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

Jonas Hjort
UCL
& BREAD & CEPR & U. Oslo

Hannes Malmberg
University of Minnesota

Todd Schoellman
Federal Reserve Bank of Minneapolis

Abstract

This paper establishes that the high cost of middle management deters the expansion of the modern sector in developing countries. We use data from compensation and recruitment consulting firms to show that their clients – large, leading domestic and multinational firms – pay $42,000 per year for managers and business professionals even in the poorest countries in the world. Managers and business professionals also account for a large share of total costs in modern firms. We use an appropriate technology model to quantify the importance of these facts for firms' decision to adopt large-scale production with modern technologies. Cost of management has an impact significantly larger than several other factors studied in the literature, including cost of electricity, tariffs on imported intermediates, or cost of external financing.

[*] j.hjort@ucl.ac.uk, pmalmber@umn.edu, todd.schoellman@gmail.com.

[†] We thank Giulio Fella, Pete Klenow, and Francesco Caselli for helpful discussions, and audiences at numerous seminars and conferences for comments that improved the paper. This project was funded by the European Union (ERC, ACCESS, 101043465). Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Council. Neither the European Union nor the granting authority can be held responsible for them. The views expressed are also not necessarily those of the Federal Reserve Bank of Minneapolis or the Federal Reserve System.

1 Introduction

Economic development requires the adoption and widespread use of improved technologies. Many technological breakthroughs derive their productivity advantage from leveraging economies of scale or scope, so that their adoption requires a concurrent reorganization of production away from small, informal enterprises to large, formal ones (Kuznets, 1973). Developing countries display an incomplete transition characterized by a dual economy: co-existence of large, productive modern firms using new technologies and small, unproductive traditional firms or own-account workers who produce using out-of-date technologies.[1] Understanding why the modern sector does not expand and displace the traditional sector is one of the fundamental goals of growth and development research: no country yet has achieved sustained rises in living standards while relying on traditional technologies and small-scale production.

This paper points to a factor not yet studied in the literature – the cost of middle management. We build on the insight of Chandler (1977, 1990) that as firms grow large, they encounter new challenges, such as purchasing and transporting sufficient quantities of inputs, coordinating complex and rapid production, and marketing and selling the resulting output. Successfully meeting these challenges requires that firms hire a hierarchy of salaried managers and business professionals. The main contribution of this paper is to show that modern firms face high costs for these workers in developing countries and that this is a critical barrier to the growth of the modern sector.

We start with the data. A key challenge with studying dual economies empirically is that standard, representative data sets cover both the traditional and modern sectors.[2] We want to isolate the modern sector, which may face different prices or hire different types of workers. For example, Bassi *et al.* (2023) show that managers and laborers in traditional firms in Uganda perform very similar sets of tasks; this is unlikely to be the case for, say, multinational firms. We overcome this challenge by drawing on data from two consulting companies that help large, modern firms navigate labor markets for skilled workers in developing and emerging economies. The first is a compensation consulting firm that advises clients on labor market conditions and pay, for example for retention purposes.

[1] The notion of the dual economy dates to Lewis (1954) and Jorgenson (1961). See Comin & Hobijn (2004) and Comin & Hobijn (2010) for empirical evidence on lags in technology adoption in developing countries, Gollin (2008) on the prevalence of self-employment and Bento & Restuccia (2017), Poschke (2018), and Bento & Restuccia (2021) for facts about firm and establishment size.

[2] See also Buera & Trachter (2024), who investigate co-existence of modern and traditional production in India.

We have access to this firm's database containing records of actual compensation paid by over 1,000 of the firm's clients to over 300,000 workers in 146 countries around the world. The second is a recruitment consulting firm that helps clients find and hire suitable workers. We have access to this firm's published salary survey, which provides less detailed information on the prevailing salaries paid in skilled labor markets based on their market expertise.

The key observation is that firms face high costs for managers and business professionals, even in the poorest countries. The database of the compensation consultant shows that the average annual compensation for managers and business professionals is $42,000 in the poorest decile of countries in the sample, as compared to $80,000 in the richest decile. The salary guide of the recruitment consultant lists similarly high salary ranges: the midpoint of the annual salary range for a General Manager in Central Africa as $101,000; for a General Accountant in East Africa, $35,000; for a Sales & Marketing Manager in West Africa, $79,000 (all figures expressed in 2017 U.S. dollars and not yet adjusted for purchasing power parity).

We use the compensation consultant's database to investigate these results further. We study heterogeneity by skill level. The compensation of the lowest levels of management varies more across countries, whereas compensation of upper managers is the same in developing and developed countries. This is related to recent work by Minni (2024), who finds a similar result using data from one large multinational firm (see also Hjort *et al.* (2020), who analyze the multinationals subset of one of the databases we use).[3] We show that the high-cost-of-management phenomenon is in fact much broader: leading domestic firms in developing countries also face similarly high costs.

Our second contribution is to quantify the importance of the cost of middle management for expansion of the modern sector. We develop an appropriate technology model where potential producers choose between operating traditional or modern firms. Modern production conveys the advantage of producing at scale with new technologies. Producers weigh this benefit against the difference in factor costs associated with switching to modern production. We show that the contribution of any factor to cross-country differences in technology adoption can be summarized through the product of cross-country differences in relative factor costs and cross-technology differences in relative factor intensity. Put more simply, factors can explain low adoption if they are expensive in devel-

[3] Hjort *et al.* (2020) find surprisingly little variation in compensation across countries within multinational firms, including in lower-skill jobs.

oping countries and used more intensively by modern than by traditional production. A useful feature of this approach is that it leverages the detailed cost data provided by the consulting firms.

We estimate the importance of management in modern and traditional firms using data from the literature on firm hierarchies (Caliendo *et al.*, 2015). We show that our trends for management compensation imply that the high cost of middle management has an effect equivalent to a 27 percent tax levied on the gross output of large, modern firms in developing countries. An advantage of our model is that it can be applied to compute the equivalent effect of any factor for which we can estimate relative factor costs and relative factor intensities. We apply this insight to show that management costs are roughly four times as important as electricity costs and twice as important as external financing costs or tariffs that drive up the prices of imported intermediate inputs in raising the cost of operating a modern firm in developing countries. We take away from this that the cost of management is a first-order determinant of low adoption of new technologies and large firms, worthy of further study.

Our paper is most directly related to the literature that studies why large firms and productive technologies do not spread to developing countries, either through domestic adoption (Murphy *et al.*, 1989; Ciccone, 2002; Cole *et al.*, 2016) or foreign direct investment by multinational firms (Antràs & Yeaple, 2014; Ramondo *et al.*, 2015). Our approach builds on the appropriate technology hypothesis, which posits that production via small firms and traditional technologies may be an optimal response to differences in factor endowments and costs, broadly construed (Stewart, 1977; Verhoogen, 2023). Our main contribution to this literature is to identify a factor that is both expensive in developing countries and important for modern production. By contrast, most existing quantitative work on appropriate technology adoption focuses on educated labor (Basu & Weil, 1998; Acemoglu & Zilibotti, 2001; Caselli & Coleman, 2006). Empirically, the relative cost of educated labor does not vary much with development, unlike the relative cost of management (Banerjee & Duflo, 2005; Rossi, 2022; Malmberg, 2023).

Our work is also related to the literature on cross-country differences in worker compensation. As described above, our results are consistent with the finding in the literature that compensation of highly skilled workers varies little across countries (Hjort *et al.*, 2020; Minni, 2024).[4] We extend these findings by showing that high compensation holds broadly, not just within multinational firms. More importantly, while the existing litera-

[4]By contrast, Brinatti *et al.* (2022) find more variation in pay for workers who use an internet job platform.

ture focuses on the implications of these findings for workers, our contribution is to focus instead on the implications for *firms*. Our key message is that these costs are a critical barrier to the adoption of new technologies and expansion of large firms in developing countries.

Finally, our work also touches on the growing 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). We also 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).

2 Data

We start by describing our data sources. As outlined in the introduction, we think of developing countries as being characterized by a dual economy with the co-existence of a traditional and a modern sector. Our goal is to characterize the cost of management for the modern firms. This cost may differ from that faced by traditional firms if modern firms hire different workers or if modern and traditional firms hire from segmented labor markets; we return to this point in Section 5.

Our data come from two consulting companies that specialize in helping large, modern firms navigate labor markets for skilled workers around the world, including in developing and emerging economies. These consulting companies serve different functions and their data are constructed differently. The first is a compensation consulting firm that advises clients on how their pay at a particular establishment compares to the local market. As a part of this function, the compensation consultant collects data on pay of all employees in the client's establishment. The second is a recruitment consulting firm that helps clients find and hire suitable workers. As a part of this function, the recruitment consultant develops data on the going market rate for newly-hired workers in key positions. We now describe each of these data sources at greater length.

Our data access agreement with the global compensation consulting company prevents us from revealing their name, so we refer to them simply as the "Company". Their central business proposition is to provide clients with information on how the compensation of their employees compares with the prevailing rate for similar workers in the local

labor market. The Company's niche among compensation consulting firms is information on developing and emerging markets.

In order to provide comparable information on labor market conditions across a wide range of countries, the Company employs professional jobs analysts who conduct interviews to learn about the tasks, responsibilities, and skills associated with each position. The analysts use this information to translate each position into the Company's internal, globally standardized job classification scheme. This scheme is extremely detailed, consisting of more than 200 job titles that allow for both horizontal and vertical differentiation of jobs (accounting versus human resources; junior accountant versus senior accountant). 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 workers' self-reported occupations.

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 market 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 data. 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, average compensation of workers in the position in the establishment, and in many cases also the total number of such workers.[5] All observations pertain to local workers; expatriates are reserved to a separate database, which unfortunately we cannot access.

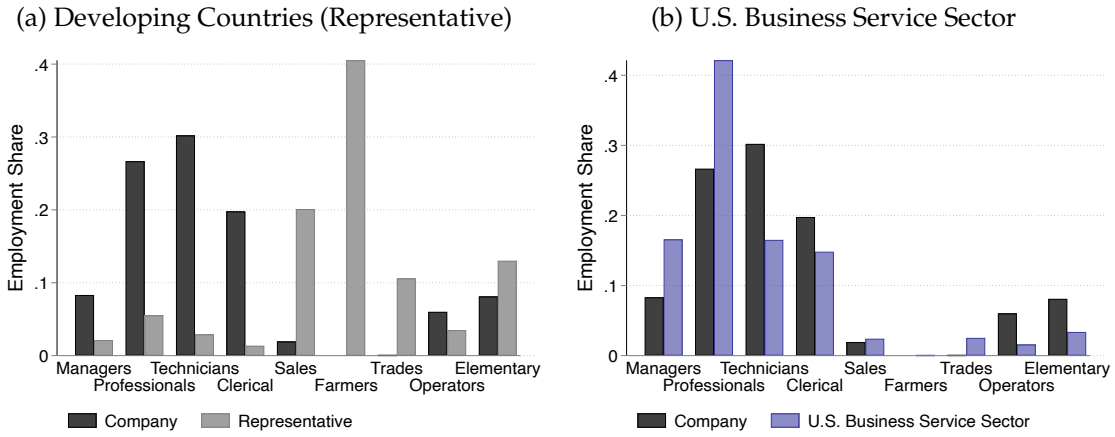
We use the firm name to merge on the firm's industry, profit/non-profit status, and headquarters location. Throughout, we restrict attention to for-profit firms and exclude charities and governmental organizations. A central feature of the database for our research question is that it covers almost exclusively modern business enterprises. Three-fourths of the compensation observations come from multinational firms. These 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

[5]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.

of all revenue and 44 percent of all R&D investment in Compustat North America. The remaining one-fourth of the observations come from large domestic firms. Both types of firms come from a wide variety of sectors, including banking, consulting, health care, mining and other natural resources, technology, telecommunications, and transport.

The establishments that appear in the Company database provide local business and headquarter services. We have verified that many firms also have separate production or sales establishments in the same country, but these establishments are not in the database, likely reflecting that the labor markets for sales and production workers are thicker, information on prevailing compensation is easier to access, and compensation for such workers is much lower. The distribution of occupations is heavily weighted towards managers and business professionals, with a small share of support workers who are captured incidentally because they work in the local headquarters establishment. If we map Company job titles to 1-digit ISCO-08 occupations, we find that the occupational profile in developing countries is very different from representative samples covering the same countries and instead similar to the profile of the U.S. business service sector (Figure 1).[6]

FIGURE 1: OCCUPATIONAL DISTRIBUTION OF COMPANY DATA



Note: Company data represent average distribution among countries with PPP GDP per worker less than $10,000.

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

[6]Developing countries includes all countries with GDP per worker less than $10,000 in 2017 international dollars. See Appendix A.1 for details on data sources used for comparison groups.

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 second data source is information provided by the recruitment consultant Robert Walters, a self-described "global specialist professional recruitment consultancy."[8] Robert Walters helps firms recruit for positions in key business areas that overlap substantially with the labor markets covered by the Company.[9] As a part of their business, they employ recruiters who identify and maintain contacts with workers who are interested in moving to new positions. When contacted by clients, they use this information to help fill vacancies.

Like most recruitment consultants, Robert Walters charges clients a fee that is based on the new hire's compensation. In most cases, the fee structure is a fixed percentage of the first year's salary, exclusive of benefits. Thus, as part of its business Robert Walters amasses a wealth of information on the actual first-year salaries paid to newly-hired workers in specialized labor markets. It uses this information to produce an annual Salary Survey, which is what we access for data. The Salary Survey aggregates the information in Robert Walters' database to provide a salary range for key positions by broad regions. For example, it reports the typical salary range for HR Managers in West Africa over the previous few years. While this aggregation prevents us from merging on firm character-

[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.

[8] https://www.robertwaltersgroup.com/careers/robert-walters/where-we-work.html, July 18, 2023.

[9] Their website decomposes these business areas as accounting & finance; banking & financial services; human resources; legal, risk, & compliance; sales & marketing; technology & digital; and engineering.

istics or conducting a detailed investigation, it is useful to have data from a second data source that is also publicly available.

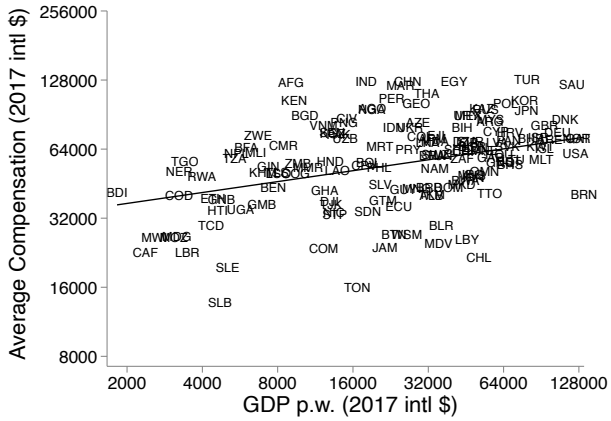
We focus on their data for Africa exclusive of South Africa, which contains most of the poorest countries in the Company's sample. The geographic detail in the Salary Survey increases over time; we collect data from the 2017 survey, which was the first to decompose Africa into four geographic regions: 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. We replace the salary range for each position with the midpoint and adjust to 2017 international dollars using the same algorithm that we applied to the Company's database.

3 Empirical Results

We now turn to what these two data sets reveal about the cost of management and business professionals around the world. The introduction already gave examples of the high nominal costs of these types of workers in developing countries. We now focus on real (PPP-adjusted) total compensation. We compute the average mean log compensation for each country in the Company database. Figure 2 plots the exponential of mean log compensation against PPP GDP per worker, both reported in 2017 international dollars. The main take-away is that the level of compensation in developing countries is high relative to their GDP per worker. The poorest decile of countries have an average GDP per worker of just over $4,000 but report an average compensation per worker in the Company database of $49,000.

As described in the introduction, Robert Walter's data include similarly high figures for the poorest countries in the world. Further, the two data sets broadly agree on salary levels. To make this point, we match the Robert Walters survey 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 compare Robert Walters' salary figures, which do not include benefits or other compensation, to the Company's figures for gross salary. We find that across Africa, the Company reports salaries that are 28 percent lower than those in Robert Walters. This gap is plausibly accounted for by the fact that Robert Walters data deals exclusively with newly-hired

FIGURE 2: MIDDLE MANAGER COMPENSATION AND DEVELOPMENT



workers who are likely to have higher salaries.

Thus, both data sources agree that large, modern firms face a high cost of managers and business professionals in developing countries. In the rest of this section, we use the greater detail in the Company's database to help understand and decompose this result. 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 real GDP per worker in country c, and X is a vector of controls. The main parameter of interest is η, the elasticity of compensation with respect to GDP per worker.

This compensation elasticity captures how much the cost of 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 1 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, which corresponds to the trend line shown in Figure 2. 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 columns (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. Column (5) is particularly useful for alleviating any remaining concern about the comparability of jobs across countries, as it compares compensation for the same job in the same parent firm across affiliates in different countries.

TABLE 1: ESTIMATED COMPENSATION ELASTICITY W.R.T. GDP PER WORKER

	(1)	(2)	(3)	(4)	(5)
Log GDP p.w.	0.158***	0.114***	0.113***	0.088***	0.085***
	(0.038)	(0.007)	(0.007)	(0.005)	(0.004)
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 2. We cannot include firm fixed effects when investigating domestic establishments, so we control for job-year interactions as in column 3 of Table 1. The first column repeats those results for comparison.

The remaining two columns show the results for foreign affiliates and domestic establishments. Note again that the majority of our sample is foreign affiliates (126,039/160,455 $\approx$ 79 percent). However, the estimated compensation elasticity for the two groups is almost identical. This implies that our findings also apply to large, modern domestic firms.

TABLE 2: ESTIMATED COMPENSATION ELASTICITY BY ESTABLISHMENT TYPE

	All	By Firm Type	
		Foreign	Domestic
Log GDP p.w.	0.113***	0.111***	0.110***
	(0.007)	(0.006)	(0.014)
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

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

We also investigate how our results vary by skill level. We use the vertical dimension of the Company's internal job classification scheme to group workers into four broad skill levels. The bottom skill level includes workers who are not in manager or business professional roles. These are cleaners, guards, drivers, and so on. The remaining groups capture different skill levels of managers and business professionals. 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 3: 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***	0.069***	0.012*
	(0.007)	(0.019)	(0.013)	(0.005)	(0.005)
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 3 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.[10]

The low compensation elasticity for managers and business professionals – equivalently, higher relative compensation for managers and business professionals in developing countries – is the central empirical finding of our paper. In Section 4 we take these relative costs as given and investigate their consequences for the adoption and expansion of modern business enterprises. But first, we show the importance of using data specific to modern firms in countries characterized by a dual economy.

3.1 Comparison to Nationally Representative Data Sets

A key strength of our empirical work is that both data sources we use provide information on the costs faced by modern firms. As we have emphasized, this is important if modern and traditional firms face different costs because they hire different types of workers or hire in segmented labor markets. In this section, we show the results that arise if we use nationally representative data sets that mix workers employed by traditional and modern firms. Our goal here is twofold. First, we want to show the quantitative importance of having access to data specific to modern firms. Second, we want to establish some findings on the compensation at traditional firms that will be useful when quantifying the technology adoption choice in the next section.

The key limitation of standard data sets is that they ask workers detailed questions about their occupation but few questions about the organization or structure of their employer. As a result, in general the best we can do is to classify workers based on their self-reported occupation. The drawback of this approach is that it pools together a diverse set of workers who have different qualifications and perform different tasks at different types of firms: the managers of small retail establishments have little in common with regional presidents of multinational firms. Further, the share of managers who are middle and upper managers varies systematically with development (Tamkoç, 2023). In practice, most self-identified managers in developing countries work in traditional firms.

We construct compensation from nationally representative data sets for three countries. We focus on the poorest countries (Bangladesh and Bolivia) and the richest country

[10] A related question is whether clients vary the relative mix of skill levels that they hire in response to this variation in relative costs. In Appendix A.2 we show that there is no evidence that they do so.

(United States) for which we have nationally representative data sets that also include data on earnings. In each of the three chosen countries we compute weighted mean log earnings for managers and non-managers in the nationally representative data sets and the Company database. In all cases we divide through by non-agricultural GDP per worker, which we construct using data from World Bank (2022). We use non-agricultural GDP because most agricultural workers are self-employed and do not report earnings in our microdata. Further, it is well-known that agricultural workers have lower earnings, particularly in developing countries, so this restriction makes our earnings and productivity figures more comparable (Gollin *et al.*, 2014).

TABLE 4: LABOR EARNINGS BY OCCUPATION AND SOURCE

	Managers		Non-Managers	
	Company	Representative	Company	Representative
Country				
Bangladesh	8.94	1.65	0.85	0.44
Bolivia	4.39	0.94	0.96	0.49
United States	0.52	0.34	0.61	0.33

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 earnings relative to non-agricultural GDP per worker.

Table 4 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. This reflects a combination of the fact that modern firms are common and the fact that modern-traditional pay gaps for managers are not too large in the United States. Second, compensation is much higher in the Company database than the nationally representative data sets for the developing countries. We return to the general difference in pay levels in Section 5.3. Third, this gap is much larger for managers than for production workers. This gap reflects exactly that most firms in developing countries are traditional and pay gaps between supervisors or owner-managers in traditional firms versus middle and upper managers in modern firms are large.[11]

[11] Esfahani (2022) also studies the gap in earnings between managers and non-managers using representative data from 76 countries. He also finds that the relative earnings of managers declines with development, consistent with our representative findings.

4 Quantifying the Importance of Management Costs

This section shows that management costs are a quantitatively important deterrent to the expansion of the modern sector. Closing the gap in management costs between developing and developed countries would have the same impact as eliminating a 27 percent tax on the gross output of modern firms. This is a significantly larger effect than the one that would follow from closing the gap in electricity costs, costs of financing, or costs of imported intermediate goods.

Our analysis uses a general appropriate technology framework where output can be produced using either a modern or a traditional technology, each with different productivities and factor mixes. Potential producers choose the optimal technology given prevailing factor prices. We use this framework to quantify the importance of observed differences in factor prices. We start with a simple case where production functions are all Cobb-Douglas, which yields simple expressions that are useful for building intuition.

4.1 Appropriate Technology Framework

The economy has a unit interval of goods $i \in [0, 1]$ and a set of factors $f = 1, \ldots, F$. Each good can be produced using a traditional or a modern technology, with the respective production functions given by

$$y^T(i) = A^T(i) \prod_{f=1}^{F} \left(\frac{x_f^T(i)}{\alpha_f^T} \right)^{\alpha_f^T},$$

$$y^M(i) = e^{-\tau} A^M(i) \prod_{f=1}^{F} \left(\frac{x_f^M(i)}{\alpha_f^M} \right)^{\alpha_f^M}.$$

The terms $A^T(i)$ and $A^M(i)$ capture the productivity of traditional or modern technologies, which varies by good. For example, the productivity benefits of large-scale production of steel or cement are sufficiently large that they are produced this way essentially everywhere, whereas for other industries such as plumbing services the benefits are evidently much smaller and small-scale production remains the norm. The term τ is an additional productivity penalty on modern production meant to capture general barriers to modern production such as contracting frictions, bad intellectual property rights, or low-quality infrastructure. Finally, $x_f^T(i)$ and $x_f^M(i)$ denote factor inputs and α_f^T and α_f^M

the corresponding factor intensities.

Without loss of generality, we assume $A^M(i)/A^T(i)$ is decreasing in i; for expositional purposes, we also assume that it is continuous. This implies that there is a cutoff technology i^* such that

$$\frac{A^M(i^*)}{A^T(i^*)} = e^{\tau} \prod_f w_f^{(\alpha_f^M - \alpha_f^T)}, \tag{2}$$

where w_f is the price of factor f. Intuitively, adoption is low if there are high barriers τ or if there are high factor prices w_f of factors that are used intensively in modern production as compared to traditional production. Given the adoption equation, a sufficient statistic for the adoption effect of changing factor prices is

$$\sum_f (\alpha_f^M - \alpha_f^T) \Delta \log w_f. \tag{3}$$

This expression highlights that from the firm's perspective, information on factor costs and factor intensities encodes the information necessary for the adoption decision. For example, the firm does not need to know whether high factor costs are the result of low supply, intense demand from their competitors, or frictions in the labor market that make it necessary to pay efficiency wages.

4.2 Quantifying Factor Prices

We now quantify the effect of cross-country differences in factor prices. In addition to the cost of management, we perform similar calculations for several other factors considered in the literature: electricity, external financing, and imported intermediates. For each, we quantify the cross-country differences in factor prices and the difference in factor shares between modern and traditional firms. As equation (3) shows, these two differences are sufficient to summarize the importance of a factor on firms' adoption decisions. Formally, in any model featuring the adoption cutoff (2), the adoption effect of shocks to primitives will be given by the effect of those primitives on factor prices mediated by equation (3). In Appendix B we show how these counterfactuals can be interpreted within a general equilibrium framework where shifts in exogenous model primitives induce the corresponding movements in factor prices.

Management prices. We start with the effect of the cost of managers and business professionals. More specifically, we quantify the relative cost of managers and business professionals to production workers. This is the relevant margin because both modern and traditional firms use labor with similar intensity (Gollin, 2002), but modern firms use managers and business professionals more intensively, while traditional firms use production workers more intensively.

We take the cost of management from the Company's database. We focus on the managers and business professionals and estimate the average compensation after residualizing for job-year interactions, which controls for cross-country differences in workforce composition. We estimate the cost of production labor for a wide range of countries by taking 44 percent of each country's non-agricultural GDP per worker. As we showed in Table 4, this estimate closely approximates the cost of non-managerial labor in representative data sets. Given these definitions, the relative cost of managers and business professionals is 14 times higher in the lowest compared to the highest decile in the country income distribution.

For compensation shares, we use evidence from the recent literature that analyzes empirically the organization of production in firms. Caliendo *et al.* (2015) use French matched employer-employee data that describes each worker's position in the firm hierarchy, from production workers to top managers. They show that firms follow a natural hierarchy: simpler firms have one or two layers (production workers and supervisors), while more complex firms have three or four layers.[12] We define modern firms as those with three or four hierarchical layers, and the manager share as the compensation share of workers at levels three or four.[13]

Our distinction between traditional and modern firms aims to capture the difference between typical small firms in developing countries and those in our database. Bassi *et al.* (2023) show that typical small firms in developing countries have only production workers and a manager who mainly supervises and participates in production. They lack senior staff or top managers who oversee other managers, set strategy, formalize policies, or allocate resources. In contrast, all firms in our Company data are modern by our definition, having local headquarters with middle and upper managers, implying at least three hierarchical layers. By defining the compensation share as payments to upper

[12]See Garicano (2000) and Garicano & Rossi-Hansberg (2006) for the development of the theory of why firms form hierarchies.

[13]This division implies that just over half of French firms are modern, but their larger size means that they account for 95 percent of value added.

hierarchy levels, we capture the labor costs of higher-level managers found in our dataset.

By our definition, $\alpha^T_{man} = 0$ since traditional firms by definition do not have workers at level 3 and 4. We obtain $\alpha^M_{man} = 0.09$ by multiplying the compensation share of level 3 and 4 workers in modern firms (0.28) with a labor share of value added (0.66) and an intermediate input share (0.5).

Electricity prices. For electricity, we model a price reduction equivalent to fully replacing generator-produced electricity with grid-based electricity. We base our numbers on the study by Fried & Lagakos (2023) of electricity use by firms in Sub-Saharan Africa. They find that firms with generators use them to produce 59% percent of their electricity and that the cost per kilowatt-hour is 5.51 times higher than that for grid-based electricity.[14] The higher costs reflect both variable costs (\$0.28/kWh vs \$0.06/kWh) and maintenance and capital costs for generators (\$0.08/kWh), all in 2014 dollars.

We define the cost change of eliminating generator dependence as:[15]

$$\Delta \log w_{electricity} = \log\left(\frac{0.06}{0.06 \times (1 - 0.59) + 0.59 \times 0.34}\right) = -1.32.$$

For the electricity factor share, we set $\alpha^M_{electricity} = 0.035$, derived by multiplying Lagakos and Fried's estimate of electricity's value-added share in the modern sector (0.07) with an intermediate input share of 0.5. Consistent with their assumption that traditional firms do not use electricity, we set $\alpha^T_{electricity} = 0$.

External financing costs. To model financial frictions, we examine the impact of lower costs of external financing for modern firms. We base our numbers on Cavalcanti *et al.* (2024), who provide an analysis of comprehensive loan-level data from a credit registry in Brazil. They find that firms face a credit-weighted average of credit spreads of 45 percentage points in their study. We consider a decline of this spread to 5 percentage points, which is an estimate of U.S. credit spreads based on the difference between the U.S. high-yield index and the market yield on 10-year U.S. treasury securities (2015 values) .

To calculate the resulting decrease in the user cost of capital, we follow Cavalcanti *et al.* (2024) in assuming a risk-free rate of 2.5% and a depreciation rate of 3%, implying a

[14] Fried & Lagakos (2023, Online Appendix, Table C.1).

[15] This calculation assumes that the aggregate self-generation share equals that found for firms with generators. In reality, 18% of modern firms lack generators, which would imply a smaller initial self-generation share and thus a smaller cost change if we made an adjustment.

reduction of

$$\Delta \log w_{ext} = \log\left(\frac{0.025 + 0.03 + 0.05}{0.025 + 0.03 + 0.45}\right) = -1.57.$$

For the cost share of external financing in the modern sector, we set $\alpha_{ext}^{M} = 0.066$. This estimate combines three factors: a capital share of value added (0.33) from Cavalcanti *et al.* (2024), an intermediate input share of gross output of 0.5, and a generous upper bound on the external financing share in the modern sector of 0.4. Cavalcanti *et al.* (2024) find that the share of the total capital stock that is externally financed is 0.19; if modern firms hold at least half of the capital stock, then no more than 40 percent of that can be externally financed. For comparison, the top 10% of firms have 77% of employment. Finally, we set the share of external financing in traditional firms to zero. This choice maximizes the difference to the modern sector, creating a best-case scenario for financial frictions to influence the adoption of modern technologies.[16]

Intermediate input tariffs. Finally, we consider the effect of reducing intermediate input tariffs. This experiment is motivated by the work of Goldberg *et al.* (2010), who show that reductions in intermediate input tariffs played an important role in the adoption of modern technologies in India during the country's economic liberalization period in the early 1990s.

For our experiment, we model a reduction in input tariffs from 36% to 12%, which aligns with the estimates provided by Goldberg *et al.* (2010) for the effects of India's reforms. Importantly, their tariff measure represents the tariffs as a percent on all intermediate inputs, both imported and domestically sourced. As such, the reduction from 36% to 12% should be interpreted as the full input price effect across all intermediate inputs. This tariff reduction corresponds to a change in log prices of:

$$\Delta \log P_x = \log\left(\frac{1 + 0.12}{1 + 0.36}\right) = -0.19$$

Given that this is a cost estimate for all intermediate inputs, it is multiplied by the intermediate input share, which we take to be 0.5 for modern firms. To maximize the potential impact of tariffs in our model, we make the stark assumption that traditional firms do not use imported intermediates.

[16] Technically, to obtain the compensation share of externally financed capital, we should also adjust for the difference between the cost of external capital and internal funds. In the model in the appendix, we show that the borrowing constraint that implies a Cobb-Douglas cost function also implies that the compensation share of external capital is bounded above by the share of externally financed capital.

4.3 Results

Table 5 reports the results of these calculations. Each column of the table corresponds to one of the factor inputs described in the previous section. The first three rows summarize the difference in factor costs between developing and developed countries, the factor share of modern production, and the factor share of traditional production for the input. Finally, the last row shows the overall relative cost shifter.

TABLE 5: FACTOR COST RESULTS

	Factor Input			
	Management	Electricity	Financing	Intermediates
Cost Difference ($\Delta \log w_f$)	-2.64	-1.32	-1.57	-0.19
Modern Factor Share (α_f^M)	0.09	0.035	0.066	0.50
Traditional Factor Share (α_f^T)	0	0	0	0
Relative Cost Shifter ($\Delta \log w_f \times (\alpha_f^M - \alpha_f^T)$)	-0.24	-0.046	-0.10	-0.09

The main take-away of Table 5 is that the cost of management is an important cost shifter. It is equivalent to a tax of $\exp(0.24) = 27$ percent on the gross output of modern firms in developing countries. This effect is more than twice as large as the cost shifter associated with the other factor inputs. Its importance stems from both the substantial price effect ($\Delta \log w_f = -2.64$, representing a 14-fold decrease in relative costs) and the relatively large difference in the factor shares for managers and business professionals between modern and traditional firms. External financing and electricity are both less expensive in developing countries and less important for modern production. Intermediate inputs are important for modern production, but even dramatic trade liberalization episodes induce small changes in the overall price of intermediates. We take from this that the cost of management is an important area worthy of further study.

4.4 Beyond Cobb-Douglas

This section extends our analysis beyond the Cobb-Douglas framework to provide a more general characterization of how factor costs affect technology adoption. As before, each good can be produced using a traditional and a modern technology. Production functions

are given by

$$y^T(i) = A^T(i) f^T(x_1^T(i), \ldots, x_F^T(i)),$$
$$y^M(i) = A^M(i) f^M(x_1^M(i), \ldots, x_F^M(i)),$$

where f^T and f^M are general production functions satisfying standard properties. The modern technology is used when

$$\frac{A^M(i)}{A^F(i)} > \frac{c_M(w_1, \ldots, w_F)}{c_T(w_1, \ldots, w_F)},$$

where c_T and c_M are the unit cost functions associated with the production functions f^T and f^M. To analyze the impact of changes in factor costs, we note that the change in relative unit costs satisfy

$$\frac{d \log \frac{c_M}{c_T}}{d \log w_f} = \alpha_f^M(w_1, \ldots, w_F) - \alpha_f^T(w_1, \ldots, w_F),$$

where α_f^M, α_f^T are the factor compensation shares of f in the modern and traditional technology respectively. Note that this formula coincides with the Cobb-Douglas setup, with the one difference that factor shares are now functions of factor prices, rather than constants. This means that the effect on relative unit costs, and hence adoption, of a change in a factor price $\Delta \log w_f = \log(w_f^1 / w_f^0)$ is given by

$$\Delta \log \frac{c_M}{c_T} = \int_{w_f^0}^{w_f^1} [\alpha_f^M(w_1, \ldots, w_f', \ldots w_F) - \alpha_f^T(w_1, \ldots, w_f', \ldots w_F)] d \log w_f'.$$

When the production function is Cobb-Douglas, factor shares are independent of factor prices and we recover $(\alpha_f^M - \alpha_f^T)\Delta \log w_f$ as before. In the general case, there is an additional effect coming from factor shares changing, with the effect being stronger if the modern-traditional share difference expands with the price change, and the effect being weaker if the modern-traditional share shrinks. We use these insights in our sensitivity analysis.

4.5 Sensitivity Analysis

Our sensitivity analysis focuses on relaxing the Cobb-Douglas assumption for each factor. The implications vary across the different experiments, as we discuss below.

We calibrate the factor share of management using data from France. A Cobb-Douglas production function then imposes that the factor share is the same in all countries – even developing countries with very different factor prices. To assess whether this is a reasonable approximation to the data, we examine evidence on how factor shares change between developed and developing countries as the relative price of management moves.

To find a consistent set of modern firms in rich and poor countries, we use data from the Bureau of Economic Analysis on business activities of majority-owned foreign affiliates of U.S. multinational enterprises. Until 2007, they collected data on total labor compensation and compensation of managerial, professional, and technical labor by country of affiliate. We use data from 2004, the last benchmark year with this breakdown (Bureau of Economic Analysis, 2004, Table III.H 1). On average, 49 percent of compensation goes to managerial, professional, and technical workers. This figure is higher than for average French firms in Caliendo *et al.* (2015), reflecting that multinational affiliates are typically more skill-intensive. While multinationals differ in the *level* of factor shares, the shares remain relatively stable across income levels, despite large relative price movements. For the 53 countries with both compensation statistics and real GDP data, the correlation between log GDP per worker and the management share of compensation is only 0.16. A regression of management compensation shares on log GDP per worker predicts only a 6 percentage point difference between the richest and poorest countries. This evidence suggests that a constant management share is a reasonable approximation, supporting our use of the Cobb-Douglas assumption for management.

For electricity, deviating from Cobb-Douglas would likely involve a lower elasticity of substitution. This would weaken the effect of lowering electricity prices, as the factor share of electricity would fall with cheaper electricity. Thus, our Cobb-Douglas assumption likely provides an upper bound on the impact of electricity prices.

For financing costs, the natural deviation from Cobb-Douglas is that the external financing share rises as credit spreads fall. This mechanism is evident in Cavalcanti *et al.* (2024), where there is a negative correlation between a firm's credit spreads and its use of credit. However, incorporating this effect is unlikely to dramatically change our results for two reasons. First, our 40% external financing share is already quite high; for comparison, total private credit in the US is only 64% of fixed assets. Second, the adoption effect is

only strengthened if the *difference* between modern and traditional firms' external finance share expands as credit spreads fall. If reduced credit spreads primarily benefit smaller firms, it could actually narrow this gap, meaning our current approach would overstate the impact of lower credit spreads.

Standard estimates suggest that demand for imported intermediates is elastic, implying that the import share of intermediates should increase with falling tariffs. This would result in a larger effect of tariff reductions than simply using a tariff decline weighted by initial input shares. To bound this effect, we consider the full tariff decline from 97% to 40%, giving a total change of:

$$\log\left(\frac{1+0.40}{1+0.97}\right) = -0.34$$

This is consistent with the tariff estimate in Goldberg *et al.* (2010), given an initial import share of 55%. When input shares change in response to price changes, we can provide a second-order approximation of the final price effect by using the average of the pre- and post-shares times the change in factor prices (Diewert, 1976). Making the stark assumption that the imported intermediate share reaches 100% after the reform, we obtain the following approximation for the full effect of the tariff

$$0.5 \times \frac{0.55+1.0}{2} \times (-0.34) = -0.13$$

This estimate is 44% larger than our initial Cobb-Douglas estimate but still smaller than the effect of management cost reductions.

5 Understanding Management Compensation

So far we have established that modern firms face a high relative cost for management and business professionals in developing countries. We calculate that this is an important deterrent to the adoption and expansion of modern business enterprises in developing countries. We now discuss several candidate explanations for why the cost of management and business professionals for modern firms in developing countries is high.

5.1 Quality Differences

Modern firms may face higher costs for management than traditional firms because they hire higher-quality managers. This explanation would make sense given the overall scarcity of highly skilled workers in developing countries. For example, a much lower share of the workforce has completed tertiary education in developing countries, which is often a necessary entry requirement for management and business professional roles in modern firms (Barro & Lee, 2013). Adding to this, the overall quality of education is much lower in developing countries, which leads to less human capital among college graduates in developing countries (Hanushek & Woessmann, 2012; Schoellman, 2012; Cubas *et al.*, 2016; Martellini *et al.*, 2024). Thus, the premium may reflect in part that modern firms are bidding up the price of a scarce resource. This interpretation is consistent with the growing evidence that management training interventions improve the quality of management and firm profitability (Bloom *et al.*, 2013; Giorcelli, 2019; Bianchi & Giorcelli, 2022). Engbom *et al.* (2024) construct a theory where the aggregate supply of skills in a country plays an important role in the determining the share of white-collar workers and the number and size of large firms in an economy.

5.2 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 developing countries (Kerr *et al.*, 2016; Martellini *et al.*, 2024). While these flows are not always large relative to the total population, they can exacerbate the shortage of skilled managers coming from the lack of high-quality education. Related to migration, we also observe that 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 3); 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.

5.3 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. 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 developing 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.*, 2023; 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 developing 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 managers and business professionals 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.[17] 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 in foreign establishments (see also Goldschmidt & Schmeider, 2017; Derenoncourt & Weil, 2024). 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 1 , Column 5). However, we note that our results do not appear to be driven particularly by multinational firms (Table 2).

6 Conclusion

Developing countries are characterized by a dual economy: large, productive modern firms using new technologies co-exist with small, unproductive traditional firms or own-account workers who produce using out-of-date technologies. A central question of growth and development is why the modern sector does not expand to displace the traditional sector, either through greater domestic adoption of new technologies and large firms or through greater foreign direct investment by leading foreign multinational firms. This paper puts forth the hypothesis that high costs of managers and business professionals can help explain the limited size of the modern sector.

We draw on data from two consulting companies that help large, modern firms navigate labor markets for skilled workers in developing and emerging economies. Both companies report that the average compensation for managers and business professionals is an order of magnitude larger than GDP per worker. These high costs are faced by both domestic and multinational modern firms. The compensation of the lowest levels of management varies more across countries, whereas compensation of upper managers is the same in developing and developed countries.

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

We use a technology adoption model to quantify the importance of management costs for the small size of the modern sector in developing countries. We show that a factor is an important deterrent if it is relatively more expensive in developing countries and used more intensively in modern production. Management costs satisfy both criteria and hence are a quantitatively significant deterrent relative to many other factors that the literature has studied.

Looking ahead, we hope that our work can inspire more research into the nature of skilled labor markets in developing countries. Many open questions remain. To what extent do high management prices reflect scarcity of skills or labor market frictions? If the high prices reflect scarcity, what prevents workers from acquiring these skills, or firms from training workers? 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.

References

ABEBE, GIRUM, CARIA, A. STEFANO, & ORTIZ-OSPINA, ESTEBAN. 2021. The Selection of Talent: Experimental and Structural Evidence from Ethiopia. *American Economic Review*, **111**(6), 1757–1806.

ACEMOGLU, DARON, & ZILIBOTTI, FABRIZIO. 2001. Productivity Differences. *Quarterly Journal of Economics*, **116**(2), 563–606.

ACEMOGLU, DARON, JOHNSON, SIMON, & ROBINSON, JAMES A. 2005. Institutions as a Fundamental Cause of Long-Run Growth. *Chap. 6, pages 385–472 of:* AGHION, PHILIPPE, & DURLAUF, STEVEN N. (eds), *Handbook of Economic Growth*, vol. 1A. Elsevier.

AKCIGIT, UFUK, ALP, HARUN, & PETERS, MICHAEL. 2021. Lack of Selection and Limits to Delegation: Firm Dynamics in Developing Countries. *American Economic Review*, **111**(1), 231–275.

ALFARO-URENA, ALONSO, MANELICI, ISABELA, & VASQUEZ, JOSE P. 2021. *The Effects of Multinationals on Workers: Evidence from Costa Rican Microdata*. Mimeo Universidad de Costa Rica.

ANTRÀS, POL, & YEAPLE, STEPHEN R. 2014. Multinational Firms and the Structure of International Trade. *Chap. 2, pages 55–130 of:* GOPINATH, GITA, HELPMAN, ELHANAN, & ROGOFF, KENNETH (eds), *Handbook of International Economics*, vol. 4. Elsevier.

BANERJEE, ABHIJIT V., & DUFLO, ESTHER. 2005. Growth Theory through the Lens of Development Economics. *Chap. 7, pages 473–554 of:* AGHION, PHILIPPE, & DURLAUF, STEVEN N. (eds), *Handbook of Economic Growth*, vol. 1A. Amsterdam: Elsevier.

BARRO, ROBERT J., & LEE, JONG WHA. 2013. A New Data Set of Educational Attainment in the World, 1950–2010. *Journal of Development Economics*, **104**, 184–198.

BASSI, VITTORIO, LEE, JUNG HYUK, PETER, ALESSANDRA, PORZIO, TOMMASO, SEN, RITWIKA, & TUGUME, ESAU. 2023. *Self-Employment Within the Firm*. NBER Working Paper 31740.

BASU, SUSANTO, & WEIL, DAVID N. 1998. Appropriate Technology and Growth. *Quarterly Journal of Economics*, **113**(4), 1025–1054.

BENTO, PEDRO, & RESTUCCIA, DIEGO. 2017. Misallocation, Establishment Size, and Productivity. *American Economic Journal: Macroeconomics*, **9**(3), 267–303.

BENTO, PEDRO, & RESTUCCIA, DIEGO. 2021. On Average Establishment Size across Sectors and Countries. *Journal of Monetary Economics*, **117**, 220–242.

BIANCHI, NICOLA, & GIORCELLI, MICHELA. 2022. The Dynamics and Spillovers of Management Interventions: Evidence from the TWI Program. *Journal of Political Economy*, **130**(6), 1630–1675.

BLOOM, NICHOLAS, & VAN REENEN, JOHN. 2007. Measuring and Explaining Management Practices Across Firms and Countries. *Quarterly Journal of Economics*, **122**(4), 1351–1408.

BLOOM, NICHOLAS, SADUN, RAFFAELLA, & VAN REENEN, JOHN. 2012. The Organization of Firms Across Countries. *Quarterly Journal of Economics*, **127**(4), 1663–1705.

BLOOM, NICHOLAS, EIFERT, BENN, MAHAJAN, APRAJIT, MCKENZIE, DAVID, & ROBERTS, JOHN. 2013. Does Management Matter? Evidence from India. *Quarterly Journal of Economics*, **128**(1), 1–51.

BLOOM, NICHOLAS, LEMOS, RENATA, SADUN, RAFFAELLA, SCUR, DANIELA, & VAN REENEN, JOHN. 2014. The New Empirical Economics of Management. *Journal of the European Economic Association*, **12**(4), 835–876.

BOEHM, JOHANNES, & OBERFIELD, EZRA. 2020. Misallocation in the Market for Inputs: Enforcement and the Organization of Production. *The Quarterly Journal of Economics*, **135**(4), 2007–2058.

BRINATTI, AGOSTINA, CAVALLO, ALBERTO, CRAVINO, JAVIER, & DRENIK, ANDRES. 2022. *The International Price of Remote Work*. mimeo, University of Michigan.

BUERA, FRANCISCO J., & TRACHTER, NICHOLAS. 2024. *Sectoral Development Multipliers*. mimeo, Washington University in St. Louis.

BUREAU OF ECONOMIC ANALYSIS. 2004. *U.S. Direct Investment Abroad (USDIA) Final Benchmark Data*. Tech. rept. Accesssed July 25, 2023.

CALIENDO, LORENZO, MONTE, FERDINANDO, & ROSSI-HANSBERG, ESTEBAN. 2015. The Anatomy of French Production Hierarchies. *Journal of Political Economy*, **123**(4), 809–852.

CASELLI, FRANCESCO, & COLEMAN, II, WILBUR JOHN. 2006. The World Technology Frontier. *American Economic Review*, **96**(3), 499–522.

CAVALCANTI, TIAGO, KABOSKI, JOSEPH PAUL, MARTINS, BRUNO SILVA, & SANTOS, CEZAR. 2024. *Financing Costs and Development*. STEG Working Paper 092.

CHANDLER, JR., ALFRED D. 1977. *The Visible Hand: The Managerial Revolution in American Business*. Harvard University Press.

CHANDLER, JR., ALFRED D. 1990. *Scale and Scope: The Dynamics of Industrial Capitalism*. Cambridge, Massachusetts: The Beklnap Press of Harvard University Press.

CHO, JAEHAN. 2018. Knowledge Transfer to Foreign Affiliates of Multinationals through Expatriation. *Journal of International Economics*, **113**, 106–117.

CICCONE, ANTONIO. 2002. Input Chains and Industrialization. *Review of Economic Studies*, **69**(3), 565–587.

COLE, HAROLD L., GREENWOOD, JEREMY, & SANCHEZ, JUAN. 2016. Why Doesn't Technology Flow from Rich to Poor Countries? *Econometrica*, **84**(4), 1477–1521.

COMIN, DIEGO, & HOBIJN, BART. 2004. Cross-Country Technology Adoption: Making the Theories Fit the Facts. *Journal of Monetary Economics*, **51**(1), 39–83.

COMIN, DIEGO, & HOBIJN, BART. 2010. An Exploration of Technology Diffusion. *American Economic Review*, **100**(5), 2031–2059.

CUBAS, GERMAN, RAVIKUMAR, B., & VENTURA, GUSTAVO. 2016. Talent, Labor Quality, and Economic Development. *Review of Economic Dynamics*, **21**, 160–181.

DERENONCOURT, ELLORA, & WEIL, DAVID. 2024. *Voluntary Minimum Wages*. mimeo, Princeton University.

DIEWERT, W ERWIN. 1976. Exact and superlative index numbers. *Journal of econometrics*, **4**(2), 115–145.

DOCQUIER, FRÉDÉRIC, & RAPOPORT, HILLEL. 2012. Globalization, Brain Drain, and Development. *Journal of Economic Literature*, **50**(3), 681–730.

DONOVAN, KEVIN, LU, JIANYU, & SCHOELLMAN, TODD. 2023. Labor Market Dynamics and Development. *Quarterly Journal of Economics*, **138**(4), 2287–2325.

ENGBOM, NIKLAS, MALMBERG, HANNES, PORZIO, TOMMASO, ROSSI, FEDERICO, & SCHOELLMAN, TODD. 2024. *Economic Development According to Chandler*. mimeo, New York University.

ESFAHANI, MEHRDAD. 2022. *Investment in Skills, Managerial Quality, and Economic Development*. mimeo, Arizona State University.

FRIED, STEPHIE, & LAGAKOS, DAVID. 2023. Electricity and Firm Productivity: A General-Equilibrium Approach. *American Economic Journal: Macroeconomics*, **15**(4), 67–103.

GARICANO, LUIS. 2000. Hierarchies and the Organization of Knowledge in Production. *Journal of Political Economy*, **108**(5), 874–904.

GARICANO, LUIS, & ROSSI-HANSBERG, ESTEBAN. 2006. Organization and Inequality in a Knowledge Economy. *Quarterly Journal of Economics*, **121**(4), 1383–1435.

GIORCELLI, MICHELA. 2019. The Long-Term Effects of Management and Technology Transfers. *American Economic Review*, **109**(1), 121–152.

GOLDBERG, PINELOPI KOUJIANOU, KHANDELWAL, AMIT KUMAR, PAVCNIK, NINA, & TOPALOVA, PETIA. 2010. Imported Intermediate Inputs and Domestic Product Growth: Evidence from India. *Quarterly Journal of Economics*, **125**(4), 1727–1767.

GOLDSCHMIDT, DEBORAH, & SCHMEIDER, JOHANNES F. 2017. The Rise of Domestic Outsourcing and the Evolution of the German Wage Structure. *Quarterly Journal of Economics*, **132**(3), 1165–1217.

GOLLIN, DOUGLAS. 2002. Getting Income Shares Right. *Journal of Political Economy*, **110**(2), 458–474.

GOLLIN, DOUGLAS. 2008. Nobody's business but my own: Self-employment and small enterprise in economic development. *Journal of Monetary Economics*, **55**(2), 219–233.

GOLLIN, DOUGLAS, LAGAKOS, DAVID, & WAUGH, MICHAEL E. 2014. The Agricultural Productivity Gap. *Quarterly Journal of Economics*, **129**(2), 939–993.

GUNER, NEZIH, PARKHOMENKO, ANDRII, & VENTURA, GUSTAVO. 2018. Managers and Productivity Differences. *Review of Economic Dynamics*, **29**, 256–282.

HANUSHEK, ERIC A., & WOESSMANN, LUDGER. 2012. Do Better Schools Lead to More Growth? Cognitive Skills, Economic Outcomes, and Causation. *Journal of Economic Growth*, **17**(4), 267–321.

HJORT, JONAS, LI, XUAN, & SARSONS, HEATHER. 2020. *Across-Country Wage Compression in Multinationals*. NBER Working Paper No. 26788.

HSIEH, TSUN-YAN, LAVOIE, JOHANNE, & SAMEK, ROBERT A. P. 1999. Think global, hire local. *McKinsey Quarterly*, 92–101.

JORGENSON, DALE W. 1961. The Development of a Dual Economy. *Economic Journal*, **71**(282), 309–334.

KERR, SARI PEKKALA, KERR, WILLIAM, ÖZDEN, ÇAĞLAR, & PARSONS, CHRISTOPHER. 2016. Global Talent Flows. *Journal of Economic Perspectives*, **30**(4), 83–106.

KUZNETS, SIMON. 1973. Modern Economic Growth: Findings and Reflections. *American Economic Review*, **63**(3), 247–258.

LAGAKOS, DAVID. 2020. Urban-Rural Gaps in the Developing World: Does Internal Migation Offer Opportunities? *Journal of Economic Perspectives*, **34**(3), 174–192.

LEWIS, W. ARTHUR. 1954. Economic Development with Unlimited Supplies of Labor. *The Manchester School*, **22**(2), 139–191.

MALMBERG, HANNES. 2023. *Skill Bias and Development: Evidence from Trade and Industry Data*. Mimeo.

MARTELLINI, PAOLO, SCHOELLMAN, TODD, & SOCKIN, JASON. 2024. The Global Distribution of College Graduate Quality. *Journal of Political Economy*, **132**.

MINNI, VIRGINIA. 2024. Global Managers, Local Workers: Wage Setting Inside a Multinational Firm. *AEA Papers and Proceedings*, **114**.

MURPHY, KEVIN M., SHLEIFER, ANDREI, & VISHNY, ROBERT W. 1989. Industrialization and the Big Push. *Journal of Political Economy*, **97**(5), 1003–1026.

PORZIO, TOMMASO. 2017. *Cross-Country Differences in the Optimal Allocation of Talent and Technology*. mimeo, Columbia University.

POSCHKE, MARKUS. 2018. The Firm Size Distribution across Countries and Skill-Biased Change in Entrepreneurial Technology. *American Economic Journal: Macroeconomics*, **10**(3), 1–41.

RAMONDO, NATALIA, RODRÍGUEZ-CLARE, ANDRÉS, & TINTELNOT, FELIX. 2015. Multinational Production: Data and Stylized Facts. *American Economic Review: Papers and Proceedings*, **105**(5), 530–536.

ROBERT WALTERS. 2017. *Salary Survey*.

ROSSI, FEDERICO. 2022. The Relative Efficiency of Skilled Labor across Countries: Measurement and Interpretation. *American Economic Review*, **112**(1), 235–266.

RUGGLES, STEVEN, FLOOD, SARAH, FOSTER, SOPHIA, GOEKEN, RONALD, PACAS, JOSE, SCHOUWEILER, MEGAN, & SOBEK, MATTHEW. 2021. *IPUMS USA: Version 11.0 [dataset]*. Minneapolis, MN: IPUMS. Available online at https://doi.org/10.18128/D010.V11.0.

SCHOELLMAN, TODD. 2012. Education Quality and Development Accounting. *Review of Economic Studies*, **79**(1), 388–417.

STEWART, FRANCES. 1977. *Technology and Underdevelopment*. London, UK: The Macmillan Press, Ltd.

TAMKOÇ, M. NAZIM. 2023. *Managers, Talent Misallocation and Productivity*. mimeo, World Bank.

VERHOOGEN, ERIC. 2023. Firm-Level Upgrading in Developing Countries. *Journal of Economic Literature*, **61**(4), 1410–1464.

WORLD BANK. 2022. *World Development Indicators*. Washington DC: World Bank.

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 – managers and business professionals 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.

In Figure 1 we compare the distribution of employment in the Company's database to two relevant benchmarks. Representative data come from 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.[18] We aggregate 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 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 3.1, we compare earnings of middle managers and production workers in

[18] 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.

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.[19] Our data source for the United States is again the 2000 U.S. Census (Ruggles *et al.*, 2021).

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 4.

A.2 Substitution Among Labor Types in Company Data

This appendix studies how the mix of workers hired by clients in the Company database varies with respect to relative prices. We regress three different measures of workforce composition on the appropriate measures of relative prices to see whether clients engage in any substitution in response to the large measured relative price variation.

For our first approach we use the fact that the Company gives each job a skill level and ask whether the job levels respond to the relative price of management. We standard normalize the measure of job level to give it interpretable units. We measure the relative cost of management as the log average compensation in the Company database net of the estimated effect of job and year fixed effects minus the log of GDP per worker. Table A.1 column (1) shows the estimates: higher relative costs of management are associated with slightly higher average levels of workers, meaning more skilled and highly compensated

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

TABLE A.1: RESPONSE OF HIRING PATTERNS TO RELATIVE WAGES

	Aggregate			Within Firm		
	Level	Managers	Top Managers	Level	Managers	Top Managers
Wage/GDP p.w.	0.0308			-0.00557		
	(0.0624)			(0.0125)		
Manager Wage		-0.167			0.00206	
		(0.106)			(0.0125)	
Top Wage			-0.0929			-0.0141
			(0.0527)			(0.0329)
R-squared	0.001	0.020	0.001	0.262	0.325	0.143
N	160,681	160,329	150,354	160,675	160,323	150,348

Level is standard normalized job level from Company's internal scheme. Manager is a dummy for workers with manager rather than non-manager positions, while top managers is a dummy for workers with a medium or high-skilled manager position as compared to a low-skill one (as in Table 3). Wages are the logarithm of relative wage for the corresponding groups in the Company database. Standard errors in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

workers. Column (4) shows the results from the same specification with firm-year interactions. This specification leverages variation in hiring patterns across affiliates within a given firm. The estimated effect is now slightly negative. Both specifications yield results that are economically and statistically insignificant.

For our second and third approaches we estimate how relative hiring patterns respond to relative wages. In the second approach we use a linear probability model to estimate the effect of the relative cost of management on the probability a worker is a manager. The relative cost of management is the average log compensation of managers in the Company database minus the average compensation of non-managers in the Company database, where each measure of compensation is net of the estimated effect of job and year fixed effects. As columns (2) and (5) show, there is no consistent effect or statistically significant effect of manager compensation on the share of managers

Finally, for the third approach we use a linear probability model to estimate the effect of the relative cost of managers with an above median versus below median level on the probability that a manager has above median skills. In this case we take the global distribution of skills and define a fixed, global cutoff for which managers are above versus below median. The relative cost of above-median managers is the average log compensation of above median managers minus the relative log compensation of below median managers, where each measure of compensation is net of the estimated effect of job and year fixed effects. As columns (3) and (6) show, there is again no consistent effect or sta-

tistically significant effect of the price of above-median managers on the share of above-median managers.

We emphasize again that the Company's database is an incomplete record of its clients' hiring patterns. In particular it contains few production and supervisory workers, and so the results in columns (2) and (5) should be treated with caution. Among the workers captured, the stylized fact is that there is no consistent evidence of substitution to cheaper, less skilled workers, either at the aggregate or across affiliates within a given firm, despite large differences in relative costs.

B Full Model for Factor Price Counterfactuals

Below, we provide an example of a full equilibrium model where the balanced growth path features the adoption equation (2) from the main text, and where individual factor price shocks can be generated by shocks to primitives.

Environment. The economy is small and open, facing an exogenous interest rate r. There is a single tradable final output with its price normalized to 1. Trade is costless.

Households. Human capital is determined by a dynastic household of unit measure that decides decides on consumption, savings, and schooling to solve

$$\max_{c_t \geq 0, b_{t+1}, educ_{t+1} \in [0,1]} \sum_{t \geq 0} \beta^t u(c_t)$$

subject to

$$c_t + b_{t+1} + w_{m,t}\phi \times educ_{t+1} \leq w_{u,t}(1 - educ_t) + educ_t w_{m,t} + (1+r)b_t + T_t$$

and a no Ponzi constraint, where $educ_{t+1}$ is the share of children coming of age at $t+1$ that receives schooling, which is obtained at a cost ϕ of skilled labor. We further assume that the household's discount rate equals the world interest rate, $\beta \equiv \frac{1}{1+r}$. T_t represents transfers and profits from tariffs and the financial intermediatry. We focus on a steady-state solution with an interior solution for schooling, implying

$$w_m \phi \equiv \frac{w_m - w_u}{1+r} \iff \frac{w_m}{w_u} = 1 + (1+r)\phi.$$

That is, the skilled wage premium is a function of primitives alone.

Production. Some final good is received as an exogenous endowment, and some is produced from a continuum of varieties $i \in [0,1]$ using a CES aggregate:

$$Y = \left(\int_0^1 y(i)^{\frac{\sigma-1}{\sigma}} di \right)^{\frac{\sigma}{\sigma-1}}.$$

Each input good can be produced using a modern and traditional technology respectively, with production functions given by

$$y^T(i) = \bar{A} A^T(i) \left(\frac{k(i)}{\alpha_k^T} \right)^{\alpha_k^T} \left(\frac{\ell(i)}{\alpha_\ell^T} \right)^{\alpha_\ell^T} \left(\frac{x_{dom}(i)}{\alpha_x^T} \right)^{\alpha_x^T} \tag{B.1}$$

$$y^M(i) = \bar{A} A^M(i) \left(\frac{k(i)}{\alpha_k^M} \right)^{\alpha_k^M} \left(\frac{\ell(i)}{\alpha_\ell^M} \right)^{\alpha_\ell^M} \left(\frac{x_d(i)}{\alpha_x^M} \right)^{\alpha_{x,d}^M} \left(\frac{x_{imp}(i)}{\alpha_x^M} \right)^{\alpha_{x,imp}^M} \left(\frac{\ell_m(i)}{\alpha_m^M} \right)^{\alpha_m^M} \left(\frac{el(i)}{\alpha_{el}^M} \right)^{\alpha_{el}^M}, \tag{B.2}$$

where $k(i)$ is capital, $\ell(i)$ is production labor, $x_d(i)$ and $x_{imp}(i)$ are domestic and foreign intermediate inputs respectively, $\ell_m(i)$ is managerial input, and $el(i)$ is electricity.

The final output can be used for consumption, investment, or the production of intermediate inputs and electricity. We assume that the both domestic and imported intermediate inputs are produced linearly from the final output. The one difference is that imported good is subject to a tariff τ_{imp}, implying that their prices are

$$p_{x,dom} = 1$$
$$p_{x,imp} = e^{\tau}$$

Electricity is competitively produced locally from the final good using the production function

$$el = \min \left\{ A_{grid} \frac{y_{grid}}{1-\rho}, A_{generator} \frac{y_{generator}}{\rho} \right\},$$

where ρ is the share of production done by generators and $A_{grid}, A_{generator}$ are the TFPs of grid production and generator production respectively. This setup implies an electricity price

$$p_{el} = \frac{1}{A_{grid}} \left[(1-\rho) + \rho \times \frac{A_{grid}}{A_{generator}} \right],$$

where $A_{grid}/A_{generator}$ is the relative cost of generator electricity versus grid electricity.

Entrepreneurs. Every period a measure μ of entrepreneurs is born. An entrepreneur lives for two periods. In the first period or life, they receive an endowment $\bar{k}$ of the final good. They allocate this endowment between investment in a company and bonds to maximize second-period consumption. Agents choose b, k, i, and $s \in T, M$ to maximize consumption

$$c = (1 + r + r^s I(b < 0))b + k + \pi^x(i, k)$$

where

- r is the interest rate
- r^s is the spread over the interest rate for borrowing
- $I(\cdot)$ is an indicator function
- $\pi^x(i, k)$ represents profits net of depreciation
- δ is the depreciation rate

Their choice is subject to the constraint $b + k \leq \bar{k}$. We further assume that you cannot borrow if you run a traditional firms $(b \geq 0)$, while modern firms can borrow subject to a constraint defined later.

For any i and s, profits net of depreciation as a function of capital satisfies[20]

$$\pi^s(k, i) \equiv R^s(i) \times k \qquad s \in \{T, M\}$$

[20]This follows from the profit maximization subject to a specific capital input level k:

$$\pi(k, \{w_f\}) = \max_{\{z_f\}} pAk^{\alpha_k} \prod_f \left(\frac{z_f}{\alpha_f}\right)^{\alpha_f} - \sum_{f=2}^{F} w_f z_f,$$

where $\alpha_k + \sum_{f=2} \alpha_f = 1$, which has a solution

$$\pi(k, \{w_f\}) = k\tilde{R}$$

where

$$\tilde{R} = (pA)^{\frac{1}{\alpha_k}} \left(\prod_{f=2}^{F} w_f^{\alpha_f/\alpha_k}\right)^{-1}$$

where

$$R^s(i) + \delta = \left(\alpha_k^s p(i) A^s(i)\right)^{\frac{1}{\alpha_k^s}} \prod_f \left(w_f^S\right)^{-\frac{\alpha_f^s}{\alpha_k^s}}$$

This formulation relates profits to prices, productivity, and factor costs. In equilibrium, all industries (indexed by i) are active. We assume that $\frac{A^M(i)^{\frac{1}{\alpha_k^M}}}{A^T(i)^{\frac{1}{\alpha_k^T}}}$ is differentiable and monotonically increasing in i, going to 0 as $i \to 0$ and to infintiy as $i \to 1$. These assumption imply there is a critical variety i^* such that firms with $i \leq i^*$ operate with the traditional technology and firms with $i > i^*$ operate with the modern technology, with firms being indifference at i^*. Indifference between technologies further mean that $R^T(i)$ must be the same for $i \leq i^*$ and $R^M(i)$ must be the same for $i > i^*$. Hence,

$$p(i) = \begin{cases} p(i^*)\frac{A^T(i^*)}{A^T(i)} & i \leq i^*, \\ p(i^*)\frac{A^M(i^*)}{A^{TM}(i)} & i > i^*. \end{cases}$$

and we write R and R^M for the common capital returns in the traditional and modern sector respectively.

Starting with entrepreneurs operating in the traditional sector, we first note that we need $R > r + \delta$ in equilibrium to ensure positive production in all sectors. Given this, the entrepreneur invests everything in the firm, obtaining consumption

$$c^T = \bar{k}(1 + R).$$

For entrepreneurs in the modern sector, we assume that parameters are such that $R^M > r + r_s > r$, ensuring that it is profitable for the entrepreneur to invest in the firm and to borrow. For a given borrowing level, the entrepreneur's consumption is

$$c^M = \bar{k} + R_m[\bar{k} - b] + b(r + r_s)$$

Given the linear relationship between consumption and b, the firm chooses $b = 0$ if $R^m < r + r_s$ and maximizes borrowing otherwise. We assume that modern firms face the following borrowing constraint:

$$-\frac{b}{\bar{k}} \leq \frac{\left(\frac{r+r_s+\delta}{R+\delta}\right)^{-\theta} - 1}{1 - \left(\frac{r+r_s+\delta}{R+\delta}\right)^{1-\theta}}$$

where $\theta \in [0,1]$. This expression is decreasing in $\frac{r+r_s+\delta}{R+\delta}$,capturing that sustaining high loan ratios is more difficult if loans are less attractive, captured by the ratio of user of cost of capital when using outside capital, relative to the shadow cost of capital when using inside capital. Indifference between modern and traditional entrepreneurship implies

$$R^M(\bar{k}-b)+b(r+r_s)=R\bar{k} \iff R^M+\delta=(R+\delta)\left(\frac{r+r_s+\delta}{R+\delta}\right)^{\theta}$$

Additionally, prices at i^* satisfy[21]

$$p(i^*)=A^T(i^*)^{-1}\left(R+\delta\right)^{\alpha_k^T}\prod_f (w_f)^{\alpha_f^T}$$
$$p(i^*)=A^M(i^*)^{-1}\left(R+\delta\right)^{\alpha_k^M(1-\theta)}\left(r+r_s+\delta\right)^{\alpha_k^M\theta}\prod_f (w_f)^{\alpha_f^T}.$$

That is, in equilibrium, the free entry condition for entrepreneurs imply that prices at i^* can be interpreted as a unit cost function, with a shadow cost of own capital of $R+\delta$, and $r+\delta_s+\delta$ of outside capital. Note that since $r+r_s+\delta < R+\delta$, capital costs are unambiguously lower for the modern firm given their opportunity to borrow on capital markets. Furthermore, the advantage is increasing the lower the external lower rates are, and the more lax financial frictions are via a high θ. Putting the expressions together, we obtain the cutoff condition

$$\frac{A^M(i^*)}{A^T(i^*)}=\left(R+\delta\right)^{\alpha_k^M(1-\theta)-\alpha_k^T}\left(r+r_s+\delta\right)^{\alpha_k^M}\prod_f w_f^{\alpha_f^M-\alpha_f^T}$$

as desired. **Externally financed share as an upper bound on θ.** The problem also implies that

$$-\frac{b}{k}=\frac{-b}{\bar{k}-b}=\left(\frac{r+r_s+\delta}{R+\delta}\right)^{\theta}\frac{\left(\frac{r+r_s+\delta}{R+\delta}\right)^{-\theta}-1}{1-\left(\frac{r+r_s+\delta}{R+\delta}\right)}.$$

[21] Use that

$$R+\delta=(\alpha_k^T p(i^*)A^T(i^*))^{\frac{1}{\alpha_k^T}}\prod\left(w_f^T\right)^{-\frac{\alpha_f^T}{\alpha_k^T}}$$
$$R^M+\delta=(\alpha_k^T p(i^*)A^M(i^*))^{\frac{1}{\alpha_k^M}}\prod_f (w_f)^{-\frac{\alpha_f^M}{\alpha_k^M}}$$

The right-hand side is decreasing in the spread $\frac{r+r_s+\delta}{R+\delta}$, tending to θ when $\frac{r+r_s+\delta}{R+\delta} \to 1$. Since external financing is cheaper, we obtain

$$-\frac{b}{k} \geq \theta,$$

so the external financing share is an upper bound for the correct θ.

Factor prices spanned by primitives

The price of goods and factors satisfy the following equation

$$w_m = w_l \times [1 + (1+r)\phi], \tag{B.3}$$

$$r + r_s = r + r_s, \tag{B.4}$$

$$p_{dom,x} = 1, \tag{B.5}$$

$$p_{imp,x} = e^{\tau}, \tag{B.6}$$

$$p_{el} = (1-\rho)\frac{1}{A_{grid}} + \rho\frac{1}{A_{gen}}, \tag{B.7}$$

$$p(i^*) = \frac{1}{\bar{A} \times A^T(i^*)} w_u^{\alpha_u^T} R^{\alpha_k^T}, \tag{B.8}$$

$$p(i) = \begin{cases} p^* \frac{A^T(i^*)}{A^T(i)} & i \leq i^* \\ p^* \frac{A^M(i^*)}{A^M(i)} & i > i^* \end{cases}, \tag{B.9}$$

$$1 = p(i^*) \left(\int_0^{i^*} \left(\frac{A^T(i^*)}{A^T(i)} \right)^{1-\sigma} di + \int_{i^*}^1 \left(\frac{A^M(i^*)}{A^M(i)} \right)^{1-\sigma} \right)^{\frac{1}{1-\sigma}}, \tag{B.10}$$

$$(R+\delta)\rho\bar{k} = \int_0^{i^*} [p(i)y(i)\alpha_k^T] di + \int_{i^*}^1 p(i)y(i)(1-\theta)\alpha_k^M di, \tag{B.11}$$

$$\frac{A^M(i^*)}{A^T(i^*)} = (R+\delta)^{\alpha_k^M(1-\theta)-\alpha_k^T} (r+r_s+\delta)^{\alpha_k^M\theta} \prod_f w_f^{\alpha_f^M - \alpha_f^T}, \tag{B.12}$$

$$s(i) \equiv \frac{p(i)y(i)}{\int_i p(i')y(i')di'} = \begin{cases} \left(p^* \frac{A^T(i^*)}{A^T(i)} \right)^{1-\sigma} & i \leq i^* \\ \left(p^* \frac{A^M(i^*)}{A^M(i)} \right)^{1-\sigma} & i > i^* \end{cases}, \tag{B.13}$$

where (B.4) simply indicates that the cost of outside funds is simply the sum of two primitives. We want to show that managerial wages w_m, external financing costs $r + r_s$, imported intermediate prices $p_{imp,x}$, and electricity costs p_{el} can be independently moved by primitives, while keeping all other prices constant. To show this, we differentiate the system above and show that there primitives solving the system generate an arbitrary collec-

tion of $d\log w_m, d\log(r+r_s), d\log p_{imp,x}, d\log p_{el}$, together with $d\log w_u = d\log p_{dom,x} = d\log R = 0$.

$$
\begin{aligned}
d\log w_m &= d\log[1+(1+r)\phi] \\
d\log(r+r_s) &= d\log(r+r_s) \\
d\log p_{dom,x} &= 0 \\
d\log p_{imp,x} &= d\tau \\
d\log p_{el} &= \frac{\frac{1}{A_{gem}} - \frac{1}{A_{grid}}}{p_{el}} d\rho \\
d\log p(i^*) &= -d\log \bar{A} - \frac{\partial \log A^T(i^*)}{\partial i^*} di^* \\
0 &= d\log p(i^*) - \int_0^{i^*} s(i) d\log A^T(i^*) di - \int_{i^*}^1 s(i) d\log A^M(i^*) di \\
d\log \mu\bar{k} &= \left(\frac{(R+\delta)\rho\bar{k}}{Y}\right)^{-1} \left[\int_0^{i^*} \alpha_k^T ds(i) + \int_{i^*}^1 \alpha_k^M ds(i) di - (\alpha_k^M(1-\theta) - \alpha_k^T) s(i^*) di^*\right] \\
\frac{\partial \log A^M / A^T}{\partial i^*} di^* &= g(d\log(r+r_s+\delta), d\log w_m, d\log p_e l, d\log p_{imp,x}) \\
ds(i) &= f(d\log A^M(i^*), d\log A^T(i^*), d\log p(i^*))
\end{aligned}
$$

rom the first five equations, we obtain a direct mapping from the desired price changes to change in ϕ, $r+r_s$,τ, and ρ. To ensure that the other equations hold, we proceed recursively. From the second to last equation, we obtain di^* and hence $dA^M(i^*)$ and $dA^T(i^*)$. From the last equation, we obtain $ds(i^*)$.The equation for $d\log \mu\bar{k}$ can be satisfies by simplyingchoosing the the right shock to the measure and endowment of entrepreneurs. Last, $dA^T(i^*)$ and $dA^M(i^*)$ gives us $d\log p(i^*)$ which implies a unique TFP shift $d\log \bar{A}$ that satisfies the sixth equation. The intuition for why the appropriate shocks exist is that we hit relative prices thanks to ϕ, r_s, τ, and ρ. The only issue is to get $dw_u = dR = 0$. However, by controling the TFP, we can generate $dw_u = 0$, and by controlling the supply of entrepreneurs and their initial endowment, we can control the shadow cost of capital.