Rules and Regulations, Managerial Time and Economic Development

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March 2026

Abstract

We document that senior plant managers in less-developed countries spend more time dealing with government rules and regulations than their counterparts in richer countries. We interpret these facts through the lens of a span-of-control growth model, in which top managers run heterogeneous production plants, employing middle managers as well as production workers. The model implies that increasing the time burden on top management leads to equilibrium changes in wages, occupational sorting, the size distribution of production plants and ultimately, to a reduction in aggregate output. Quantitatively, we find that increasing the burden on managers' time from the levels observed in our benchmark economy (Denmark) to the higher levels observed in less developed economies has substantial consequences. Imposing the average time spent on regulations in Italy (Argentina) reduces aggregate output by about 20% (37%) and mean plant size by about 2.8 (5.4) employees. Our results contribute to account for differences in plant size and output across countries via a channel hitherto unexplored in the literature.

JEL Classifications: E23, E24, J24, M11, O43, O47.

Key Words: Time Tax; Economic Development; Managers; Plant Size; Distortions.

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1 Introduction

It has long been argued that the business environment in less-developed countries involves more rules, regulations and red tape than in richer ones, hindering the development of private businesses as in developed economies and ultimately contributing to lower living standards. One aspect of excessive or inefficient rules and regulations that can be particularly detrimental is when they divert time from productive activities. Simple examples abound. In Denmark, for instance, it takes on average one hundred and thirty two hours to pay taxes per year, four days to register business property, and sixty four days to deal with a building permit. In Mexico, the corresponding figures are strikingly higher: two hundred and eighty eight hours, sixty five days and ninety nine days, respectively.[1] Similar examples can be documented for economies at similar levels of development.

In this paper, we focus with high resolution on the diversion of time from productive activities of managers caused by rules and regulations. For ease of exposition, we refer to this phenomenon as the time burden on managers, or simply as the *time tax*. We first extensively document the incidence of this implicit tax across countries. We then interpret the data via the lens of a growth model, in which the span of control of managers is distorted by a time tax, and quantify its consequences.

Our empirical analysis leverages data from the World Bank Enterprise Survey, where a common set of questions are asked to representative samples of establishments in different countries. In this data, we focus on the time tax on senior or top management, defined as the fraction of their time devoted to deal with rules and regulations. In this data, the average time tax of rich countries like Denmark, the Netherlands and Sweden averages about 6-7%, while for Türkiye, Mexico and Argentina can be three times as large, at around 15-20%. Using this data, we document that senior management in richer countries systematically devote less time to deal with government rules and regulations than their counterparts in less developed countries. We find that this relationship holds after controlling for a host of plant characteristics, and also when we expand the sample to include poorer economies than in our benchmark. It also holds in manufacturing and services, and holds after controlling for two-digit industry characteristics. Our estimates imply that a 20% decline in GDP per working-age adult is associated with a decline in

[1] Source: Doing Business Report, 2016. See also Loayza *et al.* (2010) and Djankov *et al.* (2002).

the net fraction of time available to managers (one minus the time tax) of about 1.3 percentage points. We also find that larger establishments tend to be more exposed to a time tax than smaller ones. Nonetheless, we find that the differences in the burden between small and large establishments vary by country, and are on average small.

What would be the implications of changes in a time tax? Consider the standard Lucas (1978) span-of-control model with only labor as an input. In this setup, introducing a time tax that is uniform across all plants, is akin to a reduction in aggregate productivity. An increase in the time tax would just lead to a reduction in aggregate output, with no effects on the size distribution of plants in equilibrium. Yet, it is natural to surmise that the effects of a higher time tax would be more nuanced. We note that the data refers to time taxes on *top managers*, clearly suggesting that the analysis should consider more than one layer of managers. This, in turn, leads to consequences on managers at different layers and the overall organization of production.

To explore the quantitative consequences of the time tax across countries, we develop a growth model in which top managers run production units employing capital, raw (production) labor and managerial services from middle managers. In the model, a representative household accumulates capital and optimally allocates heterogeneous household members to different occupations: top management, middle management or production work. Production requires completing a continuum of imperfectly substitutable tasks. Each task requires production labor and capital. The total number of production tasks is bounded by the ability of a top manager, who can hire the services of middle managers to complement his/her ability and thus, enhance his/her span of control.

In equilibrium, more able top managers run larger production units and work with more employees (workers and middle managers). In this context, we introduce a time tax that reduces the endowment of productive time of top managers. As a result of the presence of a time tax, top managers reduce their demand for labor and managerial services, leading to changes in prices and a change in the equilibrium assignment of individuals to different occupations. This results in more top managers, fewer production workers, with an ambiguous effect on middle managers. Therefore, the introduction of time tax, even if it is fully proportional to all plants, results in a lower average plant size. Output declines due to the lower available time of top managers, the changes in the occupational

assignment, as well as the changes in capital formation across steady states.

Findings We parameterize the model environment in order to match observations of the Danish economy (one of the richest in our sample), which is characterized by a low time tax on average and around the predicted regression line connecting output per working-age adult and the time endowment of managers (net of the time tax). Our economy reproduces properties of the size distribution of production plants, including the concentration of production at the top, in conjunction with the average number of managers per plant and the relative fraction of managers at plants of different sizes. We also force the model to be consistent with observations on average time taxes in line with data and at large plants (plants with 100+ workers). We do so via the specification of a two-parameter function determining the time tax at the plant level; one parameter governs the 'level' of the tax and another how it varies with respect to the ability of the top manager - a 'curvature' parameter. We then conduct several experiments where we vary the model parameter governing the level of the time tax, how the time tax varies with plant size and the effects associated with varying the structure of the time tax according to data.

Our findings show that changes in the parameter governing the level of taxes can lead to large effects on output and size statistics. Increasing the level parameter from the benchmark (Danish) level of around 4.2 % to a level of 10% (15%), i.e. to levels observed in middle-income economies such as Argentina, Türkiye or Mexico, leads to a large, long-run drop in output in excess of 25% (40%). It also determines a reduction in average plant size, from the benchmark level of about 13.3 employees to about 9.6 (7.5), with a resulting increase in the average tax across all plants from about 6.4% to 12% (16.8%). These effects are concomitant with a drastic reallocation of production, away from larger plants. Our findings show that the employment share at large plants (more than 100 employees) drops about 10 (20) percentage points from the benchmark case.

We then apply our model to make inferences about selected countries. First, we calibrate the level parameter of the time-tax function of different countries – developed and middle income economies – to reproduce the average level of the time tax in selected countries. For the average level of the time tax of Italy, our model implies a reduction in

output of about 20%, relative to the benchmark case. Meanwhile, for the level of time taxes in Argentina, the predicted reduction in output is much larger – about 37%. The corresponding effects on mean size imply a reduction to about 10.5 and 7.9 employees for Italy and Argentina, respectively.

For these economies, we also ask what the implied gains in output would be if the structure of the time tax in Denmark is imposed. For these purposes, we recalibrate our economy to these countries to account for potential differences in the distribution of managerial ability under the time tax structure that we infer from data. Our results imply large output gains. For Italy, the implied gain in output is of nearly 29% across steady states. For Argentina, our results imply a gain of about 50%, while for Türkiye – an initially more distorted economy from the time tax perspective– the implied gain in output is larger, of nearly 80%. From these and previous exercises, we conclude that reductions in the time burden on top managers can go a long way in generating sizeable effects on aggregate output. Thus, it can be a key force in closing the output gaps with rich economies without relying on large shares of reproducible factors.

We examine the implications and robustness of our findings in different directions. We find that variation in the level of time taxes account for about 55.4% (67.1%) of the log-variance in output per adult (measured TFP) in our sample. We find that the detrimental effects of increases in the level of time taxes on output depend non-trivially upon the importance of middle management in production. In the extreme case of no middle management, recalibrating our economy, we find that between the model economy misses a substantial portion of the output losses from raising the level of mean taxes. When we raise the level of the baseline time tax from 6.4% (Denmark) to intermediate values (12.0%), we find that output losses in the benchmark case are nearly 30% larger relative to the ones predicted by the economy with no middle management. Finally, we also modify our economy to allow for a flexible degree of substitution between top and middle managers. Relative to the benchmark economy, this extension implies smaller output losses from increases in time taxes and fits non-targeted moments less well.

Related Literature Our paper is related to several, interconnected strands of literature. First, it is directly connected to the span-of-control model first developed in Poschke

(2018). Tamkoç (2024) extends this model to allow for the coexistence of top and middle management. We differ from that paper in that we use and extend the framework to study the impact of time taxes on top managers. In contrast, Tamkoç (2024) focuses on a distinct question: how size-dependent distortions are amplified when plants with varying numbers of managers coexist, and the macroeconomic implications for output and related variables.

Given our emphasis on production plants with more than one manager, our work also naturally connects with papers that follow the seminal work of Garicano (2000) and Garicano & Rossi-Hansberg (2006). Examples include Caliendo & Rossi-Hansberg (2012), Caicedo *et al.* (2019), Gumpert *et al.* (2022), Santamaría (2022), Mariscal (2018) and Lopez & Torres (2020), among others.

Our paper is also related to a growing body of work that emphasizes the role of managers and the constraints that they face in economic development, and the resulting implications for the size of production plants and productivity. Our emphasis of the time tax on top managers in data connects our paper with the empirical literature on managerial practices and performance; see Bloom & Van Reenen (2007), Bloom & Van Reenen (2010), Bloom *et al.* (2013), Bloom *et al.* (2019) and others. Bloom *et al.* (2019) in particular quantifies the role of planning for Brexit on the time allocation of top managers in the UK. Recent examples of papers that emphasize the role of managers in economic development and quantify the importance of features of the environment include Akcigit *et al.* (2021), Alder (2016), Burstein & Monge-Naranjo (2009), Chen *et al.* (2023), Esfahani (2022), Guner *et al.* (2018), Hjort *et al.* (2022) and Grobovšek (2020) among others.

Finally, our paper is related to large body of work that connects output differences and development patterns with the misallocation induced by firm or plant-specific distortions. Bento & Restuccia (2021) and Bento & Restuccia (2017) document plant-size differences across countries, and relate these differences to distortions that are size dependent. Barseghyan (2008) quantifies the productivity effects associated with entry barriers, while Moscoso Boedo & Mukoyama (2012) evaluate the productivity effects of entry and firing cost restrictions. Buera & Shin (2017) develop a model with heterogenous firms subject to distortions, and argue that removal of these distortions is consistent with ob-

served episodes of economic reforms. Hsieh & Klenow (2014) document large differences in employment growth over the life-cycle of manufacturing plants in Mexico and India relative to the United States. They relate these differences to distortions as implied by different model setups. Garcia-Santana & Pijoan-Mas (2014), Guner *et al.* (2008), Gourio & Roys (2014) and others show how particular policies can lead to size differences and lower output. In recent work with a similar emphasis to this paper, Pellegrino & Zheng (2024) use responses to survey data to identify the effect of red tape on output and investment in a set of European countries. Unlike these papers and others in the literature, we show how variation in a novel concept – the time burden of regulation on top managers – can lead to output and size differences that are substantial.

2 The Time Tax Across Countries

Our primary data source is the World Bank Enterprise Surveys (WBES). This is an establishment level survey over a representative sample of an economy's non-agricultural and non-financial private sector. From establishment characteristics to government relations, a wide range of topics is covered through face-to-face interviews with business owners and top managers. It follows stratified sampling methodology along sectors of activity, establishment size and location with a common questionnaire for all countries. Formal establishments with at least 5 full-time permanent workers are included in all WBES.[2] We also use other data on aggregate variables, such as real GDP per working-age adult (PPP) and employment numbers that are from World Development Indicators (WDI).[3] We subsequently use plant-size distribution data from economic censuses for some countries.

The key question we focus in the WBES dataset asks the following: *"In a typical week over the last year, what percentage of total senior management's time was spent on dealing with requirements imposed by government regulations?"* In this question, senior management refers to managers, directors, and officers above direct supervisors of production or

[2]Raw establishment level data is publicly available at www.enterprisesurveys.org

[3]The employment data for Antigua and Barbuda and St. Kitts and Nevis are not available. Therefore, we assume the employment and population ratio in these countries is 0.53 which is the average employment to population ratio in our sample.

sales workers. We interpret the answer to this question as the time tax on managerial activities since it refers to time spent dealing on red tape and bureaucracy that would otherwise spent on business matters according to WBES questionnaire manual.[4]

Our selection criteria is that a country is included in the analysis if it ever had a GDP working-age adult (ages 15-64) above $25,000 in PPP terms (2017 international dollars) during the years in which the survey was conducted. Using GDP per working-age adult allows to adjust for the non-trivial differences in demographics of the countries considered. As a result, there are 42 countries in our sample, which mostly consists of middle income and high-income countries. Although there are multiple rounds of WBES in most countries in our sample, we treat them as repeated cross-section data. Hence, a country appears more than once in our data if it satisfies the selection criteria. After we drop observations with missing values or "Don't Know" for the answer to the question of interest, the total value of annual sales and the number of permanent full-time workers, we have 42,751 establishments in our final sample. Table A.1 provides the list of countries and survey years. Subsequently in this section, we discuss how our findings are affected by the inclusion of poorer countries.[5]

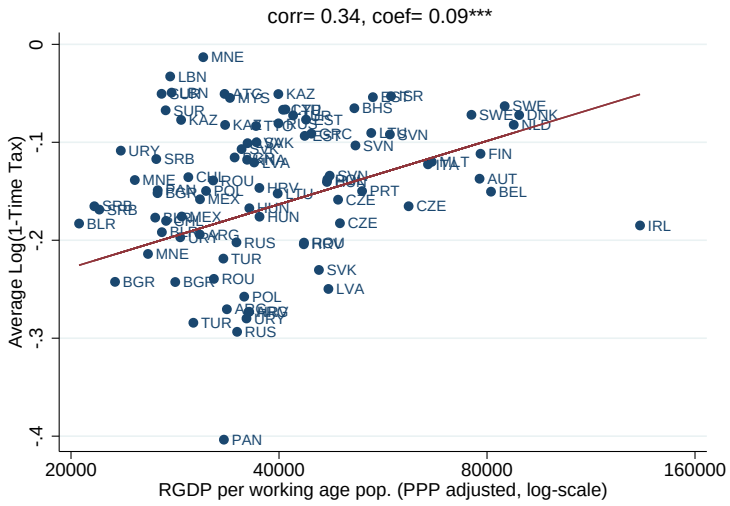
Figure 1 illustrates the main motivating fact of the paper: senior managers in richer countries tend to spend less time on dealing with government regulations. The vertical axis shows the mean of the logarithm of one minus the average time tax in a country at a survey year and the horizontal axis is the log of GDP per working age adult in a country at a survey year. The solid line represents the simple weighted regression line where the total employment is used to weight observations. The regression coefficient is positive and significant at 1% level and the correlation between the variables is 0.34. We interpret the variable of one minus the time tax as net time available for senior management after time devoted to deal with government regulations.

The figure reveals some striking features of the data when richer countries are compared with other developed economies. For example, establishments in Denmark report

[4]The questionnaire manual prepared by WBES team is available online at WBES webpage.

[5]The number of permanent full-time workers and the sales information are missing in 0.6% and 13.5% of observations in our sample, respectively. The correlation between the time tax and non-response to sales is -0.015, and the difference in the time tax between establishments with and without sales information is, on average, -0.65%, which is not statistically significant. Therefore, we conclude that non-response to sales is not related to the time tax.

Figure 1: Relationship between the Time Tax and RGDP per Working Age Pop.



Notes: This figure shows the relationship between the log of 1 minus the time tax and RGDP per working age adult. Each dot represents a country at a survey year. The solid line is the simple weighted regression line where dependent variable is the log of one minus the time tax and the independent variable is the RGDP per working-age adult. The countries are weighted according to their employment sizes. Sources: WBES and WDI.

an average time tax of about 6.4%, while in Finland (2020) is about 9.3%, about 10.% in Italy (2019), and about 14% in Portugal (2019). The differences become more striking when comparing to less-developed economies. The average time tax Argentina (2017) is more than 3 times as large (21.6%) than in Denmark. Similar figures hold for other countries around the same levels of development, such as Türkiye and Mexico. The estimated relationship implies that going from an output per working- age adult level of $80,000 to $40,000 is associated with an approximate decline in the time available to top managers of about 6.2 percentage points.

Correlation with Related Measures A natural question is how the time tax at the plant level correlate with answers to specific questions related to incidence and costs of government activity and regulation. Some questions in our data are ideal for this and we provide a basic description of these empirical associations below. For each country/year, we calculate the correlation in cross section of the log of one minus the time tax with the log of x, where x is the answer to a specific question. We then compute the simple

average of the correlation across all country/years.

Specifically, we consider answers to the following queries. (i) number of visits or required meetings with tax officials; (ii) number of days to obtain an import license; (iii) number of days to obtain a construction-related permit; (iv) identifying business licensing and permits as major or very severe obstacle. We find negative correlations with one minus the time tax, on average, of -0.076, -0.059, -0.013 and -0.083, respectively. This is intuitively expected, showing that higher values in these answers are associated with a reduction in the available time of top managers.[6]

Time Taxes and Mean Plant Size What is the relationship between time taxes and mean plant size? An answer to this question is not easy, as our sample is for plants with five or more permanent workers, and systematic economic census data is not available for all country-year observations.

However, we can provide an answer based on statistics on mean plant size provided by Bento & Restuccia (2021), who compiled data for multiple countries. For the countries that intersect with our data, we present in the Appendix B the relationship between mean size in non-agriculture and the mean of the logarithm of one minus the time tax. The figure therein shows a positive relationship (p-value 0.06), indicating that economies with high levels of available time of top managers have higher mean plant size.

We return later to this issue in our quantitative-theoretic analysis, as the model we develop has implications for plant size across countries. In our subsequent analysis, we use available, comprehensive observations on plant-size emerging from economic censuses.

2.1 General Characterization

We now present a more general characterization of the empirical relationship between the (net) time available to managers and the level of development. We estimate the following relationship:

$$\log(1 - t_{i,c,t}) = \alpha + \beta \log GDP_{c,t} + F(i, c, t) + SFE_i + u_{i,c,t} \tag{1}$$

[6]In particular, we note that the average number of meetings with tax officials and the average percentage of establishments identifying business licensing and permits as major or very severe obstacle are strongly correlated with the level of development. See corresponding figures in Appendix C

where $1 - t_{i,c,t}$ stands for 1 minus the time tax at establishment i in country c at year t. $GDP_{c,t}$ stands for the log of RGDP per working-adult in country c at year t, SFE_i is a dummy variable associated to the two digit ISIC 3.1 sector, and $F(i, c, t)$ stands for a set of establishment level characteristics for establishment i in country c at year t. We control for the experience of the top manager (years), the number of permanent-full time workers, the age of the establishment (years), whether the establishment is a part of larger firm (multi-establishment dummy), the percentage owned by foreign nationals, the percentage of sales coming from exports, the gender of the top manager and whether the establishment has a bank loan or a line of credit. All OLS regressions use Huber-White robust standard errors and the standard errors are clustered at the country, survey year, region, sector and size level.

Table 1 presents our baseline OLS estimation, where observations of each country/year are weighted by the establishment weights in the survey. Our pooled regression results strongly confirm the view that level of development is negatively associated with the time tax. Note that our specification allows us to interpret the coefficient of interest β as the elasticity between the net time available to managers with respect to level of development (GDP per working age adult). The OLS estimates of the regression coefficient are of a value around 0.057, implying that halving GDP per working-age adult is associated with a decline in the net time available to managers of about four percentage points: $-0.04 \sim 0.057 \times \log(1/2)$.

The regression analysis also reveals more findings. The senior managers of bigger establishments tend to spend more time dealing with government regulations compared to the senior managers at small establishments, as the third row in Table 1 shows. This relationship is, however, small in magnitude and of relatively low statistical significance. We investigate this issue in more detail below. The results also show that time tax for older establishments is higher when compared to that for younger establishment. Interestingly, the findings reveal more precisely that the age of the establishment is what matters, not the experience of the manager. No other explanatory variable that we consider has any statistical significance.

Fixed Effects We also perform additional estimations that are presented in the Appendix E. We repeat all estimations with country-sector fixed effects and without any fixed effects. All of these estimations strongly show that top managers in richer countries devote a fewer fraction of their time on dealing with government regulations.

It is worth noting that the estimates with country fixed effects show a much stronger relationship between the time tax and development. Our benchmark estimates imply an elasticity with respect to the level of development of about 0.057, whereas the key elasticity when country-fixed effects is about 0.195. Thus, halving GDP per working-age adult is associated with a sharper decline in the net time available to managers of 13.5 percentage points: $-0.135 \sim 0.195 \times \log(1/2)$.

This finding suggests that the correlation of fixed effects with GDP per working-age adult is *negative.* Indeed, that is the case; the correlation between the log of GDP per working-age adult and country fixed effects is -0.57. Put differently, the available time of top managers goes up faster with development than in the benchmark estimates.

Manufacturing and Services In the appendix, we show that the positive and significant relationship between the net time available to top managers and the level of development persist even if we estimate the regressions in manufacturing and services sectors separately – see Table D.1 and D.2. These results show that the relationship between the incidence of the time tax and the level of development is stronger in the manufacturing sector, even when controlling for two-digit sectors within manufacturing or services. The coefficient of interest becomes 0.0975 in manufacturing and 0.0402 in services.

2.2 Plant Size and the Incidence of the Time Tax

We now investigate in detail the relationship between the incidence of the time tax and establishment size. Our findings discussed above showed a relative small size-dependency in the time tax across establishment across countries in the sample; i.e. managers in larger establishments are more exposed to time taxes than those in smaller establishments. We first illustrate via four examples of representative countries in the data. We present the cases of Finland and Italy, two developed economies in our data, and two middle

income countries, Argentina and Türkiye. We compare them to a prototypical rich country (Denmark), one of the economies with the lowest incidence of the time tax.

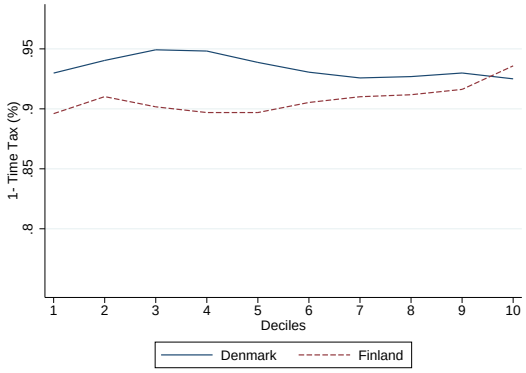


Figure 2: Finland vs Denmark

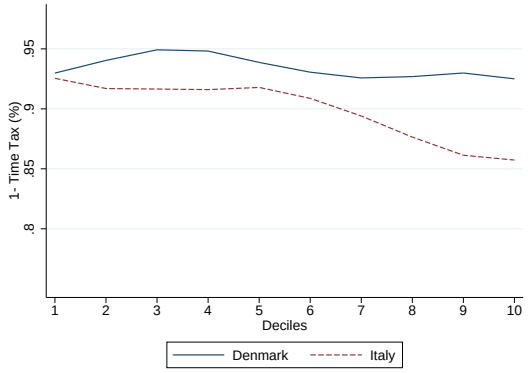


Figure 3: Italy vs Denmark

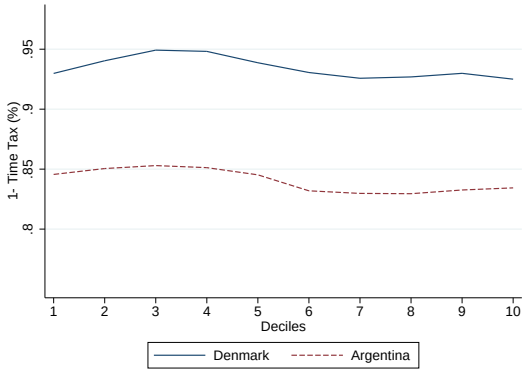


Figure 4: Argentina vs Denmark

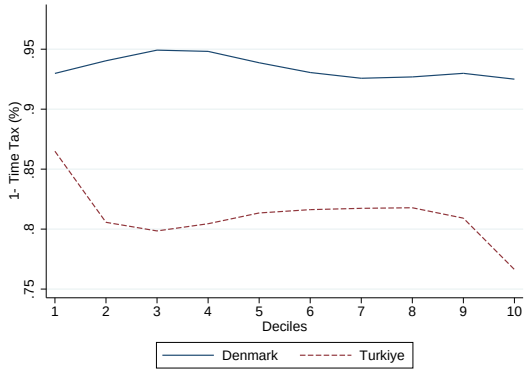


Figure 5: Türkiye vs Denmark

Note: These figures present the level of the net time available to top managers across percentiles of the establishment size distribution. The top panels compare Finland and Italy with Denmark, whereas the bottom panel compare Argentina and Türkiye with Denmark.

Figure 2 shows that the net time available to managers in Finland is lower across different plant sizes than in its richer counterpart, Denmark, but with magnitudes that are relatively similar. Figure 3 shows a larger difference on average for Italy, an economy with a lower level of output per working-age adult. However, these economies differ in the sense that as plant size increases, the burden on top managers declines in Finland relative to Denmark (and is even larger at the very top). Meanwhile, the opposite pattern holds for Italy: top managers at larger plants face a heavier burden of the time tax relative to those in smaller plants.

As illustrated in Figure 4, the net time available to top managers in Argentina is essentially a mirror image of the Denmark's case, but at a much lower level. A difference of about ten percentage points emerges between Argentina and Denmark at all size levels. Managers in large establishments in Denmark are a bit more heavily taxed than at smaller establishments, and the same pattern holds for Argentina. The case of Türkiye in Figure 5 is somewhat different. While large differences on average exist in relation to Denmark, top managers at larger establishments in Türkiye are more heavily taxed than those at the bottom relative to Denmark. Thus, we would expect a stronger relationship between the net time available to top managers and size in Türkiye relative to Denmark or Argentina. Altogether, this suggests that the size effects uncovered earlier are due to within-country effects rather than across-country effects.

To examine the relationship between the net time available to top managers and size in a more systematic way, we estimate a version of equation (1) for each country/year in our sample:

$$\log(1 - t_i) = A_0 + B_1 \log(n_i) + F(i) + SFE_i + u_i \tag{2}$$

where n_i stands for the size of establishment i in each country/year.



Figure 6: Size Coeff. and Development

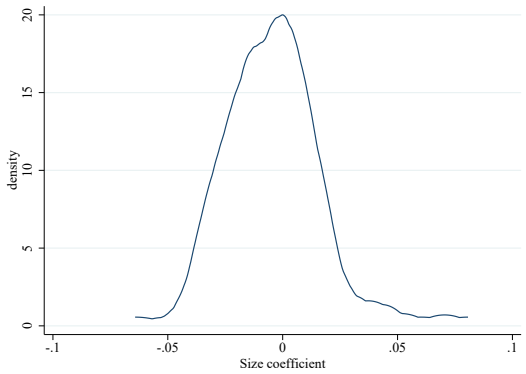


Figure 7: Size Coeff. Density

Note: These figures present properties of the coefficient B_1 associated to plant size. The left panel shows how it varies with the level of development, whereas the right panel illustrates its empirical density.

How does the coefficient B_1 vary with the level of development? Figure (6) shows that the country-specific coefficient is on average the same across levels of output per

working-age adult. Regressing the coefficient B_1 against GDP per working-age adult implies a statistically significant coefficient of about zero. In fact, the average value of B_1 is marginally negative, but quite close to zero. The right panel shows the empirical density associated to all estimated coefficients. It shows a distribution that is effectively centered around zero. The mean value is about -0.0042 and the median is about 0.0051. These results confirm our previous findings. Over the entire sample, we find a slight degree of size dependence of the time tax, but the effects are noisy as Figure 7 illustrates.

2.3 Including Poorer Countries

Our baseline results discussed so far are for a subset of middle-income and rich countries, that are included if their level of GDP per working-age adult in PPP terms is above \$25,000 (2017 international \$). A central motivation to focus on middle-income and richer economies is connected to the notion of *state capacity*: the institutions of the state are better developed there and hence, the burden associated to time taxes is meaningful.[7] We now relax this inclusion criteria, and explore the consequences of including more countries by reducing the inclusion threshold. We run our baseline regression when we gradually reduce the threshold level from the baseline level of \$25,000 to \$12,500. The results are presented in Table 2.

Our estimates show that our main results are robust to the inclusion of poorer economies. The relationship between the time tax and the level of developmentholds and is quite precise (strongly significant) for all the inclusion levels that we consider. The estimates show that the key elasticity with respect to the level of development becomes somewhat smaller as we reduce the threshold; it drops from the benchmark level of about 0.057 to 0.047 when the threshold is \$20,000, and still about 0.047 when the threshold is \$15,000. We also find that as more economies are included, the estimates of size dependency of the time tax become statistically insignificant (starting at a level of around \$20,000). Overall, our results are quite robust to the inclusion of poorer economies.[8]

[7] See Besley & Persson (2011), Dincecco (2017), and many others.

[8] As we reduce the threshold, the number of observations non trivially increases. It goes from $35,936$ in the baseline regression (Table 2, column 1) to about $58,775$ when the threshold level is \$12,500. Due to issues of data quality, observations for the economies of South Africa, Egypt, China and Indonesia are excluded.

2.4 The Time Tax as a Determinant of Value Added

We now ask a related, but different question. We ask: do time taxes contribute to account for differences in value added? Answers to this question complete the motivation for our quantitative-theoretical analysis in subsequent sections.

The answer to the question is affirmative. We use information available in our sample to construct a plant-level measure of value added (sales minus purchases of intermediate inputs), for each country and date. We then regress the log of value added per worker at a plant against the log of one minus the time tax, plus a set of similar controls as before including time effects. The results are in Table 3. The results show that an increase in the time available of top managers strongly increase value added per worker, regardless of the experience of the top manager. If we run a similar regression, of log-value added at a plant against the same set of covariates including the number of workers at the plant, we find a very similar and statistically significant point estimate.

The upshot of these findings is that the time tax appears to be a central determinant of value added. Thus, we surmise that economies with high values of time taxes will have lower levels of value added at the plant level and in the aggregate(GDP). More broadly, poorer economies are characterized by a higher incidence of time taxes, which in turn contribute lower values of output and mean size. This insight is at the core of the theory we build and quantify in the next sections.

3 Model Economy

We present below a growth model with an endogenous degree of span of control to capture key margins for the problem at hand. The model follows closely Tamkoç (2024), which in turn extends the span-of control setup in Poschke (2018) to allow for a production structure with top and middle managers.

Our model has three key features. First, it has production layers within a production plant, and thus, distinguishes between top ('senior') managers, regular managers and workers. This feature helps us to make sense of the nature of questions asked in the data. Importantly, it allows our economy to be consistent with a host of observations that a standard span-of-control model cannot account for. Second, the model leads to a size

distribution of plants in equilibrium, which we later match to actual plant-size distribution data. Finally, the model has a non-trivial role for a time tax on top managerial time. The model implies that even a time burden that is symmetric across all managers has implications for the size of plants and aggregate output in equilibrium.

3.1 Environment

There is a single household with measure one of household members. Each household member is endowed with a unit of time and managerial ability, $z \in (0, \bar{z}]$, with cdf, $G(z)$ and density $g(z)$. Differences in managerial ability are the only source of heterogeneity in the model. The household discounts the future at a rate of $\beta \in (0, 1)$ and has preferences over streams of a single consumption good, $\{C_t\}_0^\infty$, that are valued according to

$$\sum_{t=0}^{\infty} \beta^t \log(C_t) \tag{3}$$

The household assigns its members to three occupations. Each household member supplies one unit of time inelastically and becomes either a production worker, a middle manager or a top manager according to his/her ability level. Production workers earn a wage W regardless of their ability, whereas a middle manager with ability z_m earns $P_m z_m$, where P_m is the price of efficiency units in middle management.

Technology Top managers operate production plants where the single final good of the economy is produced. The final good is produced using the output from differentiated tasks (activities) indexed by j. For each activity, top managers rent capital, k_j, from the household and hire production workers, n_j. The number of activities that a top manager can run is bounded by her ability level, z, and the amount of middle managers hired, z_m.

Let $M(z, z_m)$ be the number of activities that a top manager with ability z can perform with z_m efficiency units of middle managers. The number of activities that a top manager can perform increases with the abilities of the top manager and the middle managers; i.e. M is strictly increasing in each of its arguments. We assume that M is continuous and twice differentiable, and that the ability of a top manager and middle managers are complementary, i.e. $\frac{\partial M^2(z,z_m)}{\partial z \, \partial z_m} > 0$. Finally, we focus on a case where M is convex in the

ability of the top manager. These assumptions fully pin down the occupational assignment of the household members, as we illustrate below.

The final output of a plant that performs $M(z, z_m)$ activities is given by

$$y = \left[\left(\int_0^{M(z,z_m)} \left(n_j^{\alpha} k_j^{1-\alpha} \right)^{\frac{\sigma-1}{\sigma}} dj \right)^{\frac{\sigma}{\sigma-1}} \right]^{\gamma} \tag{4}$$

where $\gamma \in (0, 1)$ stands for a span-of-control parameter in the spirit of Lucas (1978), and $\sigma > 1$ is the elasticity of substitution between the output of different activities (intermediate goods). $\alpha \in (0, 1)$ is the importance of capital in the production of intermediate goods. Capital depreciates at the rate $\delta \in [0, 1]$.

A Plant's Problem Each period, a top manager with ability z chooses the number of workers and the amount of capital for each activity as well as efficiency units of middle management in order to maximize:

$$\pi(z) = \max_{\{n_j, k_j\}_j, z_m} \left[\left(\int_0^{M(z,z_m)} \left(n_j^{\alpha} k_j^{1-\alpha} \right)^{\frac{\sigma-1}{\sigma}} dj \right)^{\frac{\sigma}{\sigma-1}} \right]^{\gamma} - \int_0^{M(z,z_m)} W n_j dj - \int_0^{M(z,z_m)} R k_j dj - P_m z_m \tag{5}$$

where R denotes the rental rate of capital services. Top managers can increase their span-of-control by hiring more middle manager services. Because of the complementary in abilities of top managers and middle management, more able top managers hire more middle management services and spend more on them than top managers of lower ability. In the appendix, we present the first-order conditions for this problem.

The Household's Problem The representative household owns the capital stock that it rents to production plants. At any date t, the household selects consumption and next period's capital as well the occupation of their household members. The latter is done by choosing two thresholds $z_{1,t}^*$ and $z_{2,t}^*$, taking prices R_t, W_t and $P_{m,t}$ as given. It follows that the flow of income accruing to the household is

$$I(z^*_{1,t}, z^*_{2,t}; R_t, W_t, P_{m,t}) \equiv \int_0^{z^*_{1,t}} W dG(z) + \int_{z^*_{1,t}}^{z^*_{2,t}} p_{m,t} z dG(z) + \int_{z^*_{2,t}}^{\bar{z}} \pi(z) dG(z) + R_t K_t. \quad (6)$$

Thus, at any date, the household's budget constraint is

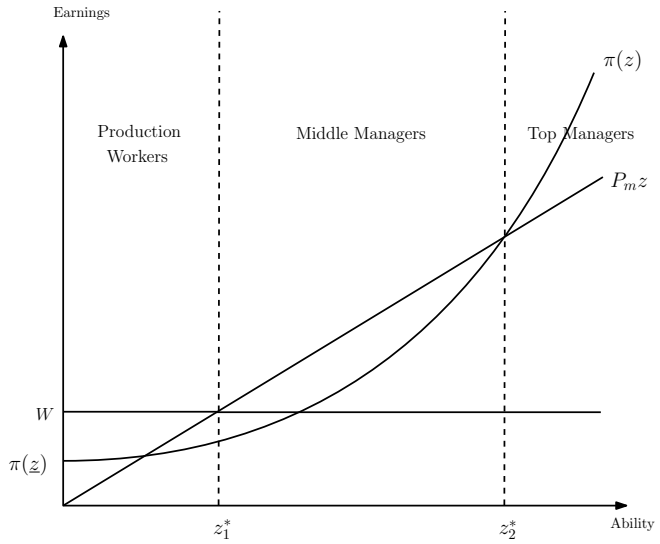
$$C_t + K_{t+1} = I(z^*_{1,t}, z^*_{2,t}; R_t, W_t, P_{m,t}) + (1-\delta)K_t \quad (7)$$

Formally, the problem of the household is to maximize (3), subject to (7) and $K_0 > 0$, by selecting sequences $\{C_t, K_{t+1}, z^*_{1,t}, z^*_{2,t}\}_0^\infty$.

The solution to the household problem involves a standard Euler equation characterizing the choice of consumption and capital, as well as the first-order conditions characterizing the occupational choices. We present these choices in detail in the appendix. In Figure (8) we illustrate the assignment of household members to different occupations. Household members with abilities greater than $z^*_{2,t}$ become top managers and run plants whereas the household members whose abilities are lower than $z^*_{1,t}$ become workers. The remaining household members with abilities between $z^*_{1,t}$ and $z^*_{2,t}$ work as middle managers. Workers earn W regardless of their managerial ability level whereas middle managers earn according to a linear function of their ability, $P_{m,t}z$. The rents (profits) of those who become top managers are also increasing in their ability and convex under the assumption of convexity of function M in the ability of the top manager.

The first threshold, $z^*_{1,t}$ exists and is unique because the earnings of production workers are constant at W, and the middle managers' income increases proportionally with their ability. The profits of top managers and the earnings of the middle managers can intersect at most twice due to the assumptions on the function M. As long as W is higher than the first intersection of the profit and the middle managers' earning functions, $z^*_{2,t}$ is uniquely determined and greater than $z^*_{1,t}$. Henceforth, the two thresholds fully define the sets that span all occupational choices.

Figure 8: Occupational Choice



Note: This figure illustrates the occupational choices for household members; production workers, middle managers and top managers.

3.2 A Time Tax

We introduce a *time tax* in the economy as a tax $\tau(z)$ on the time endowment of top managers. Thus, $1-\tau(z)$ is the available time for a top manager of ability z. Altogether, this implies that the function M that bounds the number of activities that can be carried out inside the plant is now corrected by the presence of the time tax:

$$M(z, z_m) \;\rightarrow\; M(z(1-\tau(z)), z_m) \tag{8}$$

We note that since the ability of the top manager determines the size of the plant's operations, this formulation is a simple yet flexible one that permits to accommodate time taxes that are potentially *size dependent*. A case in which all top managers are hit by the same time tax is simply $\tau(z) = \bar{\tau}$ for all z.

3.3 Competitive Equilibrium

In competitive equilibrium, the representative household and top managers make optimal decisions and markets clear. Market clearing in the market for production workers and middle managers requires

$$\int_0^{\hat{z}^*_{1,t}} g(z)dz = G(\hat{z}^*_{1,t}) = \int_{\hat{z}^*_{2,t}}^{\bar{z}} \hat{n}(z)g(z)dz \tag{9}$$

$$\int_{\hat{z}^*_{1,t}}^{\hat{z}^*_{2,t}} zg(z)dz = \int_{\hat{z}^*_{2,t}}^{\bar{z}} \hat{z}_m(z)g(z)dz \tag{10}$$

where $\hat{n}(z)$ stands for the equilibrium demand for production labor by a top manager with ability z, $\hat{z}_m(z)$ stands for the middle-manager services demanded by top manager with ability z, while a 'hat' over a variable denotes its equilibrium value. Market clearing for capital services requires:

$$\hat{K}_t = \int_{\hat{z}^*_{2,t}}^{\bar{z}} \hat{k}(z)g(z)dz \tag{11}$$

where $\hat{k}(z)$ is the capital demanded by top manager with ability z. The solution of the household problem dictates indifference conditions for occupation assignments. It implies two indifference conditions that hold in equilibrium:

$$\hat{W}_t = \hat{P}_{m,t}\hat{z}^*_{1,t}, \text{ and } \hat{P}_{m,t}\hat{z}^*_{2,t} = \pi(\hat{z}^*_{2,t}). \tag{12}$$

That is, the marginal middle manager at equilibrium prices is indifferent with the production work option at $\hat{W}_t$, and the marginal top manager is indifferent with regard to his/her compensation as a middle manager.
In equilibrium, aggregate output at t, $\hat{Y}_t$, is given by

$$\hat{Y}_t = \int_{\hat{z}^*_{2,t}}^{\bar{z}} \left[\left(\int_0^{M(z(1-\tau(z),\hat{z}_m(z))} \left(\hat{n}_j(z)^{\alpha} \hat{k}_j(z)^{1-\alpha} \right)^{\frac{\sigma-1}{\sigma}} dj \right)^{\frac{\sigma}{\sigma-1}} \right]^{\gamma} dG(z)$$

Altogether, equilibrium in the goods market implies the familiar condition in a one-sector growth model:

$$\hat{C}_t + \hat{K}_{t+1} = \hat{Y}_t + (1-\delta)\hat{K}_t \tag{13}$$

We can then define a competitive equilibrium. Given a time tax rule, $\tau(z)$, a competitive equilibrium are sequences $\{\hat{C}_t, \hat{K}_{t+1}, \hat{W}_t, \hat{P}_{m,t}, \hat{R}_t, \hat{z}^*_{1,t}, \hat{z}^*_{2,t}\}_0^{\infty}$ such that (i) Given

$\{\hat{W}_t, \hat{P}_{m,t}, \hat{R}_t\}_0^\infty$, the sequences $\{\hat{C}_t, \hat{K}_{t+1}, \hat{z}^*_{1,t}, \hat{z}^*_{2,t}\}_0^\infty$ solve the household problem; (ii) Given $\{\hat{W}_t, \hat{P}_{m,t}, \hat{R}_t\}_0^\infty$, factor demands solve the problem of each top manager at all t; (iii) Markets clear for all t; i.e. conditions 11, 10 and 9 hold for all t.

In the appendix, we show simple but important properties of competitive equilibria that we summarize in the proposition below.

Proposition 1 (*Equilibrium Properties*)**.** *In any competitive equilibrium,*

1. *The capital to labor ratio is the same for all activities and for all plants;*
2. *The plant-level capital to output ratio is the same for all plants;*
3. *The elasticity of plant-level value added and plant size (employees) equals 1.*
4. *Further, in a steady state, the aggregate capital to output ratio is equal to*

$$\frac{\hat{K}}{\hat{Y}} = \gamma \, \frac{1-\alpha}{1/\beta - 1 + \delta}. \tag{14}$$

The first two points follow from simple algebra implied by the optimization problem of plants and the corresponding first-order conditions – see Appendix F. We note that these conditions hold for all plants, regardless of the ability of the top manager and the structure of a time tax. These statements imply point 3 above, which is useful for model validation – see next section.

The last point follows from the fact that in steady state, allocations and prices are constant, as well as the thresholds $\hat{z}^*_1$ and $\hat{z}^*_2$. The Euler equation for the intertemporal choice of capital and consumption dictates the steady-state value of the rental price of capital,

$$\hat{R} = \frac{1}{\beta} - 1 + \delta.$$

Since the capital to output ratio is the same for all plants, it is also the aggregate capital to output ratio. This ratio depends only on the rental price of capital, which in steady state equals the value above.

Two simple, yet important comments are in order. First, just four parameters pindown the capital-output ratio in steady state; α, β, γ and δ. Note also that as the span of control

parameter γ approaches 1, the capital to output ratio becomes the *same* as the one in the standard one-sector growth model, under a Cobb Douglas technology with capital share $1-\alpha$.

Second, all steady states induced by different configurations of a time tax will share the same rental price of capital (same interest rate), the same capital to output ratio and the same aggregate share of payments to capital. Thus, changes in the time tax are equivalent to changes in Total Factor Productivity (TFP) in the standard one-sector growth model with a Cobb-Douglas technology. In such model, as is well known, the steady-state capital to output ratio is invariant to changes in TFP.

Model Statistics It is worth defining model statistics related to the size of production plants that can be used later on to map our model to data. Note first that total paid employees in the economy, production workers plus middle managers, amount to the fraction of agents who are not top managers. Thus,

$$\text{Total Employees} = G(\hat{z}_2^*) \tag{15}$$

Since there is one top manager per plant, it immediately follows that mean plant size, total employees per plant, is given by

$$\text{Mean Size} = \frac{G(\hat{z}_2^*)}{1-G(\hat{z}_2^*)} \tag{16}$$

Economy wide, how many managers per plant are there? Since there are $G(\hat{z}_1^*)$ production workers, there are $1-G(\hat{z}_1^*)$ middle managers and top managers. Hence, total managers per plant is given by

$$\text{Managers per Plant} = \frac{1-G(\hat{z}_1^*)}{1-G(\hat{z}_2^*)} \tag{17}$$

Meanwhile, middle managers per plant are given by

$$\text{Middle Managers per Plant} = \frac{G(\hat{z}_2^*)-G(\hat{z}_1^*)}{1-G(\hat{z}_2^*)} \tag{18}$$

4 Parameter Values

We now discuss the choice of parameter values for our economy, under the assumption that the model period is one year. We focus on stationary equilibria, and aim at reproducing aggregate and plant-size properties of a rich economy in our data, in line with observations of time taxes on top managers. We map our economy to Denmark, one of the richest economies in our sample, with observations on the time tax around the valued predicted by the estimated relationship presented in Figure (1).

We start by specifying the function mapping the ability of a top manager to time taxes. We use the average time tax function, popularized by Benabou (2002), and used in the development context recently by Guner *et al.* (2018) and others. Specifically, the distortion for a manager of ability z, $1-\tau(z)$, obeys

$$1-\tau(z) = (1-\tau_0)z^{-\tau_1} \tag{19}$$

In this formulation, τ_0 controls the 'level' of the time tax, and τ_1 the curvature of the time tax with respect to the manager's productivity. Note that if $\tau_1 = 0$, all managers face the same tax and their effective time endowment becomes $1-\tau_0$. If, however, $\tau_1 > 0$, top managers with higher abilities face higher time taxes. In other words, since higher ability managers run larger operations, τ_1 changes the size dependency of the time tax. We select τ_0 and τ_1, in conjunction with other parameters, to reproduce for Denmark's average time tax, and the time tax on large plants (more than 100 employees). Since the Enterprise Surveys considers plants with 5 or more full-time workers, we compute the corresponding statistics within the model under this restriction.

Endowments and Technology We assume that the distribution of abilities is log normal: $\ln(z) \sim N(0, \sigma_z^2)$. A critical next step in our parameterization regards the choice of the function M. Our choice is guided by observations on how the number of managers change as plant size becomes larger. Available evidence indicates that larger plants have more managers than smaller ones, and that the share of managers among all workers is smaller in larger plants compared to smaller ones. The latter observation implies that the span-of control is effectively larger in larger plants; i.e. the number of workers per

manager is larger in larger plants. Tamkoç (2024) discusses these observations across countries.

In line with the reasoning above, we choose the following specification:

$$M(z, z_m) = \bar{M}^{h(z,z_m)}, \quad h(z, z_m) \equiv (1 - \tau(z))\ z\ (1 + \phi z_m^{\theta}) \tag{20}$$

where $\bar{M} > 1$ is a level parameter, $\phi \geq 0$ governs the efficiency of middle management, and $\theta \in (0, 1)$ determines the degree of diminishing returns of middle management. When $\phi = 0$, top managers do not demand any middle managerial services, so there are only production workers and top managers in equilibrium. Note that this formulation allows for plants with no middle management.

This formulation is consistent with our assumptions. There are increasing returns to the ability of the top manager as $\bar{M} > 1$. Since the impact of the ability of the top manager on M increases with the middle management efficiency units, there is *complementarity* between the ability of a top manager and middle management: top managers with higher ability can and choose to perform more activities with extra units of middle management compared to top managers with lower ability. Diminishing returns associated with via $\theta \in (0, 1)$ imply that the span of control of top managers is bounded.

In section 6 we study the implications of an alternative specification, in which we allow for a flexible degree of substitutability between top and middle management.

Calibration We first exogenously set to usual estimates the discount factor β, the depreciation rate of capital, δ, and the aggregate share of capital, $(1 - \alpha)\gamma$, to 0.95, 0.055 and 0.33 respectively. Note that the importance of capital in the production of differentiated inputs, α, is determined after the span-of-control parameter γ is set using $(1 - \alpha)\gamma = 0.33$. We set the value of the elasticity of substitution between activities (intermediate goods), σ, to 6.6, in line with the middle (robust) estimates of Broda & Weinstein (2006), Table IV.[9]

We then proceed to calibrate the standard deviation of log ability σ_z^2, the span-of-

[9]We examine the implications of an alternative parameterization by re-calibrating the model parameters with different values of the elasticity of substitution among tasks at the plant level (σ). Appendix G discusses the robustness of results under lower and higher values of this parameter; $\sigma = 4$ and $\sigma = 8$. Our findings are that the precise choice of σ is of second-order for our results.

control parameter γ, and the parameters $\bar{M}$, ϕ and θ to reproduce jointly five observations for the Danish economy in 2016. We target the mean plant size (13.3 employees), the fraction of plants at the bottom 1-19 employees (93.1%), the employment share at (large) plants with more than 100 employees (61.7%), the mean number of managers per plant (1.3), and the share of managers at the top of the size distribution (250 and above employees) relative to those at middle and large plants (50 to 249 employees). This statistic captures the property relating managers at plants of different size mentioned above, and we informally refer to it as *management concentration ratio*. It amounts to 0.793 in 2019 Danish data from EU-LFS.

To compute plant-size statistics, we focus on 2018 data and consider all plants with at least 1 worker in all sectors while calculating the moments of plant size distribution. We use general enterprise statistics from Statistics Denmark to calculate the mean size and plant-size statistics. We use auxiliary data from ILO and Eurostat to compute the number of managers per plant.

Tables 4 and 5 show the resulting parameter values and performance of the model respectively. Figures 9 and 10 show the performance of the model in terms of the fraction of plants and employment shares at different bins of the plant-size distribution.

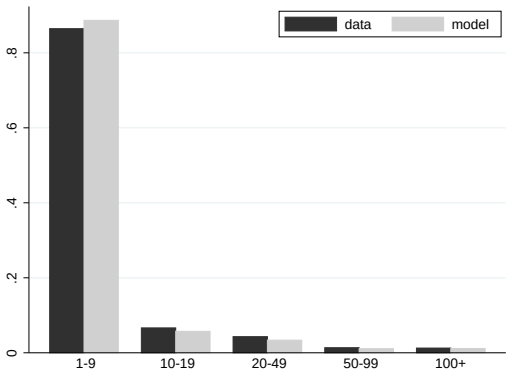


Figure 9: Fraction of Plants

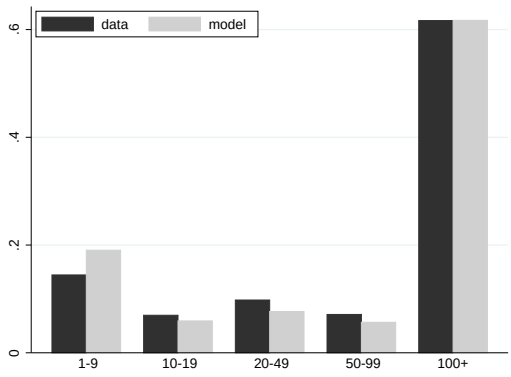


Figure 10: Employment Shares

Note: These figures present properties of the plant size distribution in terms of model and in the Danish data. The left panel shows fractions of plants at different bins of the plant-size distribution, whereas the right panel displays the corresponding shares of total employment.

A few comments are in order. First, our choices imply an aggregate capital to output ratio of around 3.1 in steady state, in line with standard estimates. Second, as it is well

known, employment is highly concentrated in large production plants. Plants with more that 100 workers constitute about 1% of the total number of plants, but they account for a disproportionate share of employment – about 61.7%. Our parsimonious model – aided by the complementary role of middle management – can easily generate the high levels of employment concentration at the top. We note that our model matches well the distribution of employment by size in data, as Figures 9, 10 and Table 5 show. Note that we only target two statistics of this data – the fraction of plants at the bottom (1-19 employees, and the employment share of large plants (100 and above employees).

Finally, our benchmark parameterization successfully matches the properties of the time tax in Denmark for plants with or more 5 employees, with a low average value and with a higher incidence for top managers at large plants. Our choices result in values for the level parameter τ_0 of 0.042, and a size-dependency parameter of 0.024. These parameters determine the observed time taxes for Denmark; of 6.4% on average and a time tax for plants with 100+ workers of about 7.1%.

4.1 Implications for Untargeted Moments

We now contrast the implications of our model with data that we have not targeted. We do so in the bottom panel of Table 5. We start by noting that our parsimonious specification captures quite well the untargeted concentration of employment at very large plants. In the data, the share of employment accounted for by plants with more than 250 employees is 53.1%, while the model implies 54.1%. This is reassuring as our model targets a management concentration ratio involving managers at very large plants.

We then we check the implications of our parameterization for inequality, and contrast the implied value of earnings dispersion among managers in the model against data. We use Danish data from EU-SILC, and focus on full time, paid managers. We define the earnings of (all) managers to be cash plus noncash income from the main job, and drop observations of those who report less than 30 hours of work per week. The data implies an average variance of log managers' income of about 0.97 for the years 2015-2019. Our calibrated model lines very well against this untargeted observation, and implies a variance of log-income of all managers of 0.91

We can also check for a theoretical prediction of the model against data. Proposition

1, part 3, states that the elasticity of output (value added) with respect to employment is 1. We use the data from the World Bank Enterprise Survey for Denmark in 2019, and construct a notion of value added at the plant level, and estimate a corresponding elasticity from this data. Again, our model lines up quite well with data, as the elasticity is estimated (significantly) at 1.01.

Altogether, these implications and properties of the model are reassuring for our subsequent use of the model to assess the impact of the time tax across countries.

5 Findings

In this section, we present and discuss the central quantitative results of the paper. We first explore the implied responses of our model economy to variations in the level of the time tax, and then evaluate the implications for specific countries. We then quantify the importance of changes in the size dependency of the time taxes.

5.1 Changes in the Time Tax: Levels

We now evaluate the consequences associated to changing the level of the time tax across steady states. In Table 6 we present the consequences of varying the 'level' parameter of time tax (τ_0) on a host of variables, , from the benchmark value up to 0.15. Note that the benchmark economy (Denmark) is characterized by a relatively low value of τ_0 (0.042), which in conjunction with the calibrated value of τ_1 (0.024), implies an average time tax of 6.4%. As τ_0 increases, the time tax increases on all managers and output declines. Quantitatively, the decline is substantial; a rise from the benchmark level of τ_0 to a value of 0.10 implies a loss output in the long run of about (25.1%) with a resulting average time tax of about 12.0%. An increase to $\tau_0 = 0.15$ leads to a sizeable loss of about 40.4%, with a corresponding average time tax 16.8%. These high value of resulting time taxes are well within the empirical range for other developed and middle income countries, as we showed in section 2 and discuss in more detail below.

The increase in τ_0 leads to an equilibrium reallocation of output and employment from larger to smaller plants, with a resulting reduction in mean size of about 3.7 employees on average as τ_0 at 0.10, and by about 5.8 employees if τ_0 reaches 0.15. The share

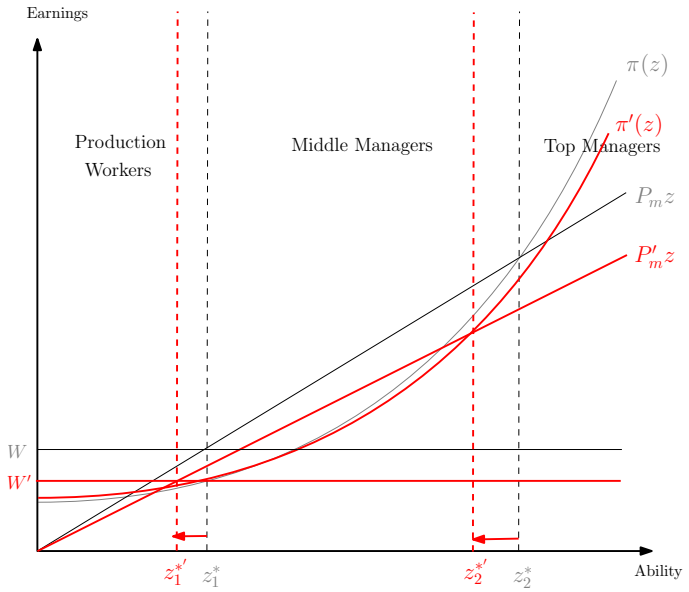
of employment at large plants drops from the baseline value to 51.4% (more than ten percentage points) for the case of $\tau_0 = 0.10$, with a concomitant increase in the share of employment accounted for by small plants, as Table 6 illustrates.

Equilibrium Effects Why do these equilibrium effects take place? As the time tax increases, the number of feasible activities within a given plant becomes lower and thus, output and managerial rents drop at fixed prices in conjunction with a reduction in the demand for labor and capital services. But, given the properties of the function M, which features increasing returns to top managerial ability, the drop in the demand of inputs is disproportionately larger in larger plants (run by more able top managers). This leads to equilibrium changes in occupational choices and thus, the size of production plants in equilibrium. Figure 11 illustrates these effects. The figure illustrates that the reduction in managerial rents takes place alongside an equilibrium reduction in the wage rate for production workers and the price of middle management efficiency units. This results in a decline in the equilibrium thresholds $\hat{z}_1^*$ and $\hat{z}_2^*$, which determines a reduction in the number of production workers, an increase in the number of top managers, and ambiguous effects on the number of middle managers. Altogether, this implies the reduction in mean size that the findings in Table 6 show.

The large effects on output driven by changes in the time tax are also connected to the changes in capital formation across steady states, with no effects on capital-output ratios as we elaborated earlier. Across steady states, the rental rate of capital is constant as τ_0 changes. Hence, as the demand for capital services drops upon an increase in the time tax, the aggregate stock of capital decreases in the new steady state as the rate of return has to be constant across steady-state equilibria.

Number and Quality of Managers Our results also show, via composition effects, a decline in the quality of management for both top managers and for middle managers across steady states. Table 6 shows a corresponding decline in the number of managers per plant. We find that the number of managers per plant decline from the benchmark value of 1.3 to 1.1 as the level of the time tax increases from the benchmark value to $\tau_0 = 0.15$. Here, we note that while the total number of managers (top and middle) increases, the number of plants increases as well.

Figure 11: Equilibrium Effects of Changes in the Time Tax.



Notes: This figure illustrates the effects of an increase in the time tax on occupational choices via an increase in τ_0.

The relatively small movements in the number of managers per plant masks the substantial changes in the organization of production induced by the increase in the level of the time tax. In the benchmark economy, the bulk of managers are concentrated at large plants. While plants have only 1.3 managers on average, plants with more than 100 employees have 18.2 managers on average as Table 6 shows. This drastically changes with increases in the level of the time tax. At $\tau_0 = 0.10$, the number of managers at large plants (100+) becomes 14.0 – a drop of more than four managers on average – while number of managers large plants under $\tau_0 = 0.15$ becomes 11.1. These findings underlie the substantial changes in output that we find across steady states as the level of time taxes increases.[10]

Some Country Examples In Figure 12 we associate observed levels of the average time tax, with changes in output and mean size driven by changes in τ_0. To construct the figure, we vary τ_0 from its benchmark value so to reproduce the empirical value of

[10]To calculate these figures, we first calculate the mean efficiency level of a middle manager in each economy (i.e. under different levels of τ_0). With this information, we infer the number of middle managers at different size bins.

average time taxes in the data. We show the implied values of output and mean size in steady state alongside the average time tax.

For illustrative purposes, we consider the same four countries we discussed earlier, Finland, Italy, Argentina and Türkiye. We add Portugal, keeping the benchmark case of Denmark in the figure. Note that for Denmark, by construction, we match the mean size observed in the data. The figure highlights the substantial effects predicted by the model when the time tax varies. A shift from time-tax levels observed in Denmark to Italy implies a fall in output of about 20%, and a corresponding reduction of about 37% for the case of Argentina. Clearly, the model naturally falls short of accounting for the actual differences in output per working-age adult for these countries as a group. Note that relative to Denmark in 2019, corresponding actual values are 87.9%, 73.8%, 59.3%, 34.5% and 37.3%, for Finland, Italy, Portugal, Argentina and Türkiye, respectively.

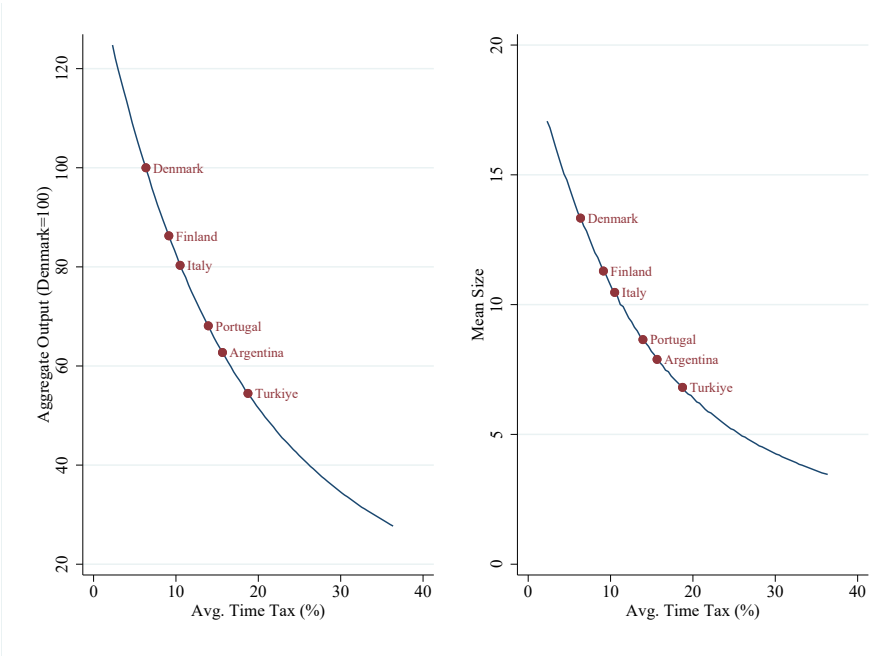
The model goes a long way in generating size differences in line with data from economic censuses for these countries. Mean plant size in data (model) amounts to 11.6 (11.3), 9.2 (10.5), 9.0 (8.7), 5.5 (7.9) and 4.8 (6.8) employees, for Finland, Italy, Portugal, Argentina and Türkiye, respectively. The model captures quite well via variation in τ_0 the size differences in countries with a lower burden of the time tax – Finland, Italy and even Portugal. The model misses a non-trivial portion of size differences for Argentina and Türkiye, naturally suggesting that other factors at play.

The findings in Figure 12 highlight that the effects of time taxes are convex as a function of the level of τ_0; i.e. effects are stronger at around low (benchmark) levels of time taxes. One reason for this finding is that as the time tax increases, there are more plants in operation, moderating in this way the negative effects of a higher time tax. A further, subtler reason is that as time tax levels increase, there are fewer middle managers and the effective span of control of top managers is lower. This determines that marginal increases in the level of the time tax result in gradually smaller changes in output across steady states.

5.2 Changes in the Time Tax: Size Dependency

We now entertain the effects across steady states associated with changes in the curvature parameter, τ_1, that governs the size dependency of the time tax. Note that increasing τ_1

Figure 12: Equilibrium Effects of Changes in the Time Tax.



Notes: This figure illustrates the effects on aggregate output and mean size for the cases of Finland, Italy, Portugal, Argentina and Türkiye, driven by changes in τ_0 that generate the observed levels of average time tax. The years considered for different countries are 2020, 2019, 2020, 2006 and 2013, for Finland, Italy, Portugal, Argentina and Türkiye, respectively.

tilts the function $\tau(.)$ counterclockwise, increasing the time tax for top managers running large plants while (potentially) reducing it at smaller plants.

Our results are summarized in Table 7, where we present results ranging from the benchmark value $\tau_1 = 0.024$ to $\tau_1 = 0.05$, covering a range of empirically plausible values for economies with size dependency. Note that increasing τ_1 from the benchmark value to $\tau_1 = 0.05$, increases the mean time tax from 6.4% to about 8.5%, while increasing the tax for large plants from the benchmark value of 7.1% by more than 3 percentage points. An increase in τ_1 increases the time tax more heavily for those top managers running larger plants, who reduce their demand for labor and capital services. This determines, in equilibrium, a reduction in mean plant size, an increase (reduction) in the employment share of smaller (larger) plants, and a change in the organization of plants at the top as previously. Output declines, due to the reduction of output at top plants alongside a reallocation towards smaller plants, and the concomitant reduction of aggregate capital across steady states.

Quantitatively, the effects of changes in τ_1 across steady states can be substantial. Increasing size dependency from its benchmark value to $\tau_1 = 0.04$, implies an increase in the average time tax of about 1.3 percentage points, but it leads to decline of output of about 9.8%, to a reduction in mean size of about 2.1 employees alongside a sharp reduction in the employment share of large plants of about 5.6 percentage points. The average number of managers at large plants drops non trivially, from the benchmark value of 18.2 to about 15.7.

Altogether, these findings indicate that the effects of changes in the level of size dependency can be important, even when taking into account that the first-order source of variation in the time tax across countries is in levels. We return later to this issue in the next section when we analyze the joint effects of levels and size dependency of time taxes for specific countries.

6 Discussion

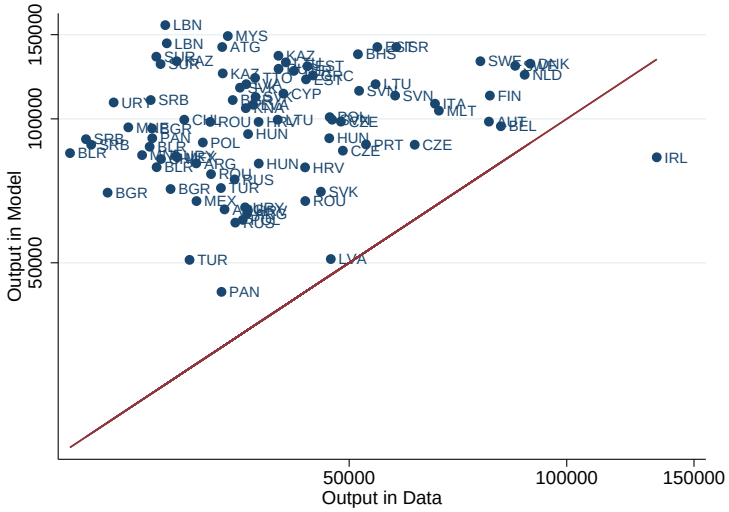
We now provide a discussion and perspective on the quantitative findings emerging from our model. We first evaluate the implications of time taxes for differences in income across

countries, TFP and mean size. We then assess the output gains for selected countries of adopting the structure of (low) time taxes of Denmark, allowing for the underlying distribution of managerial ability to vary across countries. We subsequently evaluate in detail the quantitative importance of the presence of middle managers for our findings. We conclude by providing direct evidence on the effects of time taxes using available data.

6.1 Implied Cross-Country Differences

How important are time taxes in generating dispersion in output in our sample of countries? Our model can provide an answer to this question. We start by noting that while we consider a set of middle income and rich countries in our data, the observed differences in output per working-age adult are substantial. Note that the output gap between Denmark and the poorest economy in our data exceeds a factor of 3.5.

Figure 13: Cross-Country Income Differences in the Model vs Data



Notes: This figure compares the model's prediction of aggregate output when it is disciplined to match each country's average time tax in the data using τ_0. Each dot represents a country-year and the solid line is the 45-degree line. We choose units so that the benchmark economy matches output in the data.

To answer this question, we reproduce the average time taxes for each country-year observation in our data via variations in the level parameter τ_0. We do so as the primary source of variation of time taxes in data is due to its levels, as we discussed in section 2.

The resulting output disparities across economies highlight the effects of only varying the level of mean time taxes in line with data.

Figure 13 illustrates our findings. As the figure shows, all the economies but one are above the 45-degree line. Thus, the model naturally predicts less variation in output than it is observed in data. To quantify the contribution of variation in time taxes on output per adult, we compute a measure of dispersion in output in the model and in the data. We find that the model accounts for about 55.4% of the variance of log-output per adult in the data. Regressing log-output in the model against log-output (per adult) in the data yields a statistically significant coefficient of 0.298. The raw correlation between model and data is 0.221. Thus, our model implies that the observed burden of time taxes can go a long way in accounting for the observed disparities in output in our sample of middle income and rich countries.[11]

Measured TFP and Mean Size Our analysis has implications for inferences on Total Factor Productivity (TFP) as a source of cross-country income differences, and points to a non-trivial role of time taxes in measured differences. To see this, consider a naive observer who has data on our economy under different levels of the time tax. Under traditional assumptions, the observer postulates a Cobb-Douglas aggregate technology, with capital share a and without any adjustment for labor efficiency units.

With these assumptions, one can write output per person as

$$y = \text{TFP}^{\frac{1}{1-a}} v^{\frac{a}{1-a}}, \tag{21}$$

where v is the capital to output ratio. In our economy, this ratio is invariant to changes in the time tax across steady states as illustrated in Proposition 1. Thus, the equation above can be used to infer TFP differences. In our case, the capital share takes the standard value of 0.33. This implies that if observed output per working-age adult is lower by 40.6% as in Table 6 (from the benchmark to $\tau_0 = 0.15$), the implied value of TFP is lower by about 29.1%. As we argued earlier, shifts in levels of time taxes of this magnitude are broadly in line with observations of middle-income countries. This strongly suggests that differences in time taxes can be an important source of differences in measured TFP

[11] The variance of log output per working-age adult in the data is 0.136.

across countries.

We now ask what implications our model has for measured TFP across all countries in our sample. Using a capital share of 1/3, we find that the model accounts for about 67.1% of the observed cross-country variation in TFP. As expected, this exceeds the fraction of output differences accounted for, since capital–output ratios vary across countries in data. This, in turn, contribute to reduce the correlation between model and data, which we estimate at 0.071.[12]

We can also ask the extent to which the model accounts for variation in mean size. As we cannot compute mean size using economic censuses for all country/year observations, we restrict ourselves to the available mean-size data from Bento & Restuccia (2021). As the model implies substantial effects on plant size, we find that it accounts for about 75% of the variation in mean size in this restricted sample. The correlation between model and data in this case is 0.203.

6.2 Country-specific Conditions and the Output Gains from Lower Time Taxes

We now focus on a different, but related question to income differences across countries. What are the *gains* in output associated to adopting the benchmark economy (Denmark) time taxes? For these purposes, we specifically take into account potential differences across economies in the distribution of managerial quality, income levels in conjunction with the empirical levels of time taxes and their size dependence.

We answer this question for five selected countries/years; the ones discussed earlier (Finland, Italy, Argentina and Türkiye) plus Portugal. Each of these cases is interesting on their own for the purposes of this paper. Finland, Italy and Portugal, the richest ones in the group, are poorer and more distorted than Denmark (in that order), but they differ in their degree of size dependence of time taxes as we showed in Section 2. The less developed of the group, Argentina and Türkiye, show higher levels of time taxes than the previous group. Argentina has about the same degree of size dependency than Denmark,

[12] We compute TFP using expression (21) in the text that considers only TFP and capital intensities as determinants of aggregate output. For the empirical measure of capital stocks across countries, we use the estimates from the PWT 10.1 of capital stocks at PPP U.S. dollars of 2017. Output levels are from our baseline data.

whereas time taxes are non-trivially more burdensome for larger plants in Türkiye.

We proceed as follows. We calibrate again our model for each country, where we impose their time taxes, both in terms of their level (τ_0) and their curvature (τ_1). We also force these economies to be consistent with their level of output relative to Denmark and their mean size (in the presence of observed time taxes). To match each country's relative output, we adjust the function M by the factor $\bar{M}^{-\lambda}$. Thus, a value of $\lambda > 0$, implies that all top managers in the economy can perform fewer tasks, and thus, output at the plant level and at the aggregate is lower. This is equivalent in our context to imposing different levels of exogenous, economy-wide productivity. To match each country's mean size, we adjust the variance of managerial ability. As such, our exercises take into account that the distribution of managerial ability could differ across economies. The rest of parameters are from the benchmark's case. We then proceed to impose the time-tax structure of Denmark to each of these economies.

Findings Our results are displayed in Table 8 and 9 where the last row presents the counterfactual output levels associated to Danish time taxes. We first note how the productivity factor varies across countries, depending on the required values of τ_0, τ_1, and the output gap. Argentina and Türkiye in the years considered are similar in terms of their output per-working adult gap relative to Denmark, while Türkiye has higher average time taxes with a stronger degree of size dependency. Thus, to match the observed gaps in output per adult, this dictates a larger adjustment factor λ for Argentina than for Türkiye, as the Table 9 demonstrates. An equivalent reasoning explains the low adjustment factor for richer economies like Italy and Portugal. Note that for Finland, an economy next to Denmark in terms of development but with higher yet strongly regressive time taxes, the required parameter λ is negative.

The above considerations lead to output gains for Italy of about 28.6%, and nearly 30% for Portugal. Interestingly, the gains for Finland turn out to be negative, given that moving to the benchmark time taxes of Denmark entails adopting a much higher degree of size dependence. Our findings imply larger gains in output for Türkiye than in Argentina from a shift to Danish time taxes. They imply that the steady-state output increase for a hypothetical Argentina is about 50% while the gains amounts to much more for Türkiye

– nearly 80%. Needless to say, these gains in output for middle income economies like Argentina or Türkiye, while sizeable, are far from enough to close the development gap. The output gap between a Argentina (2006) and Denmark (2019) is a factor of 2.9, while the corresponding gap with Türkiye (2013) is a factor of about 2.7.

6.3 The Importance of Middle Managers

We now investigate the importance of middle managers in the organization of production for our results – a key and novel feature in our analysis. We first consider various degrees of importance of middle managers, and also present the case with no middle managers at all. We then present an alternative parameterization, in which we allow different degrees of substitutability for middle and top managers.

Two conclusions emerge from the findings below. First, middle managers quantitatively matter for the output effects of time taxes, as a significant portion of the output losses from time taxes are missed in their absence. Second, an alternative specification does not capture observations as well, and predicts smaller effects associated to increases in time taxes.

Varying Importance of Middle Managers In Figure 14, we present the effects on output associated to changing the level parameter τ_0, for different levels of the parameter ϕ that captures the importance of middle management and its complementarity with top management. The figure displays the benchmark analysis, alongside a case in which ϕ is 25% lower and another case in which ϕ is 50% lower. When $\tau_0 = 0.1$, the benchmark analysis implies a level of output of nearly 75%, relative to Denmark, as Table 6 illustrated before. The figure shows that at the same value of $\tau_0 = 0.10$, the level of output is about 80% when the parameter takes a value equal to three fourths of the benchmark parameter, while it is about 87% when ϕ is 50% lower than the benchmark one. Hence, reducing the importance of middle management reduces the associated output losses from changes in the level of time taxes.

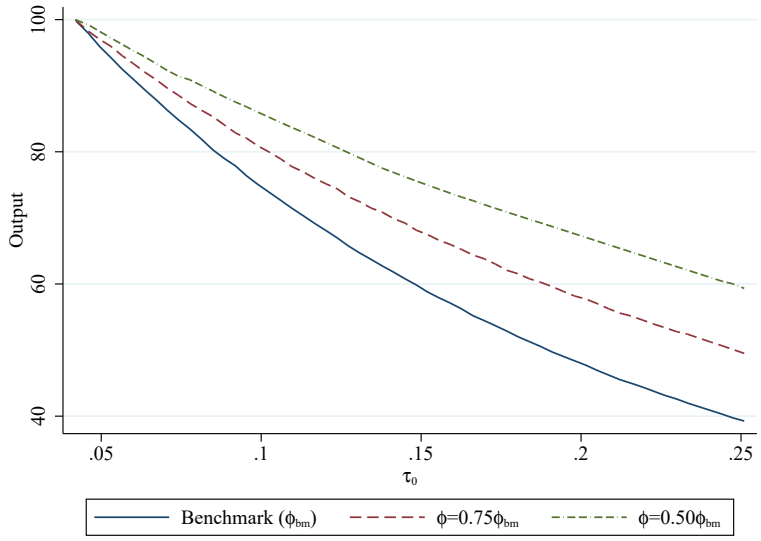
We also explore the extreme, polar case of no middle management all. That is, middle management no longer contributes to endogeneize the span of control of top managers. We recalibrate the model under this assumption, setting $\phi = \theta = 0$. This implies removing

two moments from the set of targets; the mean number of managers and the management concentration ratio moment - the number of managers at very large plants vs middle and large plants. This parameterization requires, unsurprisingly, a non-trivially higher level of the dispersion in ability, σ_z^2, is now 0.221 while it is about 0.144 in the benchmark case. Thus, in order to reproduce observations, top managers need to be much more able than in the benchmark case.

These results are summarized in Table 10. If aggregate output is normalized to 100 under the benchmark time taxes, we find that output in this scenario when $\tau = 0.10$ is 80.6 and when $\tau = 0.15$ is 68.0, while the effects on plant size are similar. Note that the corresponding values in the benchmark parameterization with middle management are 74.9 and 59.4, respectively.

We conclude from these results that the amplifying effects of the endogenous span of control via middle management are a central force in our quantitative analysis on the effects of a time tax. In the exercises just discussed, the implied output losses are nearly 30% larger in the benchmark economy relative to when middle management is absent in the model.

Figure 14: Varying Importance of Middle Managers



Notes: This figure presents the model's predicted output losses for different values of the parameter ϕ at different values of τ_0. For comparison, the figure includes the benchmark case.

Substitutability Between Top and Middle Managers We now evaluate the implications of an alternative specification for our economy, by reformulating the function M defining the number of possible tasks at a plant. We consider a case that permits an estimation of the degree of substitutability between top managers and middle managers in defining a plant's managerial capacity. We posit that

$$M(z, z_m) = \bar{M}^{h(z,z_m)}, \; h(z, z_m) \equiv (\xi((1-\tau(z))z)^{\rho} + (1-\xi)z_m^{\rho})^{\frac{1}{\rho}}, \; \rho \in (-\infty, 1) \qquad (22)$$

That is, managers of different types are imperfect substitutes via a CES aggregator in the function $h(z, z_m)$, with an elasticity of substitution of $(1/1-\rho)$. This parameterization requires that we infer values for new parameters ξ and ρ jointly with other model parameters. Intuitively, the parameter ξ contributes to match the number of middle managers per plant, whereas ρ contributes to match the management concentration ratio moment introduced earlier. Note that this parameterization implies that as the ability of the top manager increases, the marginal contribution of her ability diminishes in the function $h(z, z_m)$. This is not the case in our benchmark parameterization.

This CES parameterization nicely reproduces the targeted data, with a negative, intuitively expected value of the parameter defining substitution, $\rho = -0.142$. This implies a substitution elasticity of 0.876. Thus, top and middle managers are complements in the function $h(z, z_m)$, with a substitution elasticity less than 1. Differently from our benchmark case, this parameterization does not capture as well the underlying degree of dispersion of managerial income. The implied variance of log-managerial income is 0.71, while the average data value is about 0.97 for the years 2015-2019 as we discussed earlier.

Table 10 summarizes the main emerging findings associated to increases in the level of time taxes (τ_0). Relative to the benchmark case, the response to changes in the level of time taxes on plant size are similar. However, the benchmark model implies non-trivially *larger* effects on output. In the alternative specification, if aggregate output equals 100 under the targeted values of the Danish economy, aggregate output is about 81.7 and 69.5, for $\tau_0 = 0.10$ and $\tau_0 = 0.15$, respectively. The corresponding output levels in the benchmark case are 74.9 and 59.4, respectively.

6.4 (Some) Direct Evidence

Do time taxes have substantial effects in data as we find in our analysis? Is there any direct evidence in this respect? Our data allows us to provide a partial answer to these questions. Since some establishments in some countries are represented in more than one year in our data, we proceed to construct a *panel* to gauge the effects of time variation in time taxes on output. Focusing on plants that are observed twice or more over time, we calculate plant-level notion of value-added per worker. In doing so, we end up with a panel of 2,147 observations encompassing 24 countries.

In this context, we then estimate the elasticity of value-added per worker to changes in the time tax controlling for a host of observables. Our estimates yield an elasticity of about - 0.107.[13] This elasticity estimate implies that increasing the time tax by one percentage point – from benchmark levels – leads to a short-run drop in output of about 2%. Extrapolating to the large changes studied in Table 4 we obtain large effects. Doubling the time tax implies a change in value added per worker of about 10.7%.

One of the three largest reductions in time taxes over time occurs in Türkiye.[14] Given our analysis in Section 6.2, it is therefore instructive to assess this decline through the lens of our model. From 2013 to 2019, the average time tax in Türkiye fell sharply, from 18.7% to 7.3%. Using the calibration from Section 6.2 and accounting for changes in both the level and size dependence of the time tax over this period, the model implies a long-run output increase of 50.9%. While sizable, this gain is naturally smaller than the 80.4% gain associated with moving all the way to the benchmark (Danish) tax schedule that we showed earlier.

Overall, these empirical findings are reassuring, as they confirm our results that the effects of variation in time taxes has substantial effects on output. To put them in perspective, a few caveats are in order. First, these findings show short-run effects at the plant level while our results pertain to the long-run outcomes for the aggregate economy. Second, only a few observations from some countries are considered as the number of observations show. Finally, the panel of establishments that we construct is not necessarily

[13] In our panel estimates, we control for changes in the age of the establishment, in the experience of the manager, in the percentage owned by foreign entities and in whether the establishment has access to credit. The elasticity estimated is significant at the 1% level.

[14] The other economies are Poland and Montenegro.

representative; it is only derived from sample of plants that are interviewed in two data waves.[15]

7 Concluding Remarks

We have documented in detail properties of the time burden on top managers associated to government regulations – the *time tax* – in a set of middle-income and rich countries. We find that the incidence of the time tax is substantially larger in poorer countries relative to their richer counterparts. This finding and others are robust to a number of controls, and in particular, hold for the manufacturing and service sectors separately.

We then developed a simple span-of-control growth model in order to quantify the role of time taxes in the macroeconomy. We calibrate this model to observations from Denmark, one of the richest economies in our data, featuring a low level of a time tax. Our findings indicate that variation in time taxes within a range consistent with the cross-country data leads to substantial effects on output and plant size in the long run.

We conclude the paper with three comments. First, our analysis effectively leads to a simple theory of Total Factor Productivity (TFP) disciplined by observations on the time tax. It implies that variation in time taxes in line with data leads to a non-trivial variation in measured TFP, without effects on rates of return or capital-output ratios in the long run. Therefore, it contributes to account for measured differences in TFP that the literature has extensively documented.

Second, we have conducted our analysis under the assumption that labor effort is exogenous, and therefore, any effect of time taxes on labor supply is not considered. We conjecture that in the context of a more elaborated model with an endogenous choice of labor effort, higher time taxes would effectively lead to lower work effort from top managers. Thus, we expect larger output effects when time taxes increase in this case.

Finally, we have assumed throughout that the distribution of managerial abilities is invariant to changes in time taxes. It is natural to conjecture that changes in time taxes would affect such distribution via complementary investments to foster managerial skills, as in Guner *et al.* (2018) and Esfahani (2022). Thus, the predicted effects on output and

[15]More concretely, we do not use survey weights in our panel estimates as the data weights are not designed for these purposes.

the size distribution of plants from changes in time taxes are arguably larger than those found in this paper. We leave this and other extensions for future work.

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Table 1: Relationship between the time tax and the level of development after controlling establishment characteristics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Log RGDP per working age pop.	0.0593***	0.0672***	0.0638***	0.0615***	0.0577***	0.0579***	0.0587***	0.0568***	0.0567***
	(0.00940)	(0.0107)	(0.0111)	(0.0111)	(0.0111)	(0.0112)	(0.0114)	(0.0118)	(0.0117)
Experience of the top manager-log		-0.0161	-0.0152	-0.00622	-0.00586	-0.00599	-0.00512	-0.00620	-0.00618
		(0.00974)	(0.00983)	(0.00961)	(0.00958)	(0.00959)	(0.00968)	(0.0108)	(0.0106)
Number of workers-log			-0.0131*	-0.0108	-0.0127*	-0.0128*	-0.0111	-0.0121	-0.0122*
			(0.00620)	(0.00671)	(0.00637)	(0.00650)	(0.00646)	(0.00651)	(0.00611)
Age of the establishment (as of 2020)-log				-0.0227**	-0.0235**	-0.0237**	-0.0233**	-0.0238**	-0.0238**
				(0.00835)	(0.00854)	(0.00869)	(0.00860)	(0.00876)	(0.00897)
Multi-establishment					0.0258*	0.0209*	0.0196	0.0199	0.0195
					(0.0113)	(0.0105)	(0.0105)	(0.0109)	(0.0107)
Pct. owned by foreigns						0.0116	0.0155	0.0166	0.0166
						(0.0176)	(0.0168)	(0.0179)	(0.0187)
Pct. of sales coming from exports							-0.0231	-0.0240	-0.0234
							(0.0155)	(0.0160)	(0.0159)
Female top manager								-0.0282	-0.0282
								(0.0183)	(0.0177)
Establishment has a bank loan/line of credit									0.000352
									(0.0132)
Constant	-0.773***	-0.808***	-0.734***	-0.667***	-0.628***	-0.628***	-0.646***	-0.709***	-0.709***
	(0.101)	(0.103)	(0.112)	(0.112)	(0.114)	(0.115)	(0.117)	(0.125)	(0.125)
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Num. of Obs.	42664	42156	42152	41890	41890	41649	41536	36137	35936

Standard errors are in parenthesis and clustered at country year, sampling region, sampling size and sampling sector level.

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

Table 2: Including Poorer Economies

	(1) $25k	(2) $22.5k	(3) $20k	(4) $17.5k	(5) $15k	(6) $12.5
Log RGDP per working age pop.	0.0567***	0.0522***	0.0474**	0.0456***	0.0467***	0.0390***
	(0.0117)	(0.0111)	(0.0154)	(0.0125)	(0.0122)	(0.0109)
Experience of the top manager-log	-0.00618	-0.00548	-0.00476	-0.00335	-0.00375	-0.00388
	(0.0106)	(0.0105)	(0.0095)	(0.0090)	(0.0090)	(0.00875)
Number of workers-log	-0.0122*	-0.0119*	-0.01	-0.00967	-0.00918	-0.0101
	(0.00611)	(0.00604)	(0.00680)	(0.00642)	(0.00638)	(0.00622)
Age of the establishment (as of 2020)-log	-0.0238**	-0.0238**	-0.0226**	-0.0219**	-0.0218**	-0.0205*
	(0.00897)	(0.00890)	(0.00868)	(0.00845)	(0.00842)	(0.00832)
Multi-establishment	0.0195	0.02	0.0226*	0.0224*	0.0179	0.0179
	(0.0107)	(0.0107)	(0.0109)	(0.0105)	(0.0104)	(0.0102)
Pct. owned by foreigns	0.0166	0.0165	0.00912	0.00913	0.00954	0.00899
	(0.0187)	(0.0184)	(0.0176)	(0.0166)	(0.0165)	(0.0162)
Pct. of sales coming from exports	-0.0234	-0.0229	-0.0223	-0.0206	-0.0201	-0.0182
	(0.0159)	(0.0157)	(0.0154)	(0.0148)	(0.0146)	(0.0143)
Female top manager	-0.0282	-0.0277	-0.0163	-0.0153	-0.0154	-0.0169
	(0.0177)	(0.0175)	(0.0173)	(0.0164)	(0.0164)	(0.0160)
Establishment has a bank loan/line of credit	0.000352	0.000764	-0.00707	-0.00804	-0.00843	-0.00929
	(0.0132)	(0.0131)	(0.0143)	(0.0137)	(0.0137)	(0.0136)
Constant	-0.709***	-0.633***	-0.584***	-0.571***	-0.583***	-0.501***
	(0.125)	(0.122)	(0.169)	(0.140)	(0.137)	(0.124)
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Num. of Obs.	35936	37995	45529	53472	55230	58775

Standard errors are in parentheses and clustered at country year, sampling region, sampling size and sampling sector level.

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

Table 3: Relationship between plant-level value added per worker and the time tax after controlling establishment characteristics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
log(1-time tax)	0.294**	0.315**	0.320**	0.312**	0.306**	0.310**	0.325**	0.337**
	(0.106)	(0.106)	(0.107)	(0.107)	(0.108)	(0.107)	(0.111)	(0.110)
Experience of the top manager-log		0.141**	0.0776	0.0845	0.0958*	0.0958*	0.0959*	0.0973*
		(0.0503)	(0.0452)	(0.0447)	(0.0448)	(0.0449)	(0.0459)	(0.0460)
Age of the establishment (as of 2020)-log			0.175***	0.163***	0.160**	0.160**	0.156**	0.155**
			(0.0486)	(0.0485)	(0.0486)	(0.0490)	(0.0494)	(0.0492)
Multi-establishment				0.323***	0.284***	0.281***	0.272***	0.271***
				(0.0626)	(0.0632)	(0.0630)	(0.0654)	(0.0660)
Pct. owned by foreigns					0.434***	0.402***	0.403***	0.426***
					(0.0952)	(0.0966)	(0.0991)	(0.0997)
Pct. of sales coming from exports						0.134	0.118	0.0960
						(0.111)	(0.114)	(0.115)
Female top manager							-0.0581	-0.0522
							(0.0842)	(0.0850)
Establishment has a bank loan/line of credit								0.123*
								(0.0574)
Constant	10.94***	10.64***	10.17***	10.15***	10.15***	10.13***	13.49***	13.47***
	(0.139)	(0.185)	(0.248)	(0.246)	(0.246)	(0.244)	(0.557)	(0.557)
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Num. of Obs.	24743	24497	24341	24341	24219	24180	20953	20867

Standard errors are in parenthesis and clustered at country year, sampling region, sampling size and sampling sector level.

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

Table 4: Benchmark Parameter Values.

Parameter	Description	Value
	Exogenous	
β	Discount Factor	0.95
δ	Depreciation Rate	0.055
μ	Mean of ability distribution	0
$(1-\alpha)\gamma$	Capital Share	0.33
	Calibrated	
σ_z^2	Variance of ability distribution	0.144
ϕ	Efficiency of middle management	0.93
θ	Diminishing returns on middle management	0.005
γ	Span-of-control parameter	0.69
$\bar{M}$	Level parameter	59.3
τ_0	Level of time tax	0.042
τ_1	Size dependency of time tax	0.024

Note: This table shows the parameter values of our benchmark calibration. The top panel displays the exogenously set parameters, whereas the bottom panel presents the parameter values that are found in order to reproduce data.

Table 5: Benchmark Model Performance

Targeted Moments	Data	Model
Mean size	13.3	13.3
Managers per plant	1.3	1.3
Fraction of plants: 1-19 employees (%)	93.1	94.4
Employment share: plants 100+ employees (%)	61.7	61.7
Management Concentration Ratio	0.79	0.80
Mean time tax (plants with 5 or more employees, %)	6.4	6.4
Mean time tax 100+ (%)	7.1	7.1
Non-Targeted Moments		
Employment share: plants 250+ employees (%)	53.1	54.1
Manager's Variance Log-Income	0.97	0.91
Elasticity (size, value added)	1.01	1.0

Note: Table entries summarize the performance of the benchmark model in terms of empirical targets. The *'Management Concentration Ratio'* statistic pertains to the ratio of the fraction managers at plants with 250 employees or more, relative to the fraction of managers at plants with 50 to 249 employees.

Table 6: Changes in the Level of the Time Tax

	Benchmark			
	$\tau_0 = 0.042$	$\tau_0 = 0.10$	$\tau_0 = 0.125$	$\tau_0 = 0.15$
Mean Size	13.3	9.6	8.5	7.5
Output	100.0	74.9	66.5	59.4
Capital-Output Ratio	3.1	3.1	3.1	3.1
Employment Share (Small Plants, %)	25.0	33.4	37.5	41.7
Employment Share (Large Plants, %)	61.7	51.4	46.7	41.9
Managers per Plant	1.3	1.2	1.1	1.1
Number of Managers (Large Plants)	18.2	14.0	12.5	11.1
Top Managers Mean Ability	100.0	94.7	92.8	91.4
Middle Manager Mean Ability	100.0	94.7	92.9	90.6
Time Tax (Mean, %)	6.4	12.0	14.4	16.8
Time Tax (Large Plants, %)	7.1	12.8	15.2	17.7

Note: This table presents the quantitative experiments with different values of the level parameter of the tax function, τ_0. In this exercises, all the parameters except τ_0 are held constant at the benchmark values. Output at the benchmark is normalized to 100. The mean time tax is calculated only for plants with at least 5 employees. Large Plants are plants with 100 employees or more. Small plants are those with 1-19 employees.

Table 7: Changes in the Size Dependency of the Time Tax

	Benchmark			
	$\tau_1 = 0.024$	$\tau_1 = 0.03$	$\tau_1 = 0.04$	$\tau_1 = 0.05$
Mean Size	13.3	12.5	11.2	10.2
Output	100.0	96.1	90.2	85.1
Capital-Output Ratio	3.1	3.1	3.1	3.1
Employment Share (Small Plants, %)	25.0	26.6	29.3	32.2
Employment Share (Large Plants, %)	61.7	59.6	56.1	52.6
Managers per Plant	1.3	1.3	1.2	1.2
Number of Managers (Large Plants)	18.2	17.2	15.7	14.3
Top Managers Mean Ability	100.0	98.6	97.1	95.7
Middle Managers Mean Ability	100.0	98.8	97.1	95.9
Time Tax (Mean, %)	6.4	6.8	7.7	8.5
Time Tax (Large Plants, %)	7.1	7.8	9.0	10.2

Note: This table presents the quantitative experiments with different values of the curvature parameter of the tax function, τ_1, that defines the degree of size dependency of time taxes. In this exercises, all the parameters except τ_1 are held constant at the benchmark values. Output at the benchmark is normalized to 100. The mean time tax is calculated only for plants with at least 5 employees. Large plants are plants with 100 employees or more. Small plants are those with 1-19 employees.

Table 8: Output Gains from Adopting Benchmark Time Taxes

	DNK	FIN		ITA		PRT	
	2019	2020		2019		2019	
σ	0.377	0.355		0.377		0.366	
τ_0	0.042	0.169		0.062		0.160	
τ_1	0.024	-0.100		0.050		-0.032	
λ	0.000	-0.234		0.072		0.105	
		Data	Model	Data	Model	Data	Model
Mean Size	13.3	11.6	11.7	9.2	9.2	9.0	8.9
Time tax (Mean, %)	6.4	9.3	9.2	10.0	10.4	14.0	13.6
Time tax (Large Plants, %)	7.1	6.0	6.1	12.6	12.1	12.1	12.5
Output	100	87.9	87.9	73.8	73.7	59.3	59.3
Output (DK Time Tax)	100	-	85.7	-	94.8	-	77.2

Note: This table presents the parameterization of the economies of Finland, Italy and Portugal to reproduce the time tax in each case, in conjunction with their plant size and output level relative to the benchmark. The benchmark case (Denmark) is reproduced for illustration. The last row shows the output level when the Danish time taxes are imposed in each case. The mean time tax is calculated only for plants with at least 5 employees. Large plants are plants with 100 employees or more. See text for details.

Table 9: Output Gains from Adopting Benchmark Time Taxes

	DNK	ARG		TUR	
	2019	2006		2013	
σ	0.377	0.360		0.368	
τ_0	0.042	0.140		0.125	
τ_1	0.024	0.027		0.086	
λ	0.000	0.530		0.321	
		Data	Model	Data	Model
Mean Size	13.3	5.5	5.6	4.8	4.8
Time tax (Mean, %)	6.4	16.0	15.9	18.7	18.7
Time tax (Large Plants, %)	7.1	16.8	16.9	21.9	21.8
Output	100	34.5	34.6	37.3	37.3
Output (DK Time Tax)	100	-	51.9	-	67.3

Note: This table presents the parameterization of the economies of Argentina and Türkiye to reproduce the time tax in each case, in conjunction with their plant size and output level relative to the benchmark. The benchmark case (Denmark) is reproduced for illustration. The last row shows the output level when the Danish time taxes are imposed in each case. The mean time tax is calculated only for plants with at least 5 employees. Large plants are plants with 100 employees or more. See text for details.

Table 10: Time Taxes in Alternative Economies

	Benchmark Economy	No Middle Managers	Management Substitutability
Time Tax Level: $\tau_0 = 0.1$			
Output	74.9	80.6	81.7
Mean Size	9.6	9.6	9.2
Employment Share (Large Plants, %)	51.4	51.0	50.2
Time Tax Level: $\tau_0 = 0.15$			
Output	59.4	68.0	69.5
Mean Size	7.5	7.5	7.0
Employment Share (Large Plants, %)	41.9	41.3	39.7

Note: This table presents the quantitative experiments with different values of the level parameter of the tax function, τ_0, in three alternative scenarios. The first column presents the results from the benchmark economy. In the second column, we present the case in which there are no middle managers. The last column presents an alternative formulation, that allows estimation of the degree of substitutability between top and middle management in defining management capacity. Output at the benchmark is normalized to 100. Large Plants are plants with 100 employees or more. See the main text for further details.

Appendix

A List of Countries

Table A.1: Survey Years and the Number of Observations in WBES

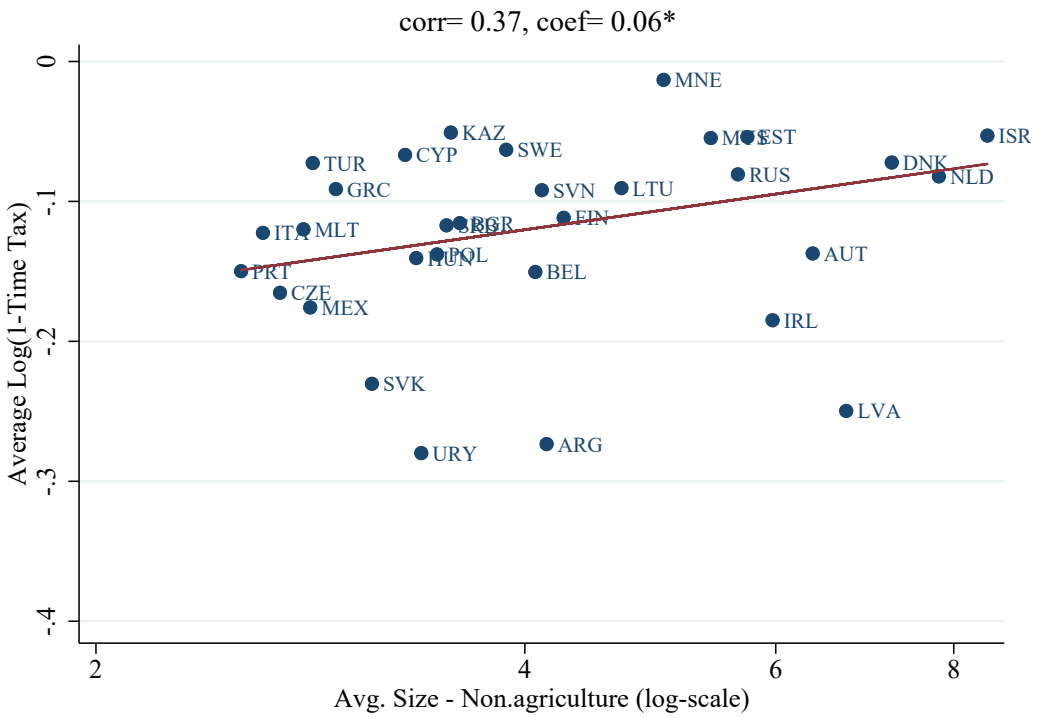
Country	Survey Year(s)	Number of Observations
Antigua and Barbuda	2010	134
Argentina	2006, 2010, 2017	2718
Austria	2021	572
Bahamas, The	2010	121
Belarus	2008, 2013, 2018	963
Belgium	2020	576
Bulgaria	2007, 2009, 2013, 2019	1953
Chile	2006, 2010	1845
Croatia	2007, 2013, 2019	1249
Cyprus	2019	189
Czech Republic	2009, 2013, 2019	855
Denmark	2020	931
Estonia	2009, 2013, 2019	797
Finland	2020	738
Greece	2018	580
Hungary	2009, 2013, 2019	1162
Ireland	2020	585
Israel	2013	426
Italy	2019	671
Kazakhstan	2009, 2013, 2019	1817
Latvia	2009, 2013, 2019	735
Lebanon	2013, 2019	984
Lithuania	2009, 2013, 2019	746
Malaysia	2015	797
Malta	2019	226
Mexico	2009, 2010	2679

Table A.1: Survey Years and the Number of Observations in WBES

Country	Survey Year(s)	Number of Observations
Montenegro	2009, 2013, 2019	271
Netherlands	2020	794
Panama	2006, 2010	631
Poland	2009, 2013, 2019	1093
Portugal	2019	822
Romania	2009, 2013, 2019	1456
Russian Federation	2009, 2012, 2019	4469
Serbia	2009, 2013, 2019	913
Slovak Republic	2009, 2013, 2019	714
Slovenia	2009, 2013, 2019	862
St. Kitts and Nevis	2010	128
Suriname	2010, 2018	307
Sweden	2014, 2020	1114
Trinidad and Tobago	2010	330
Türkiye	2008, 2013, 2019	3209
Uruguay	2006, 2010, 2017	1220

B The Time Tax and Mean Plant Size

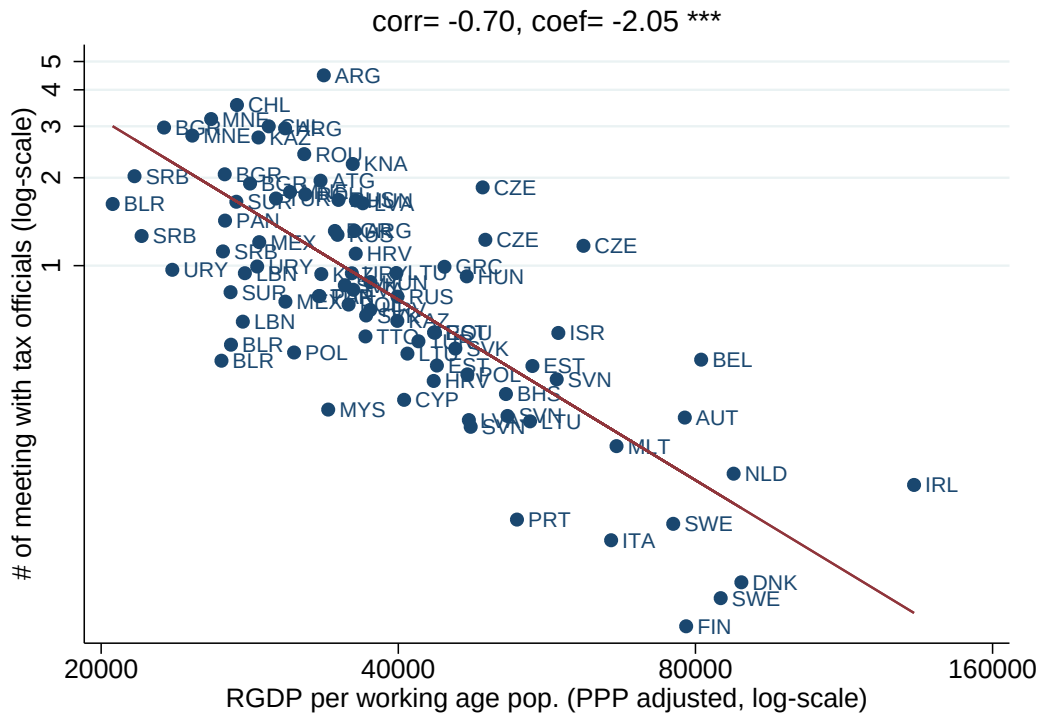
Figure B.1: Relationship between Time Taxes and Mean Size



Notes: This figure shows the relationship between mean-log of 1 minus the time tax and mean plant size in non-agriculture. Plant-size data is from Bento & Restuccia (2021). See text for more details.

C Meeting with Tax Officials and Business Licensing-permits

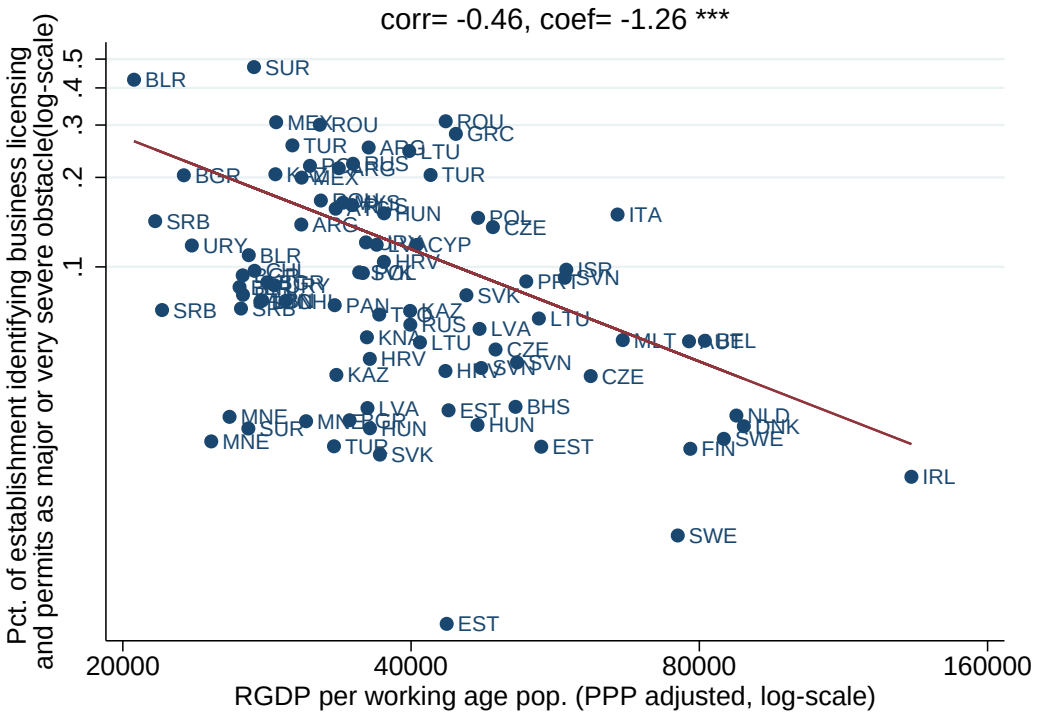
Figure C.1: The number of meetings with tax officials.



Sources: WBES and WDI

Notes: This figure shows the relationship between the mean number of meetings with tax officials and RGDP per working-age adult. Each dot represents a country at a survey year. The solid line is the simple weighted regression line where dependent variable is the log-number of meetings with tax officials and the independent variable is the log-RGDP per working-age adult. The countries are weighted according to their employment sizes.

Figure C.2: The percentage of establishments identifying business licensing and permits as a major or very severe obstacle

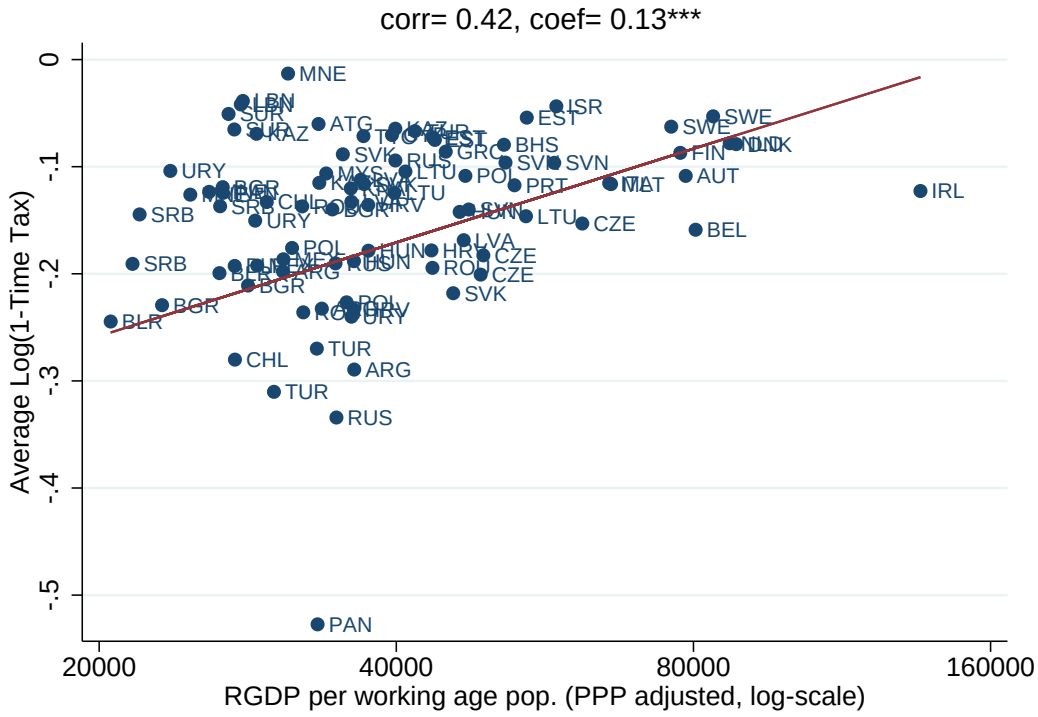


Sources: WBES and WDI

Notes: This figure shows the relationship between the percentage of establishments identifying business licensing and permits as a major or very severe obstacle and RGDP per working-age adult. Each dot represents a country at a survey year. Solid line is the simple weighted regression line where dependent variable is the log-percentage of establishments identifying business licensing and permits as a major or very severe obstacle and the independent variable is the log-RGDP per working-age adult. The countries are weighted according to their employment sizes.

D The Time Tax in Manufacturing and Services Sectors

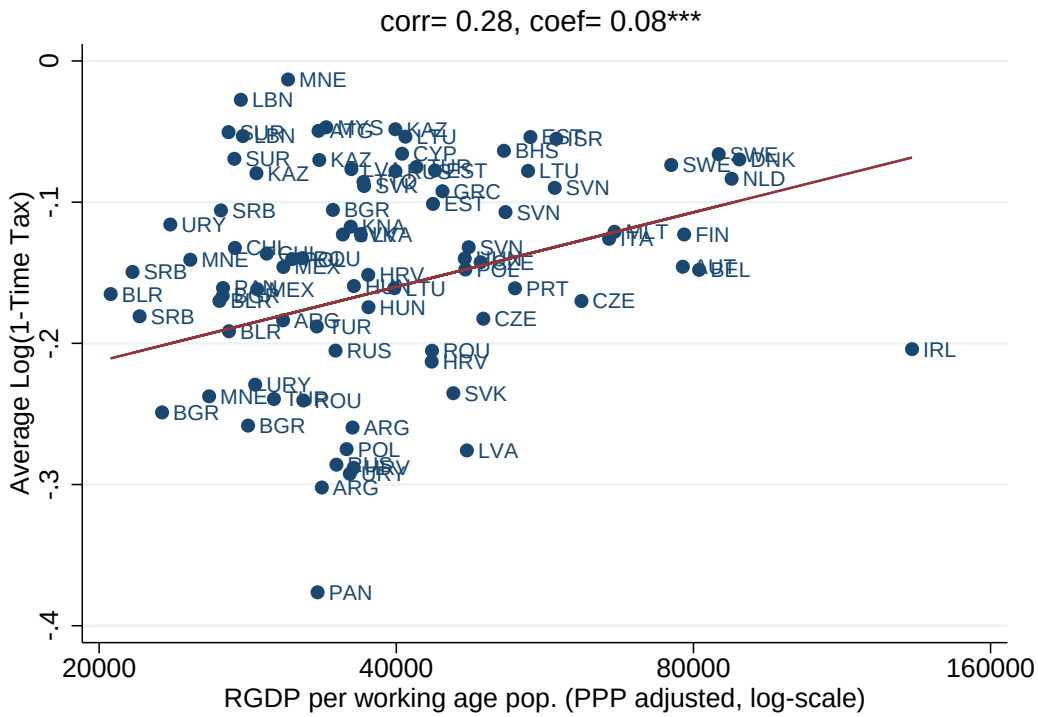
Figure D.1: Time Tax in Manufacturing Sector



Sources: WBES and WDI

Notes: This figure shows the relationship between the log of 1 minus the time tax and RGDP per working-age adult in manufacturing sector. Each dot represents a country at a survey year. Solid line is the simple weighted regression line where dependent variable is the average log of 1 minus time tax and the independent variable is the log-RGDP per working-age adult. The countries are weighted according to their employment sizes.

Figure D.2: Time Tax in Services Sector



Sources: WBES and WDI

Notes: This figure shows the relationship between the log of 1 minus the time tax and RGDP per working-age adult in services sector. Each dot represents a country at a survey year. Solid line is the simple weighted regression line where dependent variable is the average log of 1 minus time tax and the independent variable is the log-RGDP per working-age adult. The countries are weighted according to their employment sizes.

Table D.1: Manufacturing: Relationship between the time tax and the level of development after controlling establishment characteristics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Log RGDP per working age pop.	0.0965***	0.101***	0.0974***	0.0968***	0.0967***	0.0952***	0.0972***	0.0976***	0.0975***
	(0.0118)	(0.0119)	(0.0117)	(0.0115)	(0.0120)	(0.0120)	(0.0121)	(0.0124)	(0.0124)
Experience of the top manager-log		-0.0138*	-0.0144*	-0.0128*	-0.0128*	-0.0114	-0.0115	-0.00858	-0.00872
		(0.00654)	(0.00626)	(0.00600)	(0.00597)	(0.00601)	(0.00600)	(0.00589)	(0.00591)
Number of workers-log			-0.0105	-0.0101	-0.0102	-0.0111	-0.0103	-0.0108	-0.0102
			(0.00554)	(0.00596)	(0.00596)	(0.00605)	(0.00590)	(0.00660)	(0.00660)
Age of the establishment (as of 2020)-log				-0.00592	-0.00595	-0.00605	-0.00597	-0.00813	-0.00817
				(0.00782)	(0.00786)	(0.00792)	(0.00788)	(0.00827)	(0.00840)
Multi-establishment					0.000806	-0.00325	-0.00377	-0.00585	-0.00582
					(0.0129)	(0.0132)	(0.0132)	(0.0148)	(0.0150)
Pct. owned by foreigns						0.0348**	0.0386**	0.0434**	0.0407**
						(0.0116)	(0.0129)	(0.0141)	(0.0138)
Pct. of sales coming from exports							-0.0132	-0.0134	-0.0114
							(0.0184)	(0.0196)	(0.0193)
Female top manager								-0.00152	-0.00164
								(0.0190)	(0.0191)
Establishment has a bank loan/line of credit									-0.0123
									(0.0110)
Constant	-1.156***	-1.162***	-1.091***	-1.070***	-1.069***	-1.059***	-1.083***	-1.190***	-1.179***
	(0.126)	(0.125)	(0.122)	(0.120)	(0.126)	(0.125)	(0.127)	(0.134)	(0.134)
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Num. of Obs.	24551	24248	24245	24079	24079	23966	23918	19061	18953

Standard errors are in parenthesis and clustered at country year, sampling region, sampling size and sampling sector level.

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

Table D.2: Services: Relationship between the time tax and the level of development after controlling establishment characteristics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Log RGDP per working age pop.	0.0452***	0.0544***	0.0509***	0.0479**	0.0422**	0.0429**	0.0428**	0.0403**	0.0402**
	(0.0121)	(0.0143)	(0.0151)	(0.0151)	(0.0149)	(0.0150)	(0.0152)	(0.0153)	(0.0153)
Experience of the top manager-log		-0.0165	-0.0149	-0.00274	-0.00245	-0.00299	-0.00123	-0.00374	-0.00357
		(0.0131)	(0.0136)	(0.0134)	(0.0134)	(0.0133)	(0.0137)	(0.0147)	(0.0143)
Number of workers-log			-0.0145	-0.0114	-0.0142	-0.0140	-0.0122	-0.0131	-0.0134
			(0.00957)	(0.0101)	(0.00956)	(0.00972)	(0.00965)	(0.00932)	(0.00867)
Age of the establishment (as of 2020)-log				-0.0296**	-0.0307**	-0.0309**	-0.0304**	-0.0301*	-0.0304*
				(0.0112)	(0.0115)	(0.0117)	(0.0117)	(0.0118)	(0.0123)
Multi-establishment					0.0367*	0.0320*	0.0307*	0.0300*	0.0293*
					(0.0149)	(0.0138)	(0.0135)	(0.0133)	(0.0131)
Pct. owned by foreigns						-0.000615	0.00439	0.00475	0.00536
						(0.0264)	(0.0247)	(0.0252)	(0.0262)
Pct. of sales coming from exports							-0.0420	-0.0422	-0.0415
							(0.0265)	(0.0268)	(0.0265)
Female top manager								-0.0376	-0.0373
								(0.0230)	(0.0220)
Establishment has a bank loan/line of credit									0.00522
									(0.0174)
Constant	-0.578***	-0.618***	-0.548***	-0.492***	-0.424**	-0.429**	-0.440**	-0.404**	-0.406**
	(0.126)	(0.130)	(0.143)	(0.143)	(0.143)	(0.145)	(0.147)	(0.149)	(0.149)
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Num. of Obs.	18113	17908	17907	17811	17811	17683	17618	17076	16983

Standard errors are in parenthesis and clustered at country year, sampling region, sampling size and sampling sector level.

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

E The Role of Fixed Effects

Table E.1: Baseline Regression with Country and Sector Fixed Effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Log RGDP per working age pop.	0.219***	0.217***	0.200***	0.177***	0.177***	0.176***	0.175***	0.192***	0.195***
	(0.0438)	(0.0432)	(0.0417)	(0.0473)	(0.0473)	(0.0478)	(0.0480)	(0.0500)	(0.0487)
Experience of the top manager-log		-0.0101	-0.00929	-0.00336	-0.00307	-0.00317	-0.00204	-0.00253	-0.00240
		(0.0110)	(0.0110)	(0.0108)	(0.0108)	(0.0109)	(0.0108)	(0.0118)	(0.0115)
Number of workers-log			-0.0134***	-0.0119**	-0.0129**	-0.0132**	-0.0111*	-0.0121**	-0.0125**
			(0.00388)	(0.00416)	(0.00416)	(0.00435)	(0.00437)	(0.00446)	(0.00434)
Age of the establishment (as of 2020)-log				-0.0162	-0.0164	-0.0165	-0.0164	-0.0170	-0.0169
				(0.00840)	(0.00844)	(0.00864)	(0.00868)	(0.00878)	(0.00877)
Multi-establishment					0.0142	0.00783	0.00653	0.00588	0.00577
					(0.0101)	(0.00979)	(0.00977)	(0.0101)	(0.0102)
Pct. owned by foreigns						0.0187	0.0233	0.0240	0.0248
						(0.0167)	(0.0161)	(0.0171)	(0.0176)
Pct. of sales coming from exports							-0.0306*	-0.0315*	-0.0311
							(0.0154)	(0.0160)	(0.0161)
Female top manager								-0.0294	-0.0292
								(0.0167)	(0.0162)
Establishment has a bank loan/line of credit									0.00410
									(0.0129)
Constant	-2.257***	-2.207***	-2.000***	-1.725***	-1.724***	-1.714***	-1.713***	-1.972***	-2.009***
	(0.451)	(0.455)	(0.436)	(0.505)	(0.505)	(0.511)	(0.514)	(0.529)	(0.509)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observation	42664	42156	42152	41890	41890	41649	41536	36137	35936

Standard errors are in parenthesis and clustered at country year, sampling region, sampling size and sampling sector level.

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

Table E.2: Baseline Regression without Sector Fixed Effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Log RGDP per working age pop.	0.0560***	0.0639***	0.0595***	0.0564***	0.0527***	0.0527***	0.0533***	0.0520***	0.0519***
	(0.00999)	(0.0107)	(0.0110)	(0.0113)	(0.0114)	(0.0115)	(0.0118)	(0.0123)	(0.0123)
Experience of the top manager-log		-0.0161	-0.0147	-0.00694	-0.00645	-0.00658	-0.00582	-0.00685	-0.00680
		(0.00982)	(0.0100)	(0.0104)	(0.0103)	(0.0103)	(0.0104)	(0.0114)	(0.0112)
Number of workers-log			-0.0144*	-0.0123	-0.0142*	-0.0144*	-0.0128*	-0.0138*	-0.0140*
			(0.00616)	(0.00652)	(0.00613)	(0.00624)	(0.00615)	(0.00627)	(0.00592)
Age of the establishment (as of 2020)-log				-0.0194**	-0.0204**	-0.0205**	-0.0200**	-0.0206**	-0.0206**
				(0.00704)	(0.00725)	(0.00734)	(0.00724)	(0.00761)	(0.00779)
Multi-establishment					0.0278*	0.0238*	0.0225*	0.0231*	0.0228*
					(0.0114)	(0.0109)	(0.0109)	(0.0111)	(0.0110)
Pct. owned by foreigns						0.0101	0.0133	0.0145	0.0144
						(0.0176)	(0.0164)	(0.0175)	(0.0181)
Pct. of sales coming from exports							-0.0173	-0.0174	-0.0167
							(0.0172)	(0.0175)	(0.0169)
Female top manager								-0.0268	-0.0268
								(0.0156)	(0.0151)
Establishment has a bank loan/line of credit									0.000503
									(0.0131)
Constant	-0.738***	-0.779***	-0.699***	-0.636***	-0.594***	-0.592***	-0.605***	-0.578***	-0.578***
	(0.106)	(0.107)	(0.112)	(0.116)	(0.118)	(0.120)	(0.123)	(0.129)	(0.128)
Observations	42753	42244	42240	41977	41977	41735	41622	36210	36007

Standard errors are in parenthesis and clustered at country year, sampling region, sampling size and sampling sector level.

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

F The Plant Problem, the Household Problem, and Equilibrium Properties

F.1 Solving the Plant's Problem

Consider a top manager with ability z facing a time tax rule $\tau(z)$. To simplify notation, let $z_\tau \equiv z(1-\tau(z))$ be the effective managerial ability after the time tax. Let X be the aggregate of differentiated tasks (inputs): $X \equiv \left(\int_0^{M(z_\tau, z_m)} \left(n_j^\alpha k_j^{1-\alpha}\right)^{\frac{\sigma-1}{\sigma}} dj \right)^{\frac{\sigma}{\sigma-1}}$. The choices of production workers, middle manager services and capital services for this manager are found by solving the following FOCs associated to problem (5) with respect to k_j, n_j and z_m:

$$\gamma X^{\gamma-1} \left(\int_0^{M(z_\tau, z_m)} \left(n_j^\alpha k_j^{1-\alpha}\right)^{\frac{\sigma-1}{\sigma}} dj \right)^{\frac{1}{\sigma-1}} \left(n_j^\alpha k_j^{1-\alpha}\right)^{\frac{-1}{\sigma}} (1-\alpha) n_j^\alpha k_j^{-\alpha} - R = 0, \quad \forall j \tag{F.1}$$

$$\gamma X^{\gamma-1} \left(\int_0^{M(z_\tau, z_m)} \left(n_j^\alpha k_j^{1-\alpha}\right)^{\frac{\sigma-1}{\sigma}} dj \right)^{\frac{1}{\sigma-1}} \left(n_j^\alpha k_j^{1-\alpha}\right)^{\frac{-1}{\sigma}} (\alpha) n_j^{\alpha-1} k_j^{1-\alpha} - W = 0, \quad \forall j \tag{F.2}$$

$$\frac{\partial M(z_\tau, z_m)}{\partial z_m} \left(\gamma X^{\gamma-1} \frac{\sigma}{\sigma-1} \left(\int_0^{M(z_\tau, z_m)} \left(n_j^\alpha k_j^{1-\alpha}\right)^{\frac{\sigma-1}{\sigma}} dj \right)^{\frac{1}{\sigma-1}} \left(n_j^\alpha k_j^{1-\alpha}\right)^{\frac{\sigma-1}{\sigma}} - W n_j - R k_j \right) - P_m = 0 \tag{F.3}$$

F.2 Solving The Household's Problem

The household chooses sequences $\{C_t, K_{t+1}, z_{1,t}^*, z_{2,t}^*\}_0^\infty$ to maximize her preferences represented by (3). Let λ_t be the Lagrange multiplier associated the budget constraint. Then the first-order conditions of the household's problem for all t follow, with respect to $C_t, K_{t+1}, z_{1,t}^*$ and $z_{2,t}^*$, respectively:

$$\beta^t \frac{1}{C_t} = \lambda_t \tag{F.4}$$

$$\lambda_{t+1}(1 - \delta + R_{t+1}) = \lambda_t \tag{F.5}$$

$$P_{m,t} z^*_{1,t} = W_t \tag{F.6}$$

$$\pi(z_2) = P_{m,t} z^*_{2,t} \tag{F.7}$$

Combining (F.4) and (F.5) provides the familiar intertemporal Euler equation of the household:

$$\frac{C_{t+1}}{C_t} = \beta \left(1 - \delta + R_{t+1}\right) \tag{F.8}$$

Equation (F.6) requires households with ability $z^*_{1,t}$ to be indifferent between becoming a production worker and a middle manager. Similarly, Equation (F.7) requires household members with ability $z^*_{2,t}$ to be indifferent between becoming a middle manager and a top manager. Altogether, Equations (F.6), (F.7) and (F.8) characterizes the household's solution.

F.3 Equilibrium Properties

We now show basic properties of the equilibrium, with special focus on the steady state of the model economy.

We first divide Eq (F.1) by Eq (F.2) and call capital-labor ratio within an activity G:

$$\frac{k_j}{n_j} = \left(\frac{1-\alpha}{\alpha}\right) \frac{W}{R} \equiv G \tag{F.9}$$

It follows that capital-labor ratio is the same across activities, and depends only on the share parameter α in the production technology and the ratio of rental prices for labor and capital. Rewrite now Eq (F.1) using the capital-labor ratio, G:

$$\gamma\left[\left(\int_0^{M(z_\tau,z_m)}\left(n_jG^{1-\alpha}\right)^{\frac{\sigma-1}{\sigma}}dj\right)^{\frac{\sigma}{\sigma-1}}\right]^{\gamma-1}\left(\int_0^{M(z_\tau,z_m)}\left(n_jG^{1-\alpha}\right)^{\frac{\sigma-1}{\sigma}}dj\right)^{\frac{1}{\sigma-1}}\left(n_jG^{1-\alpha}\right)^{\frac{-1}{\sigma}}\alpha G^{1-\alpha}=W,\quad\forall j \tag{F.10}$$

Note that the first two terms in (F.10) are just functions of the ability of the top manager z, and thus, the same for any activity j. Then, $n_j = n_s = n, \quad \forall j, s \in [0, M(z_\tau, z_m)]$. Since G is a constant, similar argument holds for capital as well: $k_j = k_s = k, \quad \forall j, s \in [0, M(z_\tau, z_m)]$. It follows that Eq (F.10) can be rewritten after dropping the subscript j as follows:

$$\gamma\left[nG^{1-\alpha}M(z_\tau,z_m)^{\frac{\sigma}{1-\sigma}}\right]^{\gamma-1}\left(n^{\frac{\sigma-1}{\sigma}}G^{\frac{(1-\alpha)(\sigma-1)}{\sigma}}M(z_\tau,z_m)\right)^{\frac{1}{\sigma-1}}\left(nG^{1-\alpha}\right)^{\frac{-1}{\sigma}}\alpha G^{1-\alpha}=W \tag{F.11}$$

Therefore, after replacing G by its components, the (constant) amount of labor per each activity, n, is given by

$$n=\left[\gamma\left(\frac{\alpha}{W}\right)^{1-(1-\alpha)\gamma}\left(\frac{1-\alpha}{R}\right)^{(1-\alpha)\gamma}\right]^{\frac{1}{1-\gamma}}M(z_\tau,z_m)^{\frac{1-\sigma(1-\gamma)}{(\sigma-1)(1-\gamma)}} \tag{F.12}$$

Similarly, the amount of capital per each activity, k, is given by

$$k=\left[\gamma\left(\frac{\alpha}{W}\right)^{\alpha\gamma}\left(\frac{1-\alpha}{R}\right)^{1-\alpha\gamma}\right]^{\frac{1}{1-\gamma}}M(z_\tau,z_m)^{\frac{1-\sigma(1-\gamma)}{(\sigma-1)(1-\gamma)}} \tag{F.13}$$

Now using equations (F.12) and (F.13), we obtain the total labor, $n(z)$, total capital, $k(z)$, and output $y(z)$ of a top manager with ability z. It follows that

$$n(z) = \int_0^{M(z_\tau,z_m)} n dj = nM(z_\tau,z_m) \tag{F.14}$$

$$= \left[\gamma\left(\frac{\alpha}{W}\right)^{1-(1-\alpha)\gamma}\left(\frac{1-\alpha}{R}\right)^{(1-\alpha)\gamma}\right]^{\frac{1}{1-\gamma}}M(z_\tau,z_m)^{\frac{\gamma}{(\sigma-1)(1-\gamma)}} \tag{F.15}$$

$$k(z) = \left[\gamma \left(\frac{\alpha}{W}\right)^{\alpha\gamma} \left(\frac{1-\alpha}{R}\right)^{1-\alpha\gamma}\right]^{\frac{1}{1-\gamma}} M(z_\tau, z_m)^{\frac{\gamma}{(\sigma-1)(1-\gamma)}} \tag{F.16}$$

$$y(z) = \left[\gamma \left(\frac{\alpha}{W}\right)^{\alpha} \left(\frac{1-\alpha}{R}\right)^{1-\alpha}\right]^{\frac{\gamma}{1-\gamma}} M(z_\tau, z_m)^{\frac{\gamma}{(\sigma-1)(1-\gamma)}} \tag{F.17}$$

Altogether, the above imply an important property of the competitive equilibrium: the capital-output ratio for a plant run by any top manager is independent of his/her ability. It is given by

$$\frac{k(z)}{y(z)} = \gamma \frac{1-\alpha}{R} \tag{F.18}$$

Since the above holds for all plants, it is also the capital-output ratio in the aggregate.

Steady States In stationary equilibrium, since consumption growth is constant, the rental rate of capital is given by $\hat{R} = 1/\beta - 1 + \delta$. It immediately follows that the aggregate capital output ratio in steady state is given by

$$\frac{K}{Y} = \gamma \, \frac{1-\alpha}{1/\beta - 1 + \delta}. \tag{F.19}$$

Note that as the span-of-control $\gamma \to 1$, the capital to output ratio becomes the *same* than in the standard one-sector growth model under a Cobb Douglas technology with capital share $1-\alpha$. This also implies that the aggregate capital share in steady state is simply $\gamma(1-\alpha)$.

G The Role of the Elasticity of Substitution

Our quantitative results rely on an external estimate of the elasticity of substitution between intermediate inputs in the production process, σ. We used the robust estimate, 6.6, from Broda & Weinstein (2006), but there is range of estimates presented therein, depending on how narrow the classification of goods is. Other authors have used lower values. Bento & Restuccia (2017) and Hsieh & Klenow (2009) used a much lower value of 3. Poschke (2018) uses a value of 4. Atkeson & Burstein (2010) use a value of 5.

It turns out that our findings are quite robust to the precise value of the elasticity parameter, once all internal model parameters are calibrated again. Larger values of σ lead to larger output losses as the incidence of the time tax increases, but the differences are of second order. If we choose a value of $\sigma = 4$ and recalibrate internal parameters, the effects of increasing the level of time taxes via τ_0, from the Denmark values to $\tau_0 = 0.15$ determine a decline in output of 41.1% and a reduction in mean size of about 5.8 employees across steady states. Instead, choosing $\sigma = 8$ implies a decline in output of 39.5% and a reduction in mean size of about 5.9 employees. The corresponding effects in our baseline case displayed in Table 6 dictate a decline in output of about 40.6% and an decline in mean size of about 5.8-5.9 employees.

Equivalent results hold if we change the parameter controlling size dependency, τ_1. We conclude from these findings that uncertainty about the precise value of the substitution elasticity is not a concern in terms the predicted effects from changes in the time tax.