Job	Year × Job
R-squared	0.727	0.364	0.467	0.251	0.165
N	160,455	10,322	71,111	47,090	31,932
Example Job		Driver	Secretary	Accountant	Senior Executive

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4 shows the implied compensation elasticity for these different skill groups, each estimated with job-year interactions (which control for heterogeneity across countries in the mix of jobs within each broad group). The first column again shows that the elasticity in the aggregate is 0.11. Turning to the results by skill level, there is a very clear pattern: the elasticity is lower for workers with higher

skill levels. While the elasticity is 0.21 for the non-management workers, it falls to 0.15 for the least-skilled managers, 0.07 for the medium-skilled managers, and 0.01 – essentially zero – for the high-skilled managers.

The low compensation elasticity for middle managers – equivalently, higher relative compensation for middle managers in developing countries – is the central empirical finding of our paper. In Sections 4 and 5 we take these relative costs as given and investigate their consequences for the adoption of middle management and modern business enterprises. But first, we validate these findings using alternative sources that focus on modern firms and compare them to findings for the broader economy.

3.1 Validating Middle Manager Compensation

We start by validating the high real cost of management for modern firms in developing countries. Again, the important challenge is to find data that focus on the small modern sector. For this, we turn to data from a complementary data source: recruitment consultancies. Whereas compensation consulting firms provide information on market pay that can be used to help with worker retention, recruiting firms help with vacancy fulfillment. Our specific data comes from Robert Walters, a self-described "global, specialist professional recruitment consultancy."[8] Robert Walters provides recruiting services for many of the same types of positions and in many of the same countries as the Company.

Robert Walters uses its experience in vacancy fulfillment to produce an annual Salary Survey, which lists for select countries/regions and jobs the typical salary range in the current and previous year. The data in the Salary Survey differ from the Company's database in three main ways. First, it is much less detailed. In developing countries it generally aggregates countries into regions (such as East Africa) and focuses on a small set of the most commonly filled jobs. Second, the data reflect Robert Walters' experience placing new workers, including expatriates, rather than payments to all local workers. Finally, it reports salaries exclusive of bonuses and other benefits.

We focus on their data for Africa exclusive of South Africa, which contains most of the poorest countries in the Company's sample. The geographic detail in the

[8] https://www.robertwalters.com/news/about-us.html.

Salary Survey increases over time; we collect data from the 2017 survey, which was the first to decompose Africa into four geographic regions: North Africa, East Africa, West Africa, and Central-South Africa (Robert Walters, 2017). The Salary Survey includes a salary range for 65 roles spread across these four regions. Broadly, the survey supports high salaries. For example, the midpoint of the salary range for a General Manager in Central Africa is $90,000; for a Head of Supply Chain in East Africa, $67,500; for an HR Manager in West Africa, $80,000.

For a more thorough comparison, we match the Robert Walters survey responses to the Company's database. We map regions to countries by using commentary from the last four years of Salary Surveys to infer the set of countries in each region where Robert Walters is active. We merge occupations using several examples showing actual mappings from common job titles to the Company's standardized job scheme in developing countries. We replace the salary range with the midpoint and adjust to 2017 international dollars using the same algorithm that we applied to the Company's database. We compare Robert Walters' salary figures to the gross salary in the Company database (rather than total gross compensation). This procedure allows us to compare gross salary for 12,000 observations in 19 countries in Africa in the Company database to equivalent reports from Robert Walters.

We find that on average the Company compensation is actually 23 percent *lower* than that in Robert Walters. The gap is plausibly accounted for by the fact that Robert Walters includes expatriates in its database. If we aggregate the gap in pay between sources to the country level, it is weakly negatively correlated with development. We interpret these findings as showing that two sources covering the same labor market from different angles agree on the high cost of management for modern firms in developing countries. This cost is the key margin we quantify with our model in Sections 4 and 5.

3.2 Comparisons to Nationally Representative Data Sets

We also set these wages in the context of the broader economy by comparing them to wages found in nationally representative data sets. We focus on the poorest countries (Bangladesh and Bolivia) and the richest country (United States) for which we have nationally representative data sets that also include data on earn-

ings. In each of the three chosen countries we compute weighted mean log earnings for middle managers and non-managers in the nationally representative data sets and the Company database. We divide all earnings for each country by the earnings for non-managers in the representative data.

TABLE 5: LABOR EARNINGS BY OCCUPATION AND SOURCE

	Managers		Non-Managers	
	Company	Representative	Company	Representative
Country				
Bangladesh	15.74	1.68	3.73	1.00
Bolivia	7.81	2.24	2.51	1.00
United States	1.89	1.75	1.26	1.00

Company refers to findings for modern firms in the Company's database described in Section 2. Representative refers to findings for all firms from representative data sources described in Appendix A. All figures are exponentiated mean log earnings relative to non-managers in representative data.

Table 5 shows the relative earnings for each country. There are three main findings. First, the Company database and the nationally representative data sets agree closely on compensation in the United States. Second, compensation is much higher in the Company database than the nationally representative data sets for the developing countries. Third, this gap is much larger for managers than for production workers. Esfahani (2022) also studies the gap in earnings between managers and non-managers using representative data from 76 countries. For this sample the relative earnings of managers declines with development, but by a much more modest amount than the Company data imply: the paper's regression estimates imply that the manager earnings premium would be twice as large in our poorest countries as in our richest.

In the next section we develop a framework for thinking about the adoption and spread of modern business enterprises. In Section 5 we take the model to the data and use it to quantify the importance of management costs. When we do so, we use information on management costs from both the Company and representative data. We have in mind that the Company data are informative about the costs of middle to upper management at local headquarters, but that modern business enterprises may use the cheaper managers observed in representative data in other capacities. For example, they may be useful at production or sales facilities,

perhaps as part of a management hierarchy (Garicano & Rossi-Hansberg, 2006b). They may also be indirectly used by the firm through its input suppliers or the purchasers of its products. Finally, in Section 6 we return to the question of why modern firms face higher costs for workers in general and managers in particular.

4 Model: Appropriate Technology and the Organization of the Firm

This section formulates a model of appropriate technology. Inspired by Chandler (1977), the technology available for adoption is a modern business enterprise organization. When making this choice, firms trade off the benefits of economies of scale against the costs of hiring management to coordinate the high-velocity, high-volume production (Coase, 1937; Becker & Murphy, 1992). This optimal choice depends in part on the cost of management, which is the margin we quantify.

We consider a static model of a country with a continuum of industries that produce differentiated goods. Goods vary exogenously in how suitable they are for modern production, measured as relative productivity when organized along modern versus traditional lines. We first describe the technology adoption problem for firms within a single industry to highlight the essential forces. We then describe the aggregate economy, including the range of industries, the households, and the government.

4.1 Industry model

Each industry is populated by a large number of ex ante identical firms. There is free entry, with each entrant producing the same homogeneous output by choosing one of two firm organization technologies. Below we present a parameterized setup with and derive the resulting firm size and industry production function. In the appendix, we also show that the qualitative findings extend to a much richer setup.

Traditional technology. The traditional technology captures self-employment and small, single-establishment, owner-managed firms. There are no economies of

scale, so the production function is linear,

$$F^T(\ell_p) = z_T \ell_p, \qquad \ell \leq \overline{\ell}_p, \tag{2}$$

with the constraint reflecting that the owner-manager has a limited span of control.

Modern technology. The modern technology features economies of scale in the use of production workers. As a function of the number of production workers, output is

$$y = \kappa z_M \ell_p^{1+\eta}, \tag{3}$$

where $\eta > 0$ regulates the strength of scale economies, and $\kappa \equiv \left(\frac{\gamma-\eta}{\eta}\right)^{\frac{\eta}{\gamma}} + \left(\frac{\gamma-\eta}{\eta}\right)^{\frac{\eta-\gamma}{\gamma}}$ is a constant to facilitate derivations further on. Firms need management to coordinate the production workers, with management requirements growing as a convex function of the number of production workers:

$$\ell_m = \ell_p^{1+\gamma}, \tag{4}$$

where ℓ_m is a bundle of management services. The parameter γ introduces a convexity, reflecting that coordination requirements typically grow more than linearly with the number of workers. For example, the number of bilateral interactions between workers grows with the square of the number of workers, and the number of mappings from workers to distinct tasks grows with the factorial of the number of workers. We restrict $\gamma > \eta$ to ensure that coordination requirements eventually grow faster than scale economies, which leads firms to choose a finite size for all positive wages.

We assume that there is no gain in output from hiring management beyond the managerial requirement or from hiring production workers beyond the managerial capacity. These assumptions imply that equations (3) and (4) can be captured in the production function

$$F^M(\ell_p, \ell_m) = \kappa z_M \min\{\ell_p, \ell_m^{\frac{1}{1+\gamma}}\}^{1+\eta}. \tag{5}$$

Technology selection. To analyze how firms select technologies, it is helpful to express the production functions (2) and (5) in terms of average cost functions.

Let c_p and c_m be the cost of production workers and management services respectively. Consistent with the evidence from Section 3.2, we also allow that modern firms have to pay higher wages to both workers. We model this as a wedge that is equivalent to a proportional $e^\tau - 1$ tax on their input costs. The average cost functions are:

$$c^T(y) = \frac{c_p}{z_T}, \qquad y \leq z_T \overline{\ell}_p, \tag{6}$$

$$c^M(y) = \frac{e^\tau}{z_M \kappa} \left(c_p (y/z_M \kappa)^{-\frac{\eta}{1+\eta}} + c_m (y/z_M \kappa)^{\frac{\gamma-\eta}{1+\eta}} \right). \tag{7}$$

With free entry, firms operate on the bottom of their average cost curves. For the traditional technology, average costs are constant at $c^T \equiv \frac{c_p}{z_T}$. For the modern technology, differentiating average costs yields the output level y^* that minimizes average costs. Substituting this output level into the average cost function yields the attained minimum cost, which is

$$c^M(y^*) = \frac{e^\tau}{z_M} c_p^{1-\alpha} c_m^\alpha, \quad \alpha \equiv \frac{\eta}{\gamma}.$$

The parameter α is the managerial compensation share of the modern technology, and our choice of κ implies that constants cancel out from the calculation. Note that the managerial share is simply the ratio of the economies of scale (η) to the convexity of the coordination costs (γ). Our restriction that $\gamma > \eta$ implies that $0 < \alpha < 1$.

Firms adopt the modern technology if the minimum average cost is lower than for the traditional technology:

$$c^M(y^*) \leq \frac{c_p}{z_T} \iff e^\tau \left(\frac{c_m}{c_p} \right)^\alpha \leq \frac{z_M}{z_T}. \tag{8}$$

Intuitively, firms adopt the modern technology when the productivity advantage z_M/z_T dominates the wedge e^τ and the costs disadvantage c_m/c_p coming from hiring a more expensive labor bundle. A high cost of management deters adoption, with the strength of the effect depending on the managerial compensation share α.

Free entry ensures that the industry produces a flexible amount of output at its minimum attainable average cost. In the appendix, we show that this implies that aggregate industry behavior can be described using a representative firm op-

erating a linear production technology if the traditional technology has a lower average costs, and a Cobb-Douglas production function with managerial share α if the modern technology has a lower average cost. This result greatly simplifies subsequent analysis by allowing us to focus on standard functional forms. Unlike most analyses with such production functions, we have a well-defined underlying notion of firm size and the number of firms, both of which jump discontinuously at the boundary between traditional and modern organization.[9]

4.2 Aggregate Economy

The aggregate economy consists of a continuum of industries like the one described in Section 4.1. Firms in all industries face the same input costs c_m, c_p, and τ. However, industries vary in their productivity when organized along modern and traditional lines. Chandler notes that modern business enterprises and middle management were developed as solutions to new problems posed by products where it was possible to use "capital-intensive, energy-consuming, continuous or large-batch production technology to produce for mass markets" (Chandler, 1977, p. 347). For example, cement, steel, or flour are straightforward to organize using continuous or batch production technologies. They were among the first industries to adopt modern production methods in the United States and are organized in this manner essentially everywhere today. By contrast, products that lacked these characteristics – those that were labor-intensive, did not use complex machinery, produced at low volume, or who could sell their products easily through existing wholesalers – remained dominated by small firms. For example, apparel production or plumbing services have largely resisted modern organization so far.

We capture this idea by assuming that there is a continuum of industries indexed by k with the production structure describe above, but with industry-dependent productivities $z_T(k)$ and $z_M(k)$. Productivities are draws from independent Fréchet distributions with scale parameters Z_T and Z_M and a common dispersion parameter θ. With this setup, potential modernization from cheaper management will

[9]Firm size (measured as employment) is given by $\overline{\ell}_p$ for traditional firms, although results do not vary if we assume firm size is 1 (self-employment). The size of modern firms is given by:

$$\left(\frac{c_m}{c_p}\frac{\eta}{\gamma-\eta}\right)^{-\alpha}+\left(\frac{c_m}{c_p}\frac{\eta}{\gamma-\eta}\right)^{-(1-\alpha)}.$$

occur in sectors with an intermediate benefit of large-scale production. We think of these as industries such as retail which currently have a modern enterprise structure in rich countries but not in poor countries.

A final goods producer aggregates the industry output using a constant elasticity of substitution production function with elasticity σ. Note that the price $p(k)$ is taken as given by firms and drops out of the cost-minimization/technology adoption problem. The probability (share) of industries organized through the modern business enterprise is given by

$$\mathbb{P}\left(e^{\tau}\frac{c_p^{1-\alpha}c_m^{\alpha}}{z_M(k)} < \frac{c_p}{z_T(k)}\right) = \frac{[Z_M(c_m/c_p)^{-\alpha}e^{-\tau}]^{\theta}}{Z_T^{\theta} + [Z_M(c_m/c_p)^{-\alpha}e^{-\tau}]^{\theta}}. \tag{9}$$

The development and intuition for our calibration and quantitative results is eased if we use the fact, well-known in the trade literature, that this setup is isomorphic to one with a simple two-sector CES aggregator:

$$Y = \left(Y_T^{\frac{\theta}{\theta+1}} + Y_M^{\frac{\theta}{\theta+1}}\right)^{\frac{\theta+1}{\theta}}, \tag{10}$$

where Y_T and Y_M are total output of traditional and modern firms. These outputs can in turn be represented using stand-in production technologies that resemble the industry production functions derived in Section 4.1:

$$Y_T = F_T(L_{T,p}, L_{T,m}) = \Gamma\left(\frac{\theta+1-\sigma}{\theta}\right)^{\frac{1}{\sigma-1}} Z_T L_{T,p}, \tag{11}$$

$$Y_M = F_M(L_{M,p}, L_{M,m}) = \Gamma\left(\frac{\theta+1-\sigma}{\theta}\right)^{\frac{1}{\sigma-1}} \kappa Z_M L_{M,p}^{1-\alpha} L_{M,m}^{\alpha}, \tag{12}$$

We use L to distinguish aggregate labor used by the entire traditional or modern sectors; Γ is the gamma function (see the appendix for a formal demonstration). Standard CES results imply that the prices of the two industries satisfy

$$P_T = \frac{c_p}{\Gamma\left(\frac{\theta+1-\sigma}{\theta}\right)^{\frac{1}{\sigma-1}} Z_T} \tag{13}$$

$$P_M = e^{\tau}\frac{c_p^{1-\alpha}c_m^{\alpha}}{\Gamma\left(\frac{\theta+1-\sigma}{\theta}\right)^{\frac{1}{\sigma-1}} Z_M}, \tag{14}$$

where e^{τ} represents the wedge on modern sector output.

Our emphasis is on the importance of distortions, the relative productivity of the modern technology, and the relative cost of management in explaining firms' technology adoption decisions. Nonetheless, it is useful for us to close the model. We do so by including a representative household that supplies labor to the two sectors and uses its income to finance consumption of the sectoral output. The relative labor supply of the household is determined by a general function

$$\frac{L_m}{L_p} = G\left(\frac{c_m}{c_p}, \zeta\right). \tag{15}$$

where ζ is a non-wage labor supply shifter.

Empirically, countries with high relative wages for management also have low relative employment of managers. We use ζ to rationalize why this is the case. For example, we provide evidence in Section 6 that a lack of education quantity and quality in many developing countries reduces the relative supply of managerial labor by limiting the set of workers with the necessary literacy skills. In our experiments in Section 5, we explore how many firms would re-organize as a modern business enterprise for different relative costs of management. Underlying these experiments we have in mind as a primitive shifts in ζ such that, when passed through the function G, relative supply and relative demand are equated at the posited relative wage. We do not specify either G or the magnitude of the shift in ζ.

The other ingredient needed to close the model is the representative household's budget constraint,

$$PC \leq c_p L_p + c_m L_m + T. \tag{16}$$

where T is a lump-sum rebate of the tax on modern firms τ. This constraint ensures that all the distortions are rebated appropriately when the size of the modern sector is changed in equilibrium.

We now have all the necessary ingredients to define an equilibrium, which is a set of prices $\{c_p, c_m, P, P_T, P_M\}$ and quantities $\{L_p, L_m, C, Y, Y_T, Y_M\}$ such that they solve the household problem, Y satisfies (10), Y_T, Y_M satisfy (11) and (12),

P_T, P_M satisfy (13)-(14), transfers satisfy

$$T = (1 - e^{-\tau}) P_M Y_M,$$

and labor markets clear

$$L_m + L_{T,p} + L_{M,p} \leq 1$$

5 Quantifying the Importance of Management Costs

The previous section presents an appropriate technology adoption model in which the relevant technology is the organization of the firm. Choosing to organize a modern business enterprise allows firms to enjoy economies of scale, but requires them to hire managers to coordinate the resulting high volume of production. Our goal in this section is to calibrate the model and to use it to quantify the importance of the relative cost of management for explaining cross-country variation in the size of the modern sector.

5.1 Calibration Strategy

Our calibration strategy and quantitative exercises can be understood by referring to equation (9), repeated here for reference:

$$\mathbb{P}\left(e^{\tau} \frac{c_p^{1-\alpha} c_m^{\alpha}}{z_M(k)} < \frac{c_p}{z_T(k)} \right) = \frac{[Z_M (c_m/c_p)^{-\alpha} e^{-\tau}]^{\theta}}{Z_T^{\theta} + [Z_M (c_m/c_p)^{-\alpha} e^{-\tau}]^{\theta}}.$$

We assume that the parameters α and θ are common across countries. We also assume that all countries have access to the same world technology frontier, which implies that Z_M/Z_T does not vary across countries. Cross-country variation in the share of industries that organize as modern business enterprises is explained by two country-specific terms: the relative cost of management c_m/c_p and distortions to organizing as a modern firm τ.

Our goal is to isolate the importance of the relative cost of management. To do so, we need to measure the relative cost of management and the size of the modern sector for a large number of countries and estimate or calibrate the key

model parameters. We can then use the model to evaluate the effect of the observed variation in the relative cost of management on the size of the modern sector while holding the other factors constant.

We start with measuring the relative cost of management. Our key building block is the Company database, which provides new data on the cost of middle management for leading firms. We focus on workers in management roles and residualize log compensation by job-year interactions. Positive residualized compensation for an observation means that the workers are expensive in the sense that they are paid above the global average for workers in the same job. Positive average residualized compensation for a country means that its managers as a whole are expensive.

As noted in Section 3.2, the compensation figures in the Company database diverge from those for managers in representative data sources, particularly for developing countries. We allow for the possibility that modern firms hire both types of managers. The Company database covers managers in the local headquarters, but representative data may cover managers who work at the related production or sales facilities, or for the suppliers or purchasers of modern firms. We assume a Cobb-Douglas aggregator of the two types of managers, with weight ϕ on the managers in local headquarters. Building on the evidence in Section 3.2, we assume that the remaining managers are paid twice what production workers are. Finally, we set the wages of production workers at two-thirds GDP per worker so that aggregate labor payments align with the labor share of compensation.[10]

We next measure the size of the modern sector. Our approach here is to reformulate equation (9) in terms of the compensation share of middle managers, which we denote by s_m, rather than the share of modern firms. This reformulation is useful because data on the employment share and earnings of middle managers are widely available, whereas data on a representative sample of firms with useful proxies of whether firms are modern are not. Specifically, we measure the employment share of middle managers using data from the International Labour Organization on the employment share by 2-digit industry for nearly 100 countries. We count as middle managers the workers who are employed in man-

[10]With this formulation, the model has three types of labor. Appendix B shows how the labor supply formulation (15) with two labor types can be used for equilibrium determination even with two types of managers.

agerial, business professional, and business associate roles; see Appendix A.1 for details. Middle managers account for about 5 percent of employment in the poorest countries, whereas they account for around 25 percent in the United States or the United Kingdom and as much as 33 percent in Luxembourg. For relative earnings we again use that managers are paid twice what production workers are paid.

This reformulation is possible because the model provides a tight link between the size of the modern sector and the compensation share of managers. Using that relationship, and substituting in the assumptions that $c^m = (w^{company})^{\phi}(2w_p)^{1-\phi}$ and $c^p = w_p = 0.67y$, we arrive at an equation that we can take to the data,

$$\log\left(\frac{s_m/\alpha}{1-s_m/\alpha}\right) = -\tau - \theta\tau - \theta\phi\log\left(\frac{w^{company}}{y}\right) + \theta\log\frac{\widetilde{Z_M}}{Z_T}, \tag{17}$$

where $\log\frac{\widetilde{Z_M}}{Z_T} = \log\frac{Z_M}{Z_T} - (1-\phi)\log 2$ is productivity adjusted by a constant. We calibrate the value of α by assuming that the economy of Luxembourg is entirely modernized, which yields $\alpha = 0.5$. Then the importance of the relative cost of management depends on two parameters, ϕ and θ. The parameter ϕ is the weight on middle managers in local headquarters in the production and cost of managerial services; higher values of ϕ put more emphasis on the high costs of management in the Company database. The parameter θ controls the dispersion of productivity, with higher values of θ mapping to less dispersion. Intuitively, larger values of θ imply that a given change in relative wages induces firms in more industries to switch how they are organized because productivity differences between organizational structures are smaller.

Building on this discussion, if $\phi\theta$ is sufficiently large – if productivity is not too dispersed and the types of managers observed in the Company database play an important role in overall managerial services for modern firms – then the observed differences in costs can explain all of the cross-country variation in the size of the modern sector. On the other hand, if $\phi\theta$ is small, then the observed differences in costs explain little and we are left to infer an important role for other factors, which here are captured by the wedge τ. Given the central role that $\phi\theta$ plays in our analysis, we adopt a two-part calibration strategy. In Section 5.2, we use cross-country data to estimate how the aggregate relative compensation of middle managers responds to management costs, which yields an estimate of $\phi\theta$. We do not attempt

to disentangle the two parameters because doing is not important for our results. In Section 5.3 we calibrate the other, more standard parameters.

5.2 The Effect of Management Cost on Modern Firm Adoption

The challenge to estimating the parameter combination $\phi\theta$ can be understood by noting that equation (17) is a relative labor demand curve. It links relative employment of middle managers to their relative cost as well as to an unobserved demand shifter, τ. If we were willing to abstract from τ, or to assume that it was an i.i.d. error term, then we could estimate $\phi\theta$ consistently via OLS. This approach essentially assumes that all variation in relative costs are due to shifts in relative labor supply, which then traces out the relative labor demand curve.

We start by showing the results from an OLS estimation in Table 6. Column (1) estimates the equation exactly as written. In this case we find an economically and statistically significant coefficient of the expected sign. Countries with a higher relative cost of management (cost of managers in the Company database relative to GDP per worker) also have a smaller modern sector. In column (2) we use the logarithmic form of equation (17) to enter cost of management and GDP per worker separately. In this case we find an economically and statistically significant coefficient of the expected sign for each term. Countries with a higher cost of production workers (or simply more developed countries) have larger modern sectors, while countries with a higher cost of management have smaller modern sectors. Theory dictates that the coefficients should be of equal magnitude and opposite sign; instead, the effect of management costs is a little more than half as strong as the effect of GDP per worker.

As noted above, these estimates capture the coefficient of interest $\phi\theta$ only under the strong condition that τ is an i.i.d. error term. If instead shifts in labor supply and labor demand both play a role in the determination of observed wages and the size of the modern sector, then the OLS estimates suffer from endogeneity bias. Theory does not give clear direction on the sign of the bias.[11] Instead, we use an instrumental variable strategy to provide evidence on its sign and magnitude.

[11] If we view τ as an omitted variable, then the standard formula for omitted variable bias tells us that the sign of the bias depends on the product of two terms. The first is the direct effect of τ on the size of the modern sector, which is unambiguously negative. The second is the coefficient that would be obtained from regression τ on $\log(c_m)$ controlling for $\log(y)$, which is ambiguous.

TABLE 6: DETERMINANTS OF SIZE OF MODERN SECTOR: OLS ESTIMATES

	(1)	(2)
Log(Cost/GDP p.w.)	-0.903***	
	(0.0752)	
Log(Cost)		-0.555*
		(0.217)
Log(GDP p.w.)		0.914***
		(0.0747)
R-squared	0.629	0.641
N	87	87

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Our instrument uses information from the Company database that we have discarded to this point, which is the hiring activities of non-profit organizations. We restrict attention to for-profit firms when studying patterns of compensation because economic theory suggests that the pay these firms offer should be linked to the marginal product of labor; that mechanism is plausibly weaker for organizations that lack a profit motive. However, about two-thirds of the observations in the Company's database are from non-profit organizations. These observations include foreign outposts of national governments, such as embassies; regional and international governmental organizations; and charities.

Non-profit organizations represent a substantial source of competition for middle managers in developing and emerging economies. To start, we construct for each for-profit firm f, country c, and job j the number of multinational non-profits who hire in the same local labor market (c, j). We include non-profits who hire in the relevant labor market in any year because most clients only hire the Company to benchmark their locations sporadically and so only appear in select years, even though they likely operate continuously. We find that 91 percent of our for-profit observations face a non-profit competitor in the same labor market. The median firm-country-job faces 9 such competitors, the 75th percentile firm-country-job faces 19, and the maximum is more than 100 non-profit competitors. While the Company database is not an exhaustive record of non-profit activity in these labor markets, these figures suggest that we may capture enough of the relevant firms to

proxy for the overall non-profit activity.

Non-profit competition also affects the cost of management for for-profit firms. Table 7 shows the results from regressing log compensation among for-profit firms $\log(w_{c,t,f,j})$ on various measures of the extent of competition they face from non-profits in (c, j). In columns (1) and (2) we measure competition based on the number of non-profits. The distribution of competitors is highly skewed, so in column (1) we regress compensation on the $\log(1 + \text{competitors})$. The elasticity is economically large and statistically significant. In column (2) we instead break observations into quartiles based on the number of competitors that they face. Compensation is notably higher for firms facing an above-median degree of competition. In columns (3) and (4) we repeat the same specifications, but now weighting each competitor by the number of countries where it operates. This approach emphasizes competition from the largest and most globally active non-profits. The overall results are similar.

TABLE 7: FIRST-STAGE ESTIMATES: MANAGEMENT COSTS AND NON-PROFITS

	Competitors		Competitor Locations	
	(1)	(2)	(3)	(4)
Log(Competition)	0.0768***		0.0226***	
	(0.0185)		(0.00547)	
Quartile 2		0.0479		0.0206
		(0.0380)		(0.0399)
Quartile 3		0.188***		0.147***
		(0.0401)		(0.0419)
Quartile 4		0.214***		0.172**
		(0.0587)		(0.0551)
Log(GDP p.w.)	0.130***	0.137***	0.104**	0.116***
	(0.0317)	(0.0335)	(0.0307)	(0.0324)
R-squared	0.043	0.050	0.031	0.044
N	90,342	90,342	90,342	90,342

Standard errors clustered at the country level in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

In Appendix A.2 we provide additional results to help understand the relationship between non-profit competition and compensation paid by for-profit firms.

We obtain similar results if we aggregate to the country level and study only cross-country variation. The average number of competitors faced by for-profit firms ranges from 2.5 to 40 across countries. This variation is again tightly related to the average costs faced by for-profit firms. Countries that are small and remote are particularly likely to have few non-profits and low managerial costs for for-profit firms.

At the same time, not all the identifying variation comes across countries. We also estimate specifications similar to those in Table 7 but controlling for country fixed effects rather than GDP per worker. The effect of competition in these specifications is identified entirely off of within-country, cross-job variation in the degree of competition from non-profits. We find smaller but still economically and statistically significant effects.

These results show that non-profit competition is an important shifter of the managerial costs faced by for-profit firms. For them to be a valid instrument for those costs, the exclusion restriction also needs to hold. In words, this requires that the number of non-profits in a local labor market only affects the employment share of middle managers through its effect on management costs. Intuitively, this is plausible because the objectives of non-profits are very different from those of for-profit firms: governmental organizations fulfill political objectives, while charities fulfill charitable goals. These goals affect where the organizations choose to locate and what types of workers they need to hire. They are not obviously related to the demand among for-profit firms for modern versus traditional business organizations.

One way to demonstrate the divergent goals of for-profit and non-profit organizations is to show that there is large variation in the share of hiring done by each across countries and jobs. For example, the majority of organizations operating in Equatorial Guinea, Kazakhstan, or Bahrain are for-profit firms, while more than 85 percent of organizations operating in Afghanistan, the Republic of the Congo, or Niger are non-profits. For jobs, we find that the majority of engineers, supply chain workers, and upper-level managers are hired by for-profit firms, while non-profits hire more clerical workers and project/program specialists.

If non-profits are a plausibly exogenous source of variation in labor demand in local labor markets, then we can use their hiring patterns as an instrument for the compensation of managers when estimating $\phi\theta$. We have constructed Table

7 so that it captures exactly the corresponding first-stage regression results. Table 8 shows the results from the second stage, with the column numbers matched between Tables 7 and 8. Taken as a whole, the four specifications reveal very similar results. The estimated $\phi\theta$ lies in a narrow range between roughly 1.0 and 1.2. In each case the coefficient is economically significant. Notably, it is also roughly equal and opposite the effect of GDP per worker, consistent with the restriction suggested by theory.

TABLE 8: DETERMINANTS OF SIZE OF MODERN SECTOR: IV ESTIMATES

	(1)	(2)	(3)	(4)
Log(Cost)	-1.037*	-1.125*	-1.178**	-1.126*
	(0.488)	(0.497)	(0.438)	(0.495)
Log(GDP p.w.)	0.978***	0.986***	0.991***	0.986***
	(0.0909)	(0.0915)	(0.0893)	(0.0906)
N	90,342	90,342	90,342	90,342
First-Stage F	17.21	7.84	17.02	6.22

Standard errors clustered at the country level in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Since some of the identifying variation in the first stage comes between jobs within a given country, we run all regressions using the microdata. The left-hand side variable in the second stage only varies at the country level, so we cluster standard errors at the country level. Still, the results are all statistically significant at the 95 percent threshold. Table A.2 shows that if we instead aggregate all variables and run regressions at the country level we get similar and even slightly stronger results. Finally, we note that the first-stage F-statistics suggest that the parsimonious specifications underlying columns (1) and (3) are preferable to those in columns (2) and (4), which would be judged as having weak instruments by the usual criteria.

These results are consistent with the literature that argues that non-profits can generate a form of Dutch disease by raising input costs, particularly labor costs, for the rest of the economy (Godfrey *et al.* , 2002; Deserranno *et al.* , 2020). Indeed, our results are stronger than this: we show that an increase in hiring by the non-profit sector raises wages and actually reduces the overall employment share of managers. We attribute this strong effect to the fact that, unlike for-profit firms,

non-profits do not hire a broader set of managers outside their local headquarters, because they do not have associated production or sales facilities. They also use fewer local suppliers and generally do not sell products to downstream firms.

All of our results are conditional on our definition of a local labor market, which is a country-job. One potential concern is that workers may be fluid across jobs and so this may not be the relevant definition of a labor market. In Table A.3 we explore defining labor markets by including all non-profits who compete at the same horizontal level, who compete in the same vertical group, or who compete anywhere in the same country at all. Broadly similar results obtain.

To summarize, we have explored two estimates of the relationship between relative managerial compensation and relative management costs, which disciplines the key parameter product $\phi\theta$. The OLS estimate implies $\phi\theta = 0.56$. The IV estimates suggest that this may understate the sensitivity of relative management compensation to relative costs. Going forward, we produce results for both $\phi\theta = 0.56$ and $\phi\theta = 1.04$, where the latter is chosen among the IV specifications because it has the strongest first stage.

5.3 Calibration of Remaining Parameters

The rest of our parameters are chosen to fit a mixture of data from national accounts, representative labor force surveys, and Company data given the estimated value for $\phi\theta$ (see Appendix B for the full set of calibration equations). Most of our main results, including the importance of management costs for the size of the modern sector, depend only on the product $\phi\theta$. However, the results on output depend on the parameters separately. For these results we use $\phi = 0.5$ and set θ to be consistent with the product $\phi\theta$; the output effect is approximately proportional to the size of ϕ. Throughout, we assume that α, ϕ, and θ are common across countries. We also assume that countries have access to the same world technology frontier, so that Z_M and Z_T are common to all countries, normalizing $Z_T \equiv 1$ and calibrate Z_M.

We allow three parameters to vary by country: the relative cost of management, the overall productivity level A, and the distortion τ. To ensure that our findings do not reflect any single country, we calibrate to fit the data from a stylized "developed" country that includes data for all countries with PPP GDP per worker above

$100,000 and a stylized "developing" country that includes data for all countries poorer than Bolivia (approximately $18,500). We use bars over variables to denote the developed country and bars below variables to denote the developing country.

We continue to assume that total management costs are a composite of the costs of managers in representative and Company data. Thus, the relative cost of management depends on the relative cost of managers in representative data to production workers and the relative cost of managers in the Company data to production workers. We set the former equal to two in both the developed and developing countries, in line with Table 5. We set $w_m^{company}/w_p = 2$ in the developed country, consistent with the fact that Company data and representative data broadly agree on the cost of management in developed countries. We use the reported average compensation from the Company data relative to two-thirds GDP per worker for the same object in the developing country, which implies a much higher value of twelve. The relative cost of management is a geometric average of these two inputs.

Assuming that that the rich country is undistorted, $\overline{\tau} \equiv 0$, we are left with four parameters to calibrate: Z_M, $\overline{A}$, $\underline{A}$, and $\underline{\tau}$. We choose them to fit average income in the two countries from World Bank (2022) as well as the payroll share of middle managers in the two countries, which is shown in Figure A.1. As before, we use the payroll share of middle managers rather than the share of modern firms because the latter is harder to define systematically across countries.

The calibrated values for key parameters are displayed in Table 9, with the two columns representing the calibration of $\phi\theta$ using the OLS and IV results, respectively. The results from Section 3 are reflected in the high cost of management in developing countries. The adoption wedge $\underline{\tau}$ is 0.4 in developing countries when we use the IV estimate $\phi\theta = 1.04$, implying considerable barriers other than the relative cost of management to the adoption of modern business enterprises. When we use the lower OLS estimate $\phi\theta = 0.56$, the wedge is even larger, $\bar{\tau} = 0.78$, reflecting that a low elasticity makes wages less potent in explaining relative adoption rates.

Note that this calibration has assumed that Z_M / Z_T is constant across countries. The main effect of letting this value be lower in poor countries would be to reduce required differences in the wedge τ, because a low relative productivity in the modern technology would also deter the running of large firms. Provided that

TABLE 9: CALIBRATION TABLE

Parameter	Description	Target	OLS	IV
$\phi\theta$	Adoption elasticity w.r.t costs	See section 5.2	0.56	1.04
ϕ	HQ middle-management share	See text	0.5	
α	Manager share, modern	Management payroll share, Lux.	0.5	
$\bar{w}_m^{company}/\bar{w}_p$	Relative management cost, rich	Company database, WDI	2	
$\underline{w}_m^{company}/\underline{w}_p$	Relative management cost, poor	Company database, WDI	12.1	
$\overline{\tau}$	Technology wedge, developed	Normalization	0	
$\underline{\tau}$	Poor country technology wedge	Equation (17)	0.78	0.4
$\overline{Z}_M/\overline{Z}_T$	Relative productivities	Management employment share	2.07	1.74
$\overline{A}/\underline{A}$	Relative TFP	Real GDP per worker	8.04	8.98

Z_T was similar across countries, a lower Z_M/Z_T would also reduce the need for uniform TFP differences $\bar{A}/\underline{A}$ because a high Z_M would be another source of high output in the rich country.

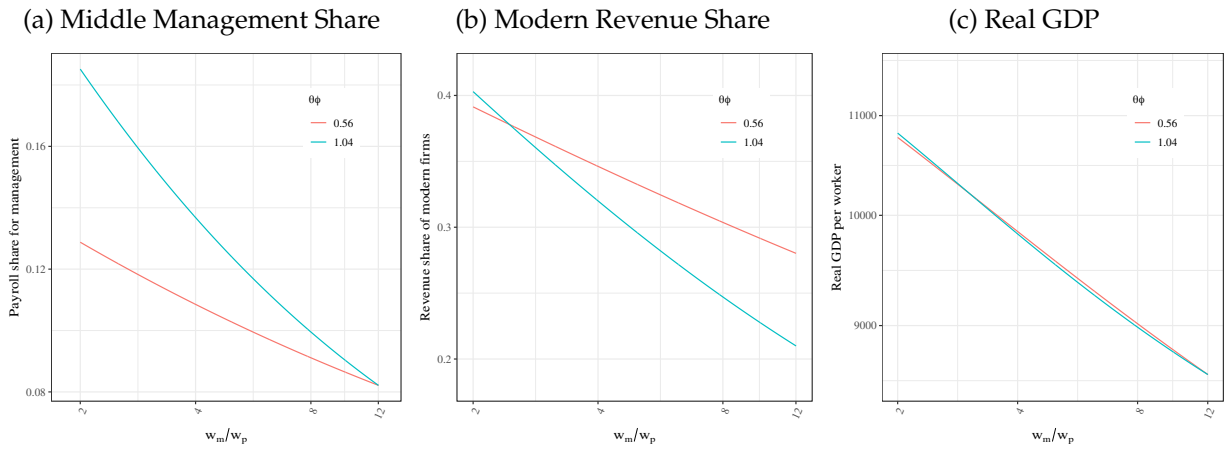
5.4 Quantitative Experiments

Our goal is to isolate the importance of the relative cost of middle management for modern firms in explaining cross-country variation in the size of the modern sector. To do so, we lower the relative wage of managers in the poor country in the model until it is the same as the rich country. Following equation (15), we have in mind changes to ζ that shift relative labor supply and lower the equilibrium relative wage. In the appendix, this approach is formalized, and in Section 6 we return to evidence on distortions and education systems.

Figure 3 shows the effect of changing relative wages on the payroll share of middle managers, the revenue share of the modern sector, and real output in the developing country. Each outcome is plotted against relative wages of managers, with the x-axis ranging from 2.0 (the measured value in the developed country) to 12.0 (the measured value in the developing country).

Figure 3a shows the results for the payroll share of middle managers. Lowering the relative cost to rich country levels increases the payroll share from 8 percent to 12 percent under the OLS estimate, and to 18 percent under the IV estimate. This effect follows directly from the fact that we measure large cross-country differences in relative costs, which we multiply by $\phi\theta = 0.56$. With the higher IV value of $\phi\theta =$

FIGURE 3: COUNTERFACTUAL RESULTS



1.04, the effect of relative costs increases proportionally, consistent with equation (17).

Figure 3b shows the revenue share of the modern sector. A lower relative cost expands the size of the modern sector substantially, from 28 to 39 percent under the OLS estimate, and from 20 to 40 under the IV estimate. Again, the effect is lower when we consider a lower value of $\phi\theta$.[12]

Finally, Figure 3c shows the effects on real output. The result is an increase in output of 25 percent that does not depend strongly on $\phi\theta$. This change closes 8 percent of the output gap to rich countries. The remainder of the output gap is attributed to gaps in total factor productivity and the distortion τ to the adoption of modern technology. When we vary ϕ keeping $\theta\phi$ constant, the output effects vary roughly in proportion. For example, with $\phi = 0.25$, the output increase is 12 percent.

We gain additional insights if we decompose our output results into three underlying channels as in Basu & Fernald (2002).[13] The main source of output increases is reallocation between industries, which reflects that lower manager costs

[12]The higher revenue share for the modern sector when $\theta\phi = 0.56$ reflects that we target the management payroll share in the poorer country. Since a lower $\theta\phi$ implies a higher wedge τ, it leads to a higher ratio of revenues to costs, enlarging the revenue share relative to the payroll share.

[13]See Appendix B.4 for a formal statement of the decomposition and a proof that it holds in our context.

expand the modern sector which has higher average wages, as well as higher markups because of the distortion. Hence, reallocating labor towards this sector raises output.

The importance of between-industry effects explain why the output results are relatively insensitive to $\phi\theta$. Changing $\phi\theta$ has two offsetting effects: a larger response of the modern sector to wage changes, but also a smaller distortion τ required to rationalize observed differences in modern firm penetration. The two effects counteract each other and render the output effect relatively insensitive to the choice of $\phi\theta$. The between-industry effect also explains why output effects rise with ϕ: a high ϕ implies a small θ which increases the required wedge and thus the reallocation gains.

6 Understanding Middle Manager Compensation

So far we have established that the cost of middle management for modern firms varies little with development. This fact implies large variation in the relative cost of middle management, which through the lens of our quantitative model is a significant deterrent to the adoption and expansion of modern business enterprises. We now discuss several candidate explanations for these empirical patterns.

6.1 Quality Differences

Our first hypothesis is that modern firms in developing countries hire higher-quality workers and particularly higher-quality managers than traditional firms. This explanation is particularly powerful if high-quality managers are scarce and therefore expensive. We have two reasons to expect that this is the case. First, secondary- and tertiary-educated workers are generally scarce in developing countries (Barro & Lee, 2013). Adding to this, a limited number of developing countries have participated in internationally standardized achievement tests such as the OECD PISA. The average scores from these developing country participants are much lower than those from developed countries (Hanushek & Woessmann, 2012; Cubas *et al.* , 2016).[14]

[14]See also Schoellman (2012) and Martellini *et al.* (2022) for alternative evidence that education quality in general and college quality in particular is lower in poor countries.

Cross-country test score differences are large but also somewhat abstract. To put them into context, we note that the average secondary school student in many developing countries scores at reading level 1b on PISA assessments. PISA characterizes reading level 1b as "Tasks at this level require the reader to locate a single piece of explicitly stated information in a prominent position in a short, syntactically simple text ..." (OECD, 2014, p. 191). They also provide a sample assessment question for students who read at this level. The question asks students to read Aesop's fable "The Miser and his Gold", which is a one-paragraph story that opens with the sentence, "A miser sold all that he had and bought a lump of gold, which he buried in a hole in the ground by the side of an old wall." Students are asked, "How did the miser get a lump of gold?" (OECD, 2014, p. 212).

We hypothesize that students reading at or below this level are not capable of storing, retrieving, and processing information at the level necessary to act as middle managers in modern business enterprises. We think of this as a shift of the relative labor supply via the parameter ζ. To formalize this idea, we develop novel empirical results utilizing the Longitudinal Surveys of Australian Youth (LSAY). The important feature of this dataset is that it tracks students who take the PISA exams in Australia as late as age 25, allowing us to measure how PISA test scores map into subsequent occupational choices in a fixed country with fixed wages. Details are available in Appendix A.3.

FIGURE 4: TEST SCORES AND OCCUPATIONAL CHOICES

(a) Australian Data (b) Cross-Country Projections

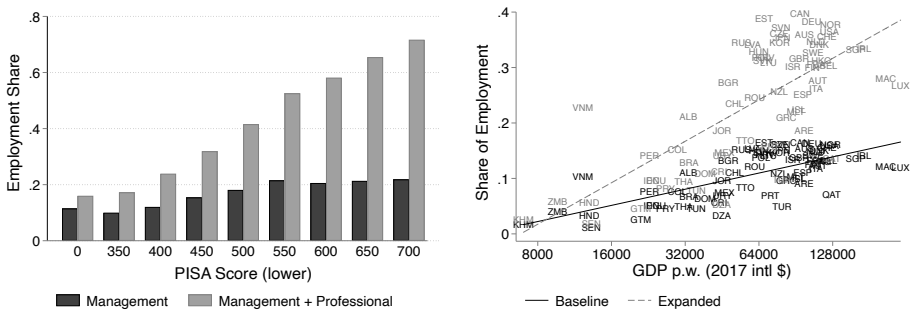


Figure 4a shows the main result from the LSAY, which is the share of workers making various occupational choices by test score bin. The black bars show the

share of workers in each bin who join middle manager occupations, which rises from 10 to 20 percent. While there is a notable trend, this probably understates the importance of test scores for the capacity to be a manager because many high-scoring Australians choose other education-intensive occupations. To make this point, the gray bars show the share choosing manager or professional occupations, which rises from 15 to over 70 percent as a function of test scores.

Essentially all Australians attend school through age 15, when PISA is administered. Further, the average reading score is sufficiently high (503 in the 2018 round) to generate a substantial number of potential and actual managers. The situation in many developing country is very different: most workers do not attend school long enough to even be eligible for PISA and the test scores among those who do so are much lower.

We perform two calculations to show that this likely limits the number of high-quality managers. First, we use the data from Barro & Lee (2013) to compute the share of each country's working age population that has some secondary or more schooling, while assuming that the rest lack the literacy skills necessary to become effective middle managers. Second, we use each country's distribution of PISA reading scores multiplied by the fraction of Australians in each test score bin who become middle managers (black bars) or middle managers and professionals (gray bars). These calculations reflect the number of workers who would become managers if faced with Australian relative wages and the number of workers with the necessary basic skills to be potential managers.

Figure 4b plots the results of each calculation against GDP per worker. Developing countries have a very low manager employment share under either calculation. For example, Cambodia's share of 2–3 percent suggests that it has few workers with the literacy skills to work in a modern business enterprise. To further add to this point, Figure A.3 in the appendix shows the distribution of test scores among the potential managers in the expanded calculation. A large majority of potential managers in the least developed countries score in the lowest test score bin. This finding complements the previous work of Bloom *et al.* (2014), who find that average management quality is strongly correlated with development. These findings could reflect that educational systems fail to provide graduates with the necessary skills to function as high-quality managers. Literacy skills are an important building blocks for language skills, which are important for transferring

knowledge within multinational firms (Guillouet *et al.* , 2022). More generally, an important role for skill is also consistent with growing evidence that management training interventions improve the quality of management and firm profitability (Bloom *et al.* , 2013; Giorcelli, 2019; Bianchi & Giorcelli, 2022).

6.2 Global Labor Market

A second reason to suspect that high-quality managers are scarce in developing countries is that migration plays an important role in these labor markets. Brain drain of skilled workers from developing countries is a well-documented phenomenon (Docquier & Rapoport, 2012). Educated, high-ability workers are particularly likely to emigrate from poor countries (Kerr *et al.* , 2016; Martellini *et al.* , 2022). These flows can exacerbate the shortage of skilled managers. On the other hand, expatriate workers continue to fill a significant share of management roles in developing and emerging markets (Hsieh *et al.* , 1999; Cho, 2018). It is hard to rationalize their continued utilization (given the cost) without appealing to a shortage of the relevant skills in these economies.

Migration offers a particularly appealing explanation for why the real cost of high-skilled managers does not vary at all across countries (Table 4); if such workers find it sufficiently easy to migrate, then we would expect a law of one price to hold, at least approximately. On the other hand, it would require a striking coincidence to generate the same result through offsetting supply and demand shifts for countries across a wide range of development.

6.3 Segmented Labor Markets

While the scarcity of high-quality management likely explains part of our wage findings, it is unlikely to explain all of them. Perhaps the clearest indicator that further exploration is needed is the high wages modern firms pay to their non-managers – the cleaners, guards, and drivers that work at the local headquarters. There are existing theories that explain why complementarities might lead modern firms to hire the best cleaners, guards, or drivers (Porzio, 2017). Nonetheless, it is hard to imagine that modern firms hire such workers whose marginal product is 2–3 times that of the typical non-manager in the economy. This finding leads us to consider theories where modern firms pay otherwise identical workers higher

wages, which maps into the parameter τ in the model. We label these theories of segmented labor markets because segmentation is needed to rationalize why workers do not move in response to wage differentials.

There are a number of potential theories for why labor markets might be segmented. First, a growing literature shows the importance of labor market frictions in poor countries. For example, workers appear to churn among jobs more frequently and are less likely to reallocate across sectors or regions in the face of large gaps in wages or productivity (Donovan *et al.* , 2020; Lagakos, 2020). These same frictions may hinder workers from moving to high-wage, modern firms. Abebe *et al.* (2021) show that it is harder to attract productive workers because those workers have a higher opportunity cost of applying for jobs, which is consistent with the presence of recruitment consultancies in developing countries.

Second, modern firms may find it optimal to pay (higher) efficiency wages in poor countries. Contracting is generally more difficult in such economies given the poorly functioning legal systems and courts (Acemoglu *et al.* , 2005; Boehm & Oberfield, 2020). Further, modern business enterprises rely on advantages conveyed by superior technologies or stocks of intangible capital. Workers and particularly middle managers at the local headquarters may have access to sensitive business information. Providing insufficient incentives could thus be very costly.

Existing work shows that firms do respond by limiting how much decision making they decentralize in poor countries or relying more on family members in management roles (Bloom *et al.* , 2012; Akcigit *et al.* , 2021; Bloom & Van Reenen, 2007; Bloom *et al.* , 2013). Efficiency wages would provide a natural mechanism in cases where sensitive information and decision-making cannot be centralized. Finally, specialized workers who cannot emigrate face a thin labor market. Given this, employers might find it optimal to increase pay to replace the motivation usually supplied by outside career options.

Third, in related work, Hjort *et al.* (2020) use the same database we use in this paper to show that wages in a firm's headquarters have a direct, causal effect on wages for the same jobs in the firm's foreign affiliates.[15] They show evidence that this is because many employers use firm-wide wage-setting procedures, which helps rationalize in particular the high wages for workers in low-skill occupations

[15]The sample analyzed in Hjort *et al.* (2020) includes public sector employers, but only multinational employers.

in foreign establishments (see also Goldschmidt & Schmeider, 2017; Derenoncourt *et al.* , 2021). Alfaro-Urena *et al.* (2021) also show that multinational firms pay a premium in Costa Rica; the premium is larger there for less skilled workers. We also find a particularly low elasticity of compensation within firms (Table 2 , Column 5). However, we note that our results do not appear to be driven particularly by multinational firms (Table 3).

7 Conclusion

This paper consists of three main exercises. First, we use the proprietary database of a compensation consulting company to document that the real cost of middle management for modern firms varies little or not at all with development, implying very high relative costs of middle management in poor countries. Second, we quantify the importance of the high relative cost of management for the adoption of modern business enterprises in a model of technology adoption. We find that giving modern firms in developing countries the same relative cost of management as rich ones would increase the revenue share of modern share of modern firms by 10–20 percentage points and increase aggregate output by 25 percent. Third, we provide preliminary evidence on why relative wages vary systematically with development, including new evidence on the supply of workers with the requisite literacy skills to attain those positions.

Our finding of high skill prices in developing countries contrasts with much of the existing literature, which has focused on educational wage premia and has found that they are relatively similar in developing and developed countries. Our results show that at least one alternative measure of the skill premium – the wage premium for middle managers at leader firms – is much higher in poor countries than in rich countries. Thus, apart from showing that some skill prices in poor countries are sufficiently high to constrain development, our results raise the question of whether other detailed measures of wages paid by occupation or type of firm might reveal similar informative trends.

Looking ahead, we hope that our work can inspire more research into the nature of skilled labor markets in poor countries. Many open questions remain. Why are educational wage premia disconnected from management prices? To what extent do high management prices reflect scarcity of skills or labor market frictions?

If the high prices reflect scarcity, what prevents people from reaping very high returns by acquiring the right skills? If the high prices reflect labor market frictions, what is the nature of these frictions? These questions require a coherent model, and while we have many building blocks – educational quality, brain drain, segmented labor markets, efficiency wages – their synthesis into a full model remains work for the future.

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Online Only Appendices

A Data Details

This appendix provides further details on data sources and empirical results.

A.1 Representative Data Sources

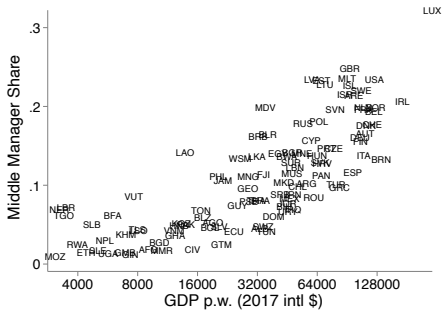
The Company's database covers a very particular population of jobs and firms – middle managers at modern business enterprises. It is not well-suited for studying typical firms or their workers in developing countries because those firms do not engage the Company's services and so do not appear in the Company's database. We assemble nationally representative datasets to study employment patterns and compensation among such firms for context.

Most of our results draw on the ILOSTAT database produced by the International Labour Organization. They tabulate a number of results from household surveys, labor force surveys, and censuses for countries around the world. The most useful tabulation for our purposes is the number of workers employed by ISCO-08 2-digit occupation category.[16] We aggregate workers into middle managers and non-middle managers using the definition in Table A.4, omitting a few countries with missing values for the codes of interest. Figure A.1 plots the employment share of middle managers against GDP per worker for all available countries. The poorest countries have an employment share of middle managers of less than 10 percent. Richer countries generally have employment shares around 20 percent, while Luxembourg is a clear outlier with a roughly 33 percent employment share.

In Figure 1 we compare the distribution of employment in the Company's database to two relevant benchmarks. Representative data come from the same ILOSTAT tabulation, except that we aggregate occupation codes to the 1-digit level. The data for the U.S. business service sector draws on the 2000 U.S. Census. We obtain census microdata from Ruggles *et al.* (2021). We focus on employed 16–70 year olds with non-zero weights and valid responses to key questions. We limit

[16] Available as "Employment by sex and occupation - ISCO level 2 (thousands) | Annual", ILO code "EMP_TEMP_SEX_OC2_NB_A", downloaded from https://www.ilo.org/ilostat-files/Documents/Excel/INDICATOR/EMP_TEMP_SEX_OC2_NB_A_EN.xlsx on March 1, 2022.

FIGURE A.1: MIDDLE MANAGEMENT SHARE AND DEVELOPMENT



attention to workers in the business service sector, which is defined as the industries: accounting, tax preparation, bookkeeping and payroll services; computer systems design and related services; management, scientific and technical consulting services; scientific research and development services; advertising and related services; management of companies and enterprises; employment services; and business support services. We use a hand-created crosswalk to assign the original SOC occupation codes to ISCO-08 1-digit equivalents. We compute the employment share of workers by 1-digit ISCO occupation using the appropriate weights (perwt).

In Section 3.2, we compare earnings of middle managers and production workers in the Company database to earnings of the same workers in representative data. Published ILO tabulations do not provide average earnings by country and occupation. Instead, we draw on microdata that contain information on earnings and occupation for three countries: Bangladesh, Bolivia, and the United States. We select the first two because they are developing countries with nationally representative surveys that report information on occupation using the ISCO-08 scheme. We use the United States as a natural benchmark.

Our data source for Bangladesh is the 2013 Labour Force and Child Labour Survey, which is a representative sample of 36,242 households in 2013, which we obtained through personal correspondence. Our data source for Bolivia is the 2015–2018 rounds of the quarterly Encuesta Continua de Empleo, a nationally representative rotating panel labor force survey.[17] Our data source for the United States is again the 2000 U.S. Census (Ruggles *et al.* , 2021).

[17] Available online for users who register at `http://anda.ine.gob.bo/index.php/catalog/82`.

In all three countries we focus on employed wage workers who are 16–70 years old. We categorize middle managers using occupational codes. Bangladesh and Bolivia collect data on monthly earnings. We annualize by multiplying this figure by 12. The United States collects data on annual earnings. We convert all figures to 2017 PPP-adjusted international dollars using the same procedure as for the Company data. We compute the weighted mean of log earnings by country and middle manager status, then exponentiate the figure and take the ratio. These figures are reported in Table 5.

A.2 Further Results on Management Cost on Modern Firms

This section includes additional results discussed in Section 5.2. Figure A.2 shows the aggregate relationship between number of competitors and management costs. The former is constructed as the average of $\log(1 + \text{competitors})$ across all observations within a country. The latter is constructed by regressing average management costs for each country on log GDP per worker and using only the residuals. Each point is the 3-digit ISO code of a particular country, while the line shows the best-fit regression line and 95 percent confidence interval.

FIGURE A.2: MANAGEMENT COSTS AND NON-PROFIT COMPETITION

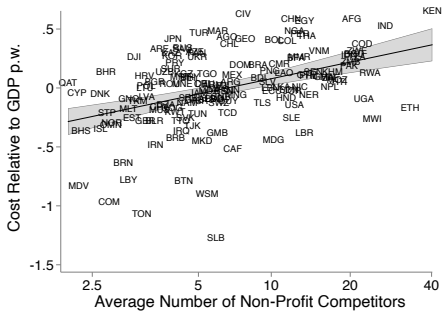


Table A.1 shows the result of estimating the relationship between non-profit competition and residualized compensation of for-profit firms with country fixed effects. Columns (1) and (3) repeat the results for the baseline specifications that use log GDP per worker as a control (columns (1) and (3) of Table 7). Columns (2) and (4) show the corresponding analysis with country fixed effects. Even if we focus on variation in competition across jobs within a country we find a positive and

statistically significant effect of labor market competition on for-profit compensation. The effect is reduced by one-half to two-thirds of the effect in the overall sample.

TABLE A.1: FIRST STAGE ESTIMATES WITH FIXED EFFECTS

	Competitors		Competitor Locations	
	(1)	(2)	(3)	(4)
Log(Competition)	0.0768***	0.0234**	0.0226***	0.0106**
	(0.0185)	(0.00793)	(0.00547)	(0.00346)
Log(GDP p.w.)	0.130***		0.104**	
	(0.0317)		(0.0307)	
Fixed effects		Country		Country
R-squared	0.043	0.296	0.031	0.296
N	90,342	90,342	90,342	90,342

Standard errors clustered at the country level in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Our baseline strategy is to estimate $\phi\theta$ using the full microdata, with standard errors clustered at the country level to account for the fact that the left-hand side variable in the second stage only varies across countries. Table A.2 shows the results if we instead average all variables up to the country level and re-run the same IV specification on aggregate variables. The four columns are exactly the same four columns as in Table 8. The estimated coefficients are actually slightly larger (in absolute value) and are statistically significant.

TABLE A.2: IV ESTIMATES OF MANAGEMENT SHARE: AGGREGATE

	(1)	(2)	(3)	(4)
Log(Cost)	-1.238**	-1.084**	-1.506*	-1.007**
	(0.444)	(0.409)	(0.627)	(0.370)
Log(GDP p.w.)	0.975***	0.961***	0.998***	0.954***
	(0.0846)	(0.0818)	(0.0961)	(0.0797)
N	87	87	87	87
First-Stage F	29.24	11.27	13.94	14.70

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

For our baseline results, we treat the relevant labor market as a country-job. As

described in the text, we have also explored our analysis using other definitions of the relevant labor market. Table A.3 shows the results. The first column repeats the baseline analysis (column 1 of Table 8), where the labor market is defined as a country-job. In the second column we consider the labor market to be a country-job level, which allows for horizontal substitution. In the third column we consider the labor market to be a country-job type, which allows for vertical substitution (for example, across different levels of accountants). Finally, in the fourth column we define the country as the relevant labor market, so that a non-profit hiring any workers at all in the same country is considered to be competing with the for-profits in that country. The results show that our findings are not sensitive to the exact definition of the relevant labor market.

TABLE A.3: IV ESTIMATES OF MANAGEMENT SHARE: LABOR MARKETS

	Specific Job	Job Level	Job Type	Aggregate
Log(Cost)	-1.037*	-0.985	-1.033	-1.022
	(0.488)	(0.615)	(0.620)	(0.634)
Log(GDP p.w.)	0.978***	0.973***	0.977***	0.976***
	(0.0909)	(0.0984)	(0.0974)	(0.0982)
N	90,342	89,850	88,419	90,342
First-Stage F	17.21	20.09	16.91	19.40

Standard errors clustered at the country level in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

A.3 Details on Longitudinal Surveys of Australian Youth

The Longitudinal Surveys of Australian Youth is a long-running research project that tracks the progress of students through school and into the early workforce. It is managed and funded by the Australian Government Department of Education, Skills and Employment, with support from various levels of the Australian government. Since 2003, the initial wave of the survey has been integrated with the Organization for Economic Cooperation and Development (OECD) Programme for International Student Assessment (PISA). Thus, the initial wave contains PISA scores for about 14,000 15-year old students per wave. Respondents are tracked for up to ten years, to age 25, with information on progress through schooling and then entry into the labor market collected over time.

Given the ten-year time horizon for the data, three waves of the survey are completed: the 2003, 2006, and 2009 cohorts (Australian Government Department of Education & Employment, 2020a,b,c). We collect data from all three waves and pool them for our analysis. Each contains similar information in terms of PISA test scores and employment and occupation outcomes at later waves. Pooling helps especially with increasing our sample size for students with low PISA test scores, which is important given low average test scores in developing countries.

We focus on reading test scores since literacy is important for management roles. PISA does not assign each worker a unique score. Instead, it assigns five "plausible values" per subject, which is designed to account for sampling variation in test scores. We implement the preferred approach of repeating the analysis for each potential score and then averaging the outcomes.

Our primary outcome of interest is adult occupation. We use the occupation at age 25 whenever possible. Some young adults lack an occupation because they are not working, do not provide enough occupational detail to permit coding, or have attrited from the survey. To combat this, we iterate backwards from age 25 for those who lack a valid occupation and explore whether they provide one at an earlier age. If they do, we use the latest possible occupation, although we disregard occupations provided before age 21.

We translate occupations into middle manager and professional roles. The LSAY uses the ANZSCO first edition occupation coding scheme, which is a modified but recognizable version of ISCO coding schemes. Table A.5 gives the mapping from this scheme into management occupations. We define professionals as anything in the 1-digit category 2: Professionals.

Our analysis simply computes the share of workers in various test score ranges who make the occupational choices. All analyses are weighting using the provided longitudinal weights that adjust for attrition.

A.4 Occupational Codes for Middle Managers

This appendix provides the occupational codes that are included in middle management in various data sources.

TABLE A.4: CODES FOR MIDDLE MANAGERS: ISCO-08

Codes	Title
11	Chief Executives, Senior Officials and Legislators
12	Administrative and Commercial Managers
13	Production and Specialized Services Managers
14	Hospitality, Retail and Other Services Managers
24	Business and Administration Professionals
33	Business and Administration Associate Professionals

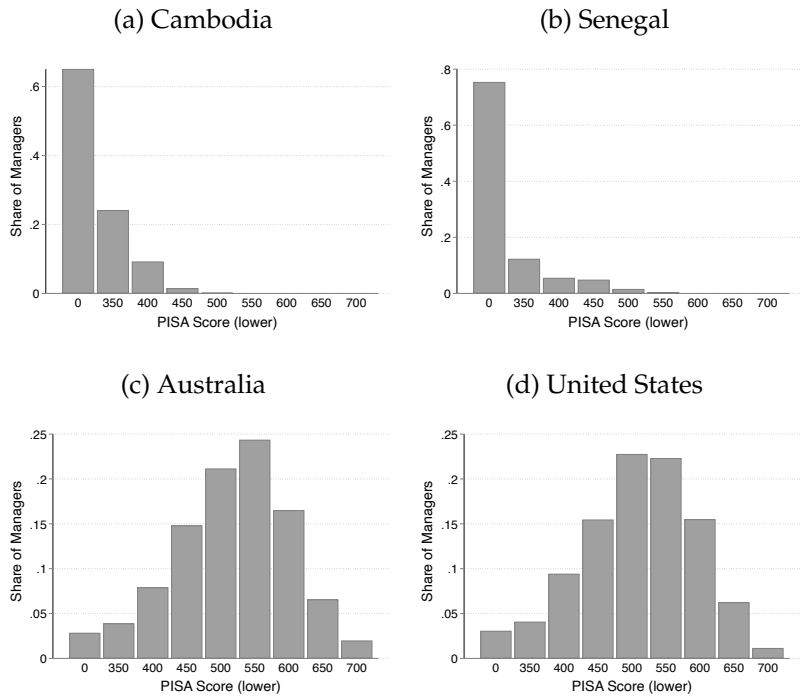
Codes reported at the 2-digit level. All remaining valid codes are considered non-managers.

TABLE A.5: CODES FOR MIDDLE MANAGERS: ANZSCO 1ST ED

Codes	Title
1111–1113	Chief Executives, General Managers and Legislators
1311–1399	Specialist Managers
1411–1499	Hospitality, Retail and Service Managers
2211–2212	Accountants, Auditors and Company Secretaries
2221–2223	Financial Brokers and Dealers, and Investment Advisers
2231–2233	Human Resource and Training Professionals
2244	Intelligence and Policy Analysts
2245	Land Economist and Valuers
2247	Management and Organization Analysts
2249	Other Information and Organization Professionals
2251–2254	Sales, Marketing and Public Relations Professionals
5111	Contract, Program and Project Administrators
5122	Practice Managers
5211	Personal Assistants
5512	Bookkeepers
5522	Credit and Loans Officers
5991	Conveyancers and Legal Executives
5992	Court and Legal Clerks
5995	Inspectors and Regulatory Officials
5996	Insurance Investigators, Loss Adjusters and Risk Surveyors

Codes refer to ANZSCO first edition, used to code occupations of young adults in the LSAY. All remaining valid codes are considered non-managers.

FIGURE A.3: COUNTERFACTUAL DISTRIBUTION OF TEST SCORES



B Theory Appendix

B.1 Generalized comparative statics

Our parametric model is analytically convenient because it allows for a firm-level tradeoff between economies of scale and coordination costs but still aggregates to a standard industry-level Cobb-Douglas production function. Nonetheless, the underlying intuition about how the cost of management affects the incentive to adopt the modern business enterprise is quite general. Here, we show that this finding obtains under much weaker assumptions on technology. Starting from a general set of techniques with the shared features of economies of scale in the use of production workers and decreasing returns to scale in coordination, we show that a higher managerial wage premium causes a decrease in scale within every technique, as well as a switch towards techniques with a smaller degree of scale economies.

Technology specification. Formally, we assume that firms have access to a set of techniques $T = \{1, \ldots, \mathcal{T}\}$, which all use production workers and a management bundle to produce output. Each technique features economies of scale in the use of production workers, summarized by a continuous function f_t mapping output y to the number of production workers ℓ_p^t used per unit of output:

$$\frac{\ell_p^t(y)}{y} = f_t(y),$$

where scale economies are captured by assuming that f_t is weakly decreasing in y. Furthermore, we assume that $t = 1, \ldots, T$ are ordered in terms of an increasing degree of scale economies, where a technology t is said to feature a higher degree of scale economies than t' if its relative use of production workers $f_t(y)/f_{t'}(y)$ is strictly decreasing in y.[18]

All technologies use managers to coordinate production workers, with the required number of managers governed by a common weakly increasing function g:

$$\ell_{m,t} = g[\ell_{p,t}(y)]$$

Apart from being weakly increasing, our only assumptions on g is continuity, and that it grows sufficiently fast so that for each technology, management-per-output $\tilde{g}_t(y) \equiv \frac{\ell_{p,t}(y)}{y}$ is weakly increasing and goes to ∞ as $y \to \infty$ (this ensures that all technologies feature a finite production scale for every managerial wage premium).

Average cost and comparative statics. Normalizing the production worker wage to 1, the average cost function of technology t is

$$\bar{c}_t(y; w) \equiv \frac{\ell_{p,t}(y)}{y} + w_m \frac{\ell_{m,t}(y)}{y} = f_t(y) + c_m \tilde{g}_t(y).$$

We write $y_t^*(c_m)$ for the output level that minimizes the average cost for each technology, $t^*(c_m)$ for the technology that attains the lowest average cost, and $y^*(c_m) \equiv y^*_{t^*(c_m)}$ for the cost-minimizing output level in the resulting technology.

[18] Since the relationship of featuring more scale economies is transitive, it induces a partial ordering on the space of continuous, non-decreasing functions. Assuming strict monotonicity simplifies the proofs.

In a competitive market, the industry operates on the bottom of its average cost curve. Our main finding is that a higher management cost reduces the optimal firm size within every technology, induces firms to switch to a technologies with less scale economies, and reduces the resulting firm size level. We prove the following proposition.

Proposition 1. *The functions $y_t^*(w_m), t^*(w_m)$, and $y^*(w_m)$ are all weakly decreasing in w_m.*

Proof. Available upon request. □

This proposition shows that the effect of expensive management generalizes well beyond the earlier Cobb-Douglas setup. The key is the tradeoff between economies of scale and coordination costs. As long as the average production worker requirement falls with output and the average manager requirement rises, then more expensive management causes a shrinking of production size. The specification of f_t covers a wide range of cases. Examples include production worker requirements exhibiting power decay, $f_t(y) = y^{-\eta_t}$, or exponential decay $f_t(y) = \exp(-\eta_t y)$, with a large η_t corresponding to a higher degree of scale economies.[19]

B.2 Aggregate industry production function

We propose an aggregate industry production function of the form (B.1):

$$F^{ind}(l_p, l_m; z_T, z_M) = \begin{cases} z_T l_p & \text{if } e^{\tilde{\tau}} \frac{c_p^{1-\alpha} c_m^{\alpha}}{z_M} > \frac{c_p}{z_T} \\ \kappa z_M l_p^{1-\alpha} l_m^{\alpha} & \text{if } e^{\tilde{\tau}} \frac{c_p^{1-\alpha} c_m^{\alpha}}{z_M} \leq \frac{c_p}{z_T} \end{cases} \tag{B.1}$$

To prove that this is an aggregate industry production function, we show that it implies the same supply correspondence as the full industry model with free entry, where a supply correspondence is defined as a mapping from a price vector to a

[19]The specification in Section 4.1 is covered by setting $\eta_t = 0$ for the small technology, with a slight modification to accommodate that both technologies should have the same managerial requirements. Formally, we assume managerial requirements is $\tilde{g}(\ell_p) = [(\ell_p - \bar{\ell})^{1+\bar{\eta}}]_+$. This specification ensures that the small-scale firm does not need to use any management (and never operate beyond $\bar{\ell}$). Since $\bar{\ell}$ is small, the resulting managerial requirement for the large firm is close to the original, $g(\ell_p) = \ell_p^{1+\bar{\eta}}$.

set of profit maximizing output-input combinations

$$S : (P, c_m, c_p) \mapsto (\ell_p, \ell_m, y),$$

where (ℓ_p, ℓ_m, y) denotes an input-output combination with production services ℓ_p, management services ℓ_m, and output y.

The supply correspondence of (B.1) is

$$S^{agg}(P, w_p, w_m) = \begin{cases} \emptyset & \text{if } P < \min\left\{\frac{c_p}{z_T}, e^{\tilde{\tau}}\frac{c_p^{1-\alpha}c_m^{\alpha}}{z_M}\right\}, \\ \tilde{S}^{agg}_{P*}(w_p, w_m) & \text{if } P = \min\left\{\frac{c_p}{z_T}, e^{\tilde{\tau}}\frac{c_p^{1-\alpha}c_m^{\alpha}}{z_M}\right\}, \\ \{(\infty, \infty, \infty)\} & \text{if } P > \min\left\{\frac{c_p}{z_T}, e^{\tilde{\tau}}\frac{c_p^{1-\alpha}c_m^{\alpha}}{z_M}\right\}. \end{cases} \tag{B.2}$$

The first and last line reflects that with constant returns to scale, there is no profit maximizing input-output combination when the price is below unit cost, and the profit maximizing combination is unbounded when the price is above unit costs. For the intermediate case, the supply correspondence is

$$\tilde{S}^{agg}_{P*}(c_p, c_m) = \begin{cases} \left\{\left(\frac{y}{z_T}, 0, y\right) : y \geq 0\right\} & \text{if } \frac{c_p}{z_T} < e^{\tilde{\tau}}\frac{c_p^{1-\alpha}c_m^{\alpha}}{z_M} \\ \left\{\left(\frac{y}{Z_M}(1-\alpha)\left(\frac{c_m}{c_p}\right)^{\alpha}, \frac{y}{Z_M}\alpha\left(\frac{c_m}{c_p}\right)^{-(1-\alpha)}, y\right) : y \geq 0\right\} & \text{if } \frac{c_p}{z_T} \geq e^{\tilde{\tau}}\frac{c_p^{1-\alpha}c_m^{\alpha}}{z_M} \end{cases}, \tag{B.3}$$

where the two cases represent the optimal input-output vectors if the traditional versus modern technology is selected. Due to constant returns to scale, all vectors yield the same (zero) profit. The input combinations are y times the unit factor requirement for a given the technology choice and the factor price vector.

To calculate the supply correspondence with multiple firms and free entry, we note that the supply is only non-zero and well defined if the the price equals the minimum point on the average cost curve. If the price is lower, there will be no entry, and if the price is higher, there will be unlimited entry. The minimum of the average cost curve is $\min\left\{\frac{c_p}{z_T}, e^{\tilde{\tau}}\frac{c_p^{1-\alpha}c_m^{\alpha}}{z_M}\right\}$, that is, the same as the unit cost for the proposed industry representative firm. Hence (B.2) also holds for the supply correspondence in the multi-firm case.

For the case when P equals the minimum of the average cost curve, it is clear

that (B.3) holds for the case when the minimum average cost is attained by the traditional technology. Indeed, in this case, free entry ensures that total output is $y = Mz_T\bar{h}$ and total production service input is $M\bar{h}$ where M is the number of entering firms. Neglecting integer constraints on M it is clear that $\left\{\left(\frac{y}{z_T}, 0, y\right) : y \geq 0\right\}$ is the set of profit-maximizing input-output combinations, just as in (B.3).

Finally, when the modern technology is selected, we use that the average cost minimizing output level is

$$y^* = \kappa z_M \left(\frac{c_m/\eta}{c_p/(\gamma-\eta)}\right)^{-\frac{1+\eta}{\gamma}} = \kappa z_M \left(\frac{c_m/\alpha}{c_u/(1-\alpha)}\right)^{-\frac{1+\eta}{\gamma}},$$

which implies

$$\begin{aligned}
\frac{\ell_p^*}{y^*} &= \frac{1}{y^*}\left(\frac{y^*}{\kappa z_m}\right)^{-\frac{1}{1+\gamma}} = \frac{1-\alpha}{z_m}\left(\frac{c_m}{c_p}\right)^{\alpha} \\
\frac{\ell_m^*}{y^*} &= \frac{1}{y^*}\left(\frac{y^*}{\kappa z_M}\right)^{\frac{1+\gamma}{1+\eta}} = \frac{\alpha}{z_M}\left(\frac{c_m}{c_p}\right)^{-(1-\alpha)},
\end{aligned}$$

where we use $\kappa = \alpha^{-\alpha}(1-\alpha)^{1-\alpha}$. Thus, we recover the same supply correspondence as in (B.2).

B.3 Isomorphism to economy with continuum of sectors and Frechét shocks

Proposition 2. *Consider an economy with the same household sector as in the main model, but a production sector with* $Y = \left(\int_0^1 y(k)^{\frac{\sigma-1}{\sigma}} dk\right)^{\frac{\sigma}{\sigma-1}}$*, where* $y(k)$ *is given by* (B.1)*, and* $\frac{z_T(k)}{Z_T}, \frac{z_M(k)}{Z_M} \overset{iid}{\sim}$ *Frechet*(θ)*. The equilibrium in that economy has the same wages, prices, aggregate outputs, sectoral employments and sectoral revenues as the baseline economy.*

Proof. We begin by deriving the equilibrium in the deterministic CES economy. We then show that the equilibrium is the same in the economy with stochastic productivities.

Equilibrium in deterministic CES economy. The expenditure share of the modern technology is

$$\frac{P_M Y_M}{PY} = \left(\frac{P_M}{P}\right)^{-\theta} = \frac{P_M^{-\theta}}{P_T^{-\theta} + P_M^{-\theta}} \equiv \pi \left(\frac{c_m}{c_p}\right). \tag{B.4}$$

Thus, total production and management labor satisfy

$$L_m = \frac{1}{c_m} \times PY \times \alpha e^{-\tau} \pi \tag{B.5}$$

$$L_p = \frac{1}{c_p} \times PY \times \left[1 - \pi + e^{-\tau}\pi(1-\alpha)\right], \tag{B.6}$$

where we use that the cost share of management is α in the modern industry, and that, due to the wedge, total costs in the modern industry are $e^{-\tau}$ times revenue. Relative prices c_m/c_p are obtained by the equation

$$G\left(\frac{c_m}{c_p}, \gamma\right) = \frac{L_m}{L_p} = \left(\frac{c_m}{c_p}\right)^{-1} \frac{\alpha e^{-\tau}\pi}{1 - \pi + \pi e^{-\tau}(1-\alpha)}, \tag{B.7}$$

using that π is only a function of c_m/c_p (with the solution being unique since the left-hand side is monotonically increasing and the right-hand side is monotonically decreasing in c_m/c_p).

With c_m/c_p given, Y is implied by the market clearing condition:

$$L = L_p + L_m \Longleftrightarrow L = Y \times \left[\frac{1 - \pi + e^{-\tau}\pi(1-\alpha))}{c_p/P} + \frac{\alpha e^{-\tau}\pi}{c_m/P}\right], \tag{B.8}$$

where we use that c_p/P and c_m/P only depends on c_m/c_p. With a normalization $c_p = 1$, all other quantities follow.

Equilibrium in the stochastic model. For the stochastic model, we use a tilde $\sim$ to denote the endogenous variables in the stochastic model. We want to show that they coincide with their deterministic counterparts. To do this, we first define the

following two quantities:

$$\tilde{P}_T \equiv \frac{\tilde{c}_p}{Z_p \Gamma\left(\frac{\theta+1-\sigma}{\theta}\right)^{\frac{1}{\sigma-1}}} \tag{B.9}$$

$$\tilde{P}_M \equiv e^{\tau} \frac{\tilde{c}_p^{1-\alpha}\tilde{c}_m^{\alpha}}{Z_M \Gamma\left(\frac{\theta+1-\sigma}{\theta}\right)^{\frac{1}{\sigma-1}}}.. \tag{B.10}$$

The aggregate price level is

$$\begin{aligned}\tilde{P} &= \left[\mathbb{E}\tilde{p}(k)^{1-\sigma}\right]^{\frac{1}{1-\sigma}} \\ &= \Gamma\left(\frac{\theta+1-\sigma}{\theta}\right)^{-\frac{1}{\sigma-1}} \left((c_p/Z_T)^{-\theta} + \left(e^{\tau}c_p^{1-\alpha}c_m^{\alpha}/Z_M\right)^{-\theta}\right)^{-1/\theta} \\ &= \left(\tilde{P}_T^{-\theta} + \tilde{P}_M^{-\theta}\right)^{-1/\theta}. \end{aligned} \tag{B.11}$$

The share of varieties that operate the modern technology is

$$\begin{aligned}\mathbb{P}\left(\frac{e^{\tau}\tilde{c}_p^{1-\alpha}\tilde{c}_m^{\alpha}}{\tilde{z}_m(k)} < \frac{\tilde{c}_p}{\tilde{z}_p(k)}\right) =& \frac{\left(\frac{e^{\tau}\tilde{c}_p^{1-\alpha}\tilde{c}_m^{\alpha}}{Z_M}\right)^{-\theta}}{\left(\frac{\tilde{c}_p}{Z_P}\right)^{-\theta} + \left(\frac{e^{\tau}\tilde{c}_p^{1-\alpha}\tilde{c}_m^{\alpha}}{Z_M}\right)^{-\theta}} \\ =& \frac{\tilde{P}_M^{-\theta}}{\tilde{P}_T^{-\theta} + \tilde{P}_M^{-\theta}} \\ \equiv& \tilde{\pi}(\tilde{c}_m/\tilde{c}_p) \end{aligned} \tag{B.12}$$

where the last step uses that $\tilde{P}_M/\tilde{P}_T$ is only a function of c_m/c_p. Standard extreme value mathematics implies that the share of expenditure equals the probability of a technology being operated. Hence

$$\tilde{c}_m\tilde{L}_m = \tilde{P}\tilde{Y} \times \alpha e^{-\tau}\tilde{\pi} \tag{B.13}$$

$$\tilde{c}_p\tilde{L}_p = \tilde{P}\tilde{Y} \times \left(1 - \tilde{\pi} + e^{-\tau}(1-\alpha)\tilde{\pi}\right), \tag{B.14}$$

where we use that the cost share of management is α in the modern industry, and that the cost share of revenue in the modern industry is only $e^{-\tau}$ due to the wedge.

The relative price $\tilde{c}_m/\tilde{c}_p$ clears the labor market via

$$G\left(\frac{\tilde{c}_m}{\tilde{c}_p}, \gamma\right) = \frac{\tilde{L}_m}{\tilde{L}_p} = \left(\frac{\tilde{c}_m}{\tilde{c}_p}\right)^{-1} \frac{\alpha e^{-\tau}\tilde{\pi}}{1-\tilde{\pi}+\tilde{\pi}e^{-\tau}(1-\alpha)}, \tag{B.15}$$

and $\tilde{Y}$ solves

$$L = \tilde{L}_p + \tilde{L}_m \Longleftrightarrow L = \tilde{Y} \times \left[\frac{1-\tilde{\pi}+e^{-\tau}\tilde{\pi}(1-\alpha))}{\tilde{c}_p/\tilde{P}} + \frac{\alpha e^{-\tau}\tilde{\pi}}{\tilde{c}_m/\tilde{P}}\right], \tag{B.16}$$

Equivalence between CES and stochastic model. Note that for all c_m/c_p, we have $\tilde{\pi}(c_m/c_p) = \pi(c_m/c_p)$, $\tilde{P}/c_m = P/c_m$ and $\tilde{P}/c_p = P/c_p$. Hence equations (B.7)-(B.8) and (B.15)-(B.16) implies the same c_m/c_p and thus the same Y. Hence, the deterministic and the stochastic model have the same prices, allocations across sectors and total output. □

Model solution. The equilibrium is characterized by the equations

$$Y_T = A \times \Gamma \left(\frac{\theta + 1 - \sigma}{\theta} \right)^{\frac{1}{\sigma - 1}} Z_T L_{T,p} \tag{B.17}$$

$$Y_M = A \times \Gamma \left(\frac{\theta + 1 - \sigma}{\theta} \right)^{\frac{1}{\sigma - 1}} \tilde{\kappa} Z_M L_{M,p}^{1-\alpha} L_{M,m,low}^{\alpha(1-\phi)} L_{M,m,high}^{\alpha\phi} \tag{B.18}$$

$$\tilde{\kappa} \equiv (1-\alpha)^{-(1-\alpha)} [\alpha(1-\phi)]^{\alpha(1-\phi)} [\alpha\phi]^{\alpha\phi} \tag{B.19}$$

$$Y = (Y_T^{\frac{\theta}{\theta+1}} + Y_M^{\frac{\theta}{\theta+1}})^{\frac{\theta+1}{\theta}} \tag{B.20}$$

$$P_T = \frac{w_p}{A\Gamma \left(\frac{\theta+1-\sigma}{\theta}\right)^{\frac{1}{\sigma-1}} Z_T} \tag{B.21}$$

$$P_M = e^{\tau} \times \text{Unit cost}_M = e^{\tau} \frac{w_p^{1-\alpha} w_{m,low}^{\alpha(1-\phi)} w_{m,high}^{\alpha\phi}}{A\Gamma \left(\frac{\theta+1-\sigma}{\theta}\right)^{\frac{1}{\sigma-1}} Z_M} \tag{B.22}$$

$$P = \left(P_T^{-\theta} + P_M^{-\theta} \right)^{-\frac{1}{\theta}} \tag{B.23}$$

$$Y_M = Y \left(\frac{P_M}{P} \right)^{-(\theta+1)} \tag{B.24}$$

$$Y_T = Y \left(\frac{P_T}{P} \right)^{-(\theta+1)} \tag{B.25}$$

$$\frac{L_{M,m,low}}{L_{M,p}} = \frac{\alpha(1-\phi)}{1-\alpha} \left(\frac{w_{m,low}}{w_p} \right)^{-1} \tag{B.26}$$

$$\frac{L_{M,m,high}}{L_{M,p}} = \frac{\alpha\phi}{1-\alpha} \left(\frac{w_{m,high}}{w_p} \right)^{-1} \tag{B.27}$$

$$1 = L_{T,p} + L_{M,p} + L_{M,low} + L_{M,m,high}, \tag{B.28}$$

The parameter set is $\{\frac{w_{m,high}}{w_p}, \frac{w_{m,low}}{w_p}, A, \theta, \sigma, Z_T, Z_M, \alpha, \phi\}$ when relative wages are treated as parameters. Shephard's lemma implies that unit labor requirements

satisfy

$$\frac{L_{T,p}}{Y_T} = \frac{1}{A \times \Gamma\left(\frac{\theta+1-\sigma}{\theta}\right)^{\frac{1}{\sigma-1}} Z_T} = \frac{P_T}{w_p} \tag{B.29}$$

$$\frac{L_{M,p}}{Y_M} = \frac{1-\alpha}{w_p} \frac{w_p^{1-\alpha} w_{m,low}^{\alpha(1-\phi)} w_{m,high}^{\alpha\phi}}{A \times \Gamma\left(\frac{\theta+1-\sigma}{\theta}\right)^{\frac{1}{\sigma-1}} Z_M} = e^{-\tau} P_M \frac{1-\alpha}{w_p} \tag{B.30}$$

$$\frac{L_{M,m,low}}{Y_M} = \frac{\phi(1-\alpha)}{w_{m,low}} \frac{w_p^{1-\alpha} w_{m,low}^{\alpha(1-\phi)} w_{m,high}^{\alpha\phi}}{A \times \Gamma\left(\frac{\theta+1-\sigma}{\theta}\right)^{\frac{1}{\sigma-1}} Z_M} = e^{-\tau} P_M \frac{(1-\phi)\alpha}{w_{m,low}} \tag{B.31}$$

$$\frac{L_{M,m,high}}{Y_M} = \frac{\phi\alpha}{w_{m,high}} \frac{w_p^{1-\alpha} w_{m,low}^{\alpha(1-\phi)} w_{m,high}^{\alpha\phi}}{A \times \Gamma\left(\frac{\theta+1-\sigma}{\theta}\right)^{\frac{1}{\sigma-1}} Z_M} = e^{-\tau} P_M \frac{\phi\alpha}{w_{m,high}}. \tag{B.32}$$

Substituting in the unit cost requirements (B.29)-(B.32) and the demand equations (B.24)-(B.25) into the labor market clearing condition (B.28), we obtain

$$\begin{aligned}
1 &= L_{T,p} + L_{M,p} + L_{M,low} + L_{M,m,high} \\
&= PY \left[\left(\frac{P_T}{P}\right)^{-\theta} \frac{L_{T,p}}{P_T Y_T} + \left(\frac{P_M}{P}\right)^{-\theta} \left(\frac{L_{M,p}}{P_M Y_M} + \frac{L_{M,low}}{P_M Y_M} + \frac{L_{M,high}}{P_M Y_M} \right) \right] \\
&= PY \left[\left(\frac{P_T}{P}\right)^{-\theta} \frac{1}{w_p} + \left(\frac{P_M}{P}\right)^{-\theta} e^{-\tau} \left(\frac{1-\alpha}{w_p} + \frac{(1-\phi)\alpha}{w_{m,low}} + \frac{\phi\alpha}{w_{m,high}} \right) \right]
\end{aligned}$$

which implies

$$Y = \frac{P/w_p}{\left(\frac{P_T}{P}\right)^{-\theta} + \left(\frac{P_M}{P}\right)^{-\theta} e^{-\tau} \left(1-\alpha + \left(\frac{w_{m,low}}{w_p}\right)^{-1} (1-\phi)\alpha + \left(\frac{w_{m,high}}{w_p}\right)^{-1} \phi\alpha\right)}$$

where it can be checked that the right-hand side is only a function of parameters. Given Y, we can solve for Y_T, Y_M from (B.24)-(B.25) and for $L_{T,p}, L_{M,p}, L_{M,m,low}, L_{M,m,,high}$ from (B.29)-(B.32). We can also solve for prices P_M, P_T and P up to a normalization with w_p.

Calibration There are a total of 14 parameters: 6 common parameters and 4×2 country-specific parameters. A key calibration quantity is the revenue share of the

modern sector, which in the model is given by

$$\frac{\pi}{1-\pi} \equiv \frac{P_M Y_M}{P_T Y_T} = e^{-\tau\theta} \left(\frac{w_{m,low}}{w_p}\right)^{-\alpha(1-\phi)} \left(\frac{w_{m,high}}{w_p}\right)^{-\alpha\phi}. \tag{B.33}$$

The revenue share of the modern sector is related to the compensation share of management through

$$s_M = \frac{\alpha\pi e^{-\tau}}{1-\pi+\pi e^{-\tau}}, \tag{B.34}$$

which is obtained by noting that the cost share of managment is α in the modern sector, and that modern sectors costs are a share $e^{-\tau}$ of revenue.

For the common parameters, we use the following equations:

Common parameters

$$\begin{aligned}
\theta &= \widehat{\theta\phi}/\phi \\
\phi &= 0.5 \\
\alpha &= \widehat{s_{m,LUX}} \\
\frac{Z_M}{Z_T} &= \left(\frac{\hat{s}_{m,rich}/\alpha}{1-\hat{s}_{m,rich}/\alpha}\right)^{1/\theta} \left(\frac{\widehat{w_{m,low,rich}}}{w_{p,rich}}\right)^{\alpha(1-\phi)} \left(\frac{\widehat{w_{m,high,rich}}}{w_{p,rich}}\right)^{\alpha\phi} \\
Z_T &= 1 \\
\sigma &= 0.5
\end{aligned}$$

where hats denote data or external estimates. The first equation sets θ to the external estimate of $\widehat{\theta\phi}$ divided by ϕ, where we set $\phi = 0.5$ in our baseline calibration. The management share in the modern sector is set to the highest payroll share of managment in the data, which is that of Luxembourg. The equation for Z_M/Z_T assumes that the wedge τ is zero in the rich country,, implying ing $\frac{s_M/\alpha}{1-s_M/\alpha} = \left(\frac{Z_M}{Z_T}\right)^{\theta} \left(\frac{w_{m,low,rich}}{w_{p,rich}}\right)^{-\theta\alpha(1-\phi)} \left(\frac{w_{m,high,rich}}{w_{p,rich}}\right)^{-\theta\alpha\phi}$ from (B.33)-(B.34). The last two equations normalize Z_T to 1 and sets the elasticity of substitution between varieties to $\sigma = 0.5$ (note that σ is irrelevant to our predictions because it only shows up in the normalization $\Gamma\left(\frac{\theta+1-\sigma}{\theta}\right)^{\frac{1}{\sigma-1}}$).

The country-specific parameters are given by:

$$
\begin{aligned}
2 =& \frac{\bar{w}_{m,low}}{\bar{w}_p} = \frac{\underline{w}_{m,low}}{\underline{w}_p} \\
2 =& \frac{\bar{w}_{m,high}}{\bar{w}_p} = \frac{\underline{w}_{m,high}}{\underline{w}_p} = \frac{w_{m,\widehat{high},poor}}{w_{p,poor}} \\
0 =& \bar{\tau} \\
0 =& \log \frac{\hat{s}_{m,rich}/\alpha}{1-\hat{s}_{m,rich}/\alpha} - \underline{\tau}\theta - \alpha\phi\theta \log\left(\frac{w_{m,high,\widehat{poor}}/w_{p,poor}}{w_{m,high,\widehat{rich}}/w_{p,rich}}\right) - \log\left(\frac{\pi(\hat{s}_{m,poor},\underline{\tau})}{1-\pi(\hat{s}_{m,poor},\underline{\tau})}\right) \\
A =& Y \frac{\left[\left(\frac{P_T}{P}\right)^{-\theta} + \left(\frac{P_M}{P}\right)^{-\theta} e^{-\tau}\left(1-\alpha+\left(\frac{w_{m,low}}{w_p}\right)^{-1}(1-\phi)\alpha + \left(\frac{w_{m,high}}{w_p}\right)^{-1}\phi\alpha\right)\right]}{\left(\frac{P/A}{w_p}\right)}
\end{aligned}
$$

The first equation sets the relative price of low-level management and production workers to 2 in all countries. The second equation shows that in the rich country, the price of high-level management is also double that of production workers. In the poor country, the relative price of management comes from the database measure of relative wages. The fourth and fifth equations normalize the wedge to zero in the rich country, and uses that the difference in the (logit) revenue share of the modern sector is given by θ times the wedge, and $\alpha\phi\theta$ times the difference in the relative wages of high level management. Since the data measure gives us the payroll share of management $\hat{s}_{m,poor}$, and since the mapping from s_M to π depends on τ, the wedge in the poor country is defined implicitly as the solution of the fifth equation. The last equation defines A to match final output, using that the right-hand side is a function of parameters alone (note that $\frac{P/A}{w_p}$ does not depend on A).

Supply model motivation for exogenous relative wages. Consider a supply model where the relative number of managers and production workers is

$$
\frac{L_{m,high} + L_{m,low}}{L_p} = G\left(\frac{\overline{w_m}}{w_p}, \gamma\right), \tag{B.35}
$$

where $\overline{\frac{w_m}{w_p}}$ is the relative average wage of managers and production workers.[20] The average wage of managers satisfies

$$\begin{aligned}
\frac{\bar{w}_m}{w_p} &= \frac{w_{m,high}}{w_p}\frac{\phi w_{m,high}^{-1}}{(1-\phi)w_{m,low}^{-1}+\phi w_{m,high}^{-1}} + \frac{w_{m,low}}{w_p}\frac{(1-\phi)w_{m,low}^{-1}}{(1-\phi)w_{m,low}^{-1}+\phi w_{m,high}^{-1}} \\
&= \left[(1-\phi)(w_{m,low}/w_p)^{-1}+\phi(w_{m,high}/w_p)^{-1}\right]^{-1} \\
&= \overline{\frac{w_m}{w_p}}\left(\underbrace{\frac{w_{m,high}}{w_p}}_{+}\right).
\end{aligned}$$

Thus, the supply of managers is an increasing function in the relative price of high-level management.

From the demand side, the relative quantity of managers and production workers satisfy

$$\begin{aligned}
\frac{L_{m,high}+L_{m,low}}{L_p} &= \frac{L_{m,high}+L_{m,low}}{L_{M,p}}\frac{L_{M,p}}{L_p} \\
&= \frac{\alpha}{1-\alpha}\left(\frac{\bar{w}_m}{w_p}\right)^{-1} \times \frac{Y_M P_M e^{-\tau}(1-\alpha)}{Y_T P_T + Y_M P_M e^{-\tau}(1-\alpha)} \\
&= \frac{\alpha}{1-\alpha}\left(\frac{\bar{w}_m}{w_p}\right)^{-1} \times \frac{(P_M/P_T)^{-\theta} e^{-\tau}(1-\alpha)}{1+(P_M/P_T)^{-\theta} e^{-\tau}(1-\alpha)} \\
&= \frac{\alpha}{1-\alpha}\left(\frac{\bar{w}_m}{w_p}\right)^{-1} \times \\
&\quad \left(1-\frac{1}{1+\left(\frac{Z_T}{Z_M}\right)^{\theta}\left(\frac{w_{m,low}}{w_p}\right)^{\theta\alpha(1-\phi)}\left(\frac{w_{m,high}}{w_p}\right)^{\theta\alpha\phi} e^{-\tau\theta}e^{-\tau}(1-\alpha)}\right).
\end{aligned}$$

Thus, the relative demand for managers is monotonically decreasing in $w_{m,high}/w_{m,low}$, ranging from 0 to ∞ whenever $\alpha > 0$. Thus, if γ is sufficiently flexible (e.g. multiplicative, $G\left(\overline{\frac{w_m}{w_p}},\gamma\right) = \gamma g(\bar{w}_m/\bar{w}_p)$), then for each value of $w_{m,high}/w_p$ and set of

[20] Note that this is consistent with the labor supply expression (15), because the management aggregate is a multiple of total number of managment workers and a function of the relative price $\overline{\frac{w_m}{w_p}}$, so that the relative amount of management and production worker aggregate L_m/L_p can be written as (15) with G appropriately modified.

parameters $\{A, \theta, Z_T, Z_M, \alpha, \phi\}$, there exists a γ such that $w_{m,high}/w_p$ is the equilibrium wage. Based on this, we treat the relative wage as a parameter, and interpret the relative wage experiment in terms of shifting γ sufficiently to move the relative wage a certain amount.

B.4 Output Decomposition

In the model, we can decompose output changes into a reallocation between industries and within industries. To state the decomposition, it is helpful to introduce notation that distinguishes between revenue shares, cost shares, and employment shares. For the modern sector, we write $s_M \equiv \frac{P_M Y_M}{PY}$ for its revenue share, $s_M^c \equiv \frac{c_p L_{M,p} + c_m L_{M,m}}{c_p L_p + c_m L_m}$ for its cost share, and $e_M \equiv \frac{L_m}{L_p + L_m}$ for its employment share. Within the modern sector, we write $e_{M,p} \equiv \frac{L_{M,p}}{L}$, $e_{M,m,low} \equiv \frac{L_{M,m,low}}{L}$, and $e_{M,m} \equiv \frac{L_{M,m}}{L}$ for the employment share of production workers, low-level managers, and managers in the total economy, and we write $e_M \equiv e_{M,p} + e_{M,m,low} + e_{M,m}$ for the total employment in the modern sector. Note that the compensation shares are $1 - \alpha$ and α respectively due to the Cobb-Douglas production structure. We can now state the following proposition.

Proposition 3. *Given a change in the supply shifter γ of managers, the change in real output satisfies*

$$d \log \left(\frac{Y}{P} \right) = \Delta_{between} + \Delta_{within} \tag{B.36}$$

where

$$\Delta_{between} = [(s_M - s_M^c) + (s_M^c - e_M)] \times (\theta + 1) \left[-\alpha\phi d \log \left(\frac{w_m}{w_p} \right) \right]$$
$$\Delta_{within} = e_M \alpha\phi(1 - \alpha\phi) \left[\frac{e_{M,m}/e_M}{\alpha\phi} - \frac{1 - e_{M,m}/e_M}{1 - \alpha\phi} \right] d \log \left(\frac{w_m}{w_p} \right)$$

where $d \log \frac{w_m}{w_p}$ is the change in the relative price of management induced by the supply shift.

Proof. Totally differentiating the labor market clearing condition implies

$$0 = e_{T,p} d \log L_{T,p} + e_{M,p} d \log L_{M,p} + e_{M,m,low} d \log L_{M,m,low} + e_{M,m} d \log L_{M,m},$$

where the e's denote employment share and the L's denote labor inputs, with (T,p) denoting production labor in the traditional sector, and (M,p), (M,m,low) and (M,m) denoting production workers, non-local HQ managers, and managers. We note that $e_T = 1 - e_{M,p} - e_{M,m,low} - e_{M,m}$ and $s_T = 1 - s_M$. Given that the change in real income is the share-weighted change in output, we have

$$
\begin{aligned}
& d\log\left(\frac{Y}{P}\right) \\
=& s_T d\log Y_T + s_M d\log Y_m \\
=& s_T d\log L_{T,p} + s_M\left[(1-\alpha)d\log L_{M,p} + \alpha(1-\phi)d\log L_{M,m,low} + \alpha\phi d\log L_{M,m}\right] \\
=& (s_T - e_T)d\log L_{T,p} + [s_M(1-\alpha) - e_{M,p}]d\log L_{M,p} + \\
& [s_M\alpha(1-\phi) - e_{M,m,low}]d\log L_{M,m,low} + [s_M\alpha\phi - e_{M,m}]d\log L_{M,m} \\
=& \left[s_M(1-\alpha) - e_{M,p}\right] d\log\left(\frac{L_{M,p}}{L_{T,p}}\right) + \\
& [s_M\alpha(1-\phi) - e_{M,m,low}]d\log\left(\frac{L_{M,m,low}}{L_{T,p}}\right) + [s_M\alpha\phi - e_{M,m}]d\left(\frac{\log L_{M,m}}{L_{T,p}}\right) \\
=& \left[s_M(1-\alpha\phi) - (e_{M,p} + e_{M,m,low})\right] d\log\left(\frac{L_{M,p}}{L_{T,p}}\right) + [s_M\alpha\phi - e_{M,m}]d\left(\frac{\log L_{M,m}}{L_{T,p}}\right),
\end{aligned}
$$

where the last line uses $d\log\left(\frac{L_{M,m,low}}{L_{T,p}}\right) = d\log\left(\frac{L_{M,p}}{L_{T,p}}\right)$, since $d\log\frac{L_{M,m,low}}{L_{M,p}}$ is fixed due to the relative wage of low-level management and production workers being fixed.

To further simplify the expression, we note that $d\log\left(\frac{L_{M,p}}{L_{T,p}}\right) = d\log\left(\frac{L_{M,p}}{Y_M}\right) + d\log\left(\frac{Y_M}{Y_T}\right)$, since $d\log L_{T,p} = d\log Y_T$. That is, the relative amount of production labor in the modern versus traditional sector is the change in production labor-per-output in the modern sector, plus the relative output of the modern versus the traditional sector. Furthermore, using the Cobb-Douglas production structure in the modern sector, we have

$$
\begin{aligned}
d\log\frac{L_{M,p}}{Y_m} &= (-\alpha\phi)d\log\frac{L_{M,m}}{L_{M,p}}, \\
d\log\frac{L_{M,m}}{Y_M} &= (1-\alpha\phi)d\log\frac{L_{M,m}}{L_{M,p}},
\end{aligned}
$$

where again, we use that $d\log\left(\frac{L_{M,m,low}}{L_p}\right) = 0$ and $d\log\frac{L_{M,m}}{L_{M,t}} = d\log\frac{L_{M,m}}{L_{M,m,low}}$ From

this, we derive

$$
\begin{aligned}
& d\log\left(\frac{Y}{P}\right) \\
=& \left[s_M(1-\alpha\phi)-(e_{M,p}+e_{M,m,low})\right] d\log\left(\frac{L_{M,p}}{L_{T,p}}\right)+\left[s_M\alpha\phi-e_{M,m}\right]d\left(\frac{\log L_{M,m}}{L_{T,p}}\right) \\
=& \left[s_M(1-\alpha\phi)-(e_{M,p}+e_{M,m,low})\right] d\log\left(\frac{L_{M,p}}{Y_M}\right)+\left[s_M\alpha\phi-e_{M,m}\right] d\log\left(\frac{L_{M,m}}{Y_m}\right)+ \\
& (s_M-e_M)d\log\frac{Y_M}{Y_T} \\
=& e_M\phi\alpha(1-\alpha\phi)\left[\frac{e_{M,m}/e_M}{\alpha\phi}-\frac{1-e_{M,m}/e_M}{1-\phi\alpha}\right] d\log\left(\frac{w_m}{w_p}\right)+ \\
& [(s_M-s_M^c)+(s_M^c-e_M)]d\log\frac{Y_M}{Y_T}.
\end{aligned}
$$

Furthermore, modern and traditional output aggregates in a CES with elasticity $\theta+1$, which together with the Cobb-Douglas production function in the modern sector implies

$$
d\log\frac{Y_M}{Y_T}=-(\theta+1)\alpha d\log\frac{w_m}{w_p}, \qquad d\log\frac{L_{M,m}}{L_{M,p}}=-d\log\left(\frac{c_m}{c_p}\right),
$$

and we obtain the final result.

□

For $\Delta_{between}$, the term $(s_M-s_M^c)+(s_M^c-e_M)$ shows that redistributing labor from the traditional to the modern sector improves output through two channels: by redistributing output to a high markup sector (captured by $s_M-s_M^c$), and by redistributing workers to a high wage sector (captured by $s_M^c-e_M$). The modern sector has a higher markup in that its revenue share exceeds its cost share, and high wages in that its cost share exceeds its employment share, so reallocation towards the modern sector raises real output.

On the other hand, Δ_{within} captures the gain from increasing the management intensity in the high wage sector. Since both types of workers are subject to the same markup, the only gain comes from moving workers towards an occupation with higher wages. This effect is captured by managers having a lower employment share $e_{M,m}$ than compensation share $\alpha\phi$, so that $\frac{e_{M,m}/e_M}{\alpha\phi}-\frac{1-e_{M,m}/e_M}{1-\phi\alpha}$ is negative, which means that higher relative wages pushes down its value.

TABLE B.6: DECOMPOSITION OF OUTPUT CHANGES

Term	Value of $\phi\theta$	
	$\phi\theta = 0.56$	$\phi\theta = 1.04$
$\Delta_{\text{efficiency}}$	0.00	0.00
Δ_{between}	0.19	0.19
Δ_{within}	0.039	0.047
$\Delta \log Y$	**0.23**	**0.23**

Also, note that there is no pure efficiency effect from increasing the number of managers. Since we have assumed that labor supply shifters are preference-based, this channel does not operate. We view this as being a conservative choice. A more general model would allow labor supply to change via more hours worked or human capital accumulation, yielding larger output effects.

Decomposition results Table B.6 shows the results of the decomposition. As described above, there is no efficiency effect. Of the two reallocation effects, the between-sector is the more important force in our model. This channel is strengthened by the management wage interacting with the distortion τ to adopting the modern firm structure. As noted by Baqaee & Farhi (2020), the effect of reallocating factors is larger in the face of other wedges, which is captured here through the markup that modern firms charge to cover the distortion τ.[21]

[21]Note that this effect would be weaker if differences in Z_M/Z_T drove adoption differences, because in that case, labor would not be misallocated across sectors initially.

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