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Innovation Strategy and Economic Development

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Innovation Strategy and Economic Development*

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Abstract

Productivity differentials have been documented as the main determinant of the variation of income per capita across countries. In this paper, we investigate whether the implementation of innovation-intensive or adoption-intensive business strategies by firms can explain differences in productivity levels and productivity growth across industries and countries. We compute a novel innovation-intensity strategy index for firms, based on textual analysis of financial reports issued in the US by firms from developed and developing countries and from a wide range of industries. We show that the index captures dimensions of the innovation process implemented by firms that go beyond R&D efforts. Our empirical results indicate that firms that pursue an innovation-based strategy exhibit higher productivity levels compared to firms that follow an adoption-based strategy. Nonetheless, the optimal business strategy depends on the distance to the world technology frontier. Firms far from the frontier grow faster when implementing an adoption-based strategy, but an innovation-based strategy better suits firms closer to the technological frontier. We provide evidence indicating that a country's financial market sophistication, competition policy and innovation capabilities –such as educational level, availability of scientists and engineers, and intellectual property protection– are key determinants of the strategy implemented by firms. The empirical evidence suggests that middle-income traps may occur if competition policy, innovation capabilities and financial market sophistication are not enhanced as a country moves closer to the technology frontier.

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"In the last forty years, the Singapore economy has grown on the basis of an investment-driven strategy. We focused on improving the quality of capital investments... We increased our productivity and enhanced management efficiency... To succeed in the future, however, we must go beyond all these. We have to be more innovative. We must use knowledge and ideas to create new products and services. In economic jargon, we need intellectual capital to generate new wealth."

Goh Chok Tong, Prime Minister of Singapore, November 2001.

1 Introduction

Explaining the significant and persistent differences in productivity across industries and countries has been the focus of an active research agenda. Using data on total factor productivity (TFP) for six sectors in a group of advanced economies, Bernard and Jones (1996), document that individual sectors display a wide variety of productivity paths across countries. In particular, they report no convergence in the manufacturing sector but significant convergence in the services sector. Harrigan (1995) shows that there are systematic differences in industry outputs across countries that cannot be explained by differences in factor endowment. And Caselli (2005), Hsieh and Klenow (2009), and Jones (2016) provide empirical evidence showing that differences in TFP are the main contributor to income differences across countries. In this paper, we provide evidence indicating that the type of business strategy implemented by a firm is an important determinant of differences in the levels of productivity and rates of growth across industries and countries.

The economic development literature has stressed that technologically backward countries can achieve higher growth rates than advanced countries by adopting technologies employed by technologically leading economies. The process of technology diffusion from technologically leading economies requires follower countries to engage in adoption efforts; however, if the cost of imitation is less than the cost of invention, the absorption of technological expertise from abroad must take place in early stages of the development process for potential economic development gains to be realized. Moreover, as modeled by Acemoglu et al. (2006), the convergence process may be hindered if firms do not switch from an adoption-based strategy to an innovation-based strategy as the economy in which they operate moves closer to the world technology frontier. The theoretical model specified by Acemoglu et al. (2006) also indicates that switching from an adoption-based strategy to an innovation-based strategy depends on the institutional environment in which firms operate. Policy encouraging an adoption-based strategy must therefore be reoriented to incentivize firms to switch to an innovation-based strategy, otherwise a country may get trapped in a state of lower development and fail to converge to the world technology frontier.

We build a novel innovation-intensity strategy index that aims to capture innovation and adoption efforts implemented by firms. Most empirical studies rely on research and development (R&D) expenditure and the number of patents registered to capture innovation efforts; however, innovation-related actions undertaken by firms are not limited to these activities. In his pioneering work, Schumpeter (1939) distinguishes five types of innovation: new products, new methods of production, new sources of supply, exploitation of new markets, and new ways to organize business. Using this framework, several studies have found evidence of activities that lead to innovation but are not related to R&D. For example, using innovation surveys, one OECD (2009) study suggests that a large proportion of firms develop their process, product, organizational, or marketing innovations without any R&D expenditure and indicates that this result even holds for new-to-market innovators who successfully introduce technological innovations. Moreover, as discussed by Griffith et al. (2004), R&D may not only be associated with an innovation-based strategy but also with an adoption-based strategy.

To construct our index we apply a textual analysis to the business description section of financial reports filed by overseas firms that issue securities in the US, known as 20-F forms. Accordingly, we are able to capture the dimensions of the innovation process that go beyond R&D efforts and the number of patents. We are also able to increase the scope of countries, particularly in terms of developing countries, and the number of economic sectors considered in the empirical analysis.[1]

A business description, such as the one required for the 20-F forms, is a description of activities that firms implement to compete in their markets, also called a business strategy. More formally, business strategy is defined as the set of activities that firms undertake to gain competitive advantage in a single market or industry.[2] Porter (1985) argues that there are two basic types of

[1]Other studies have tried to capture innovation activities using surveys, see for example Yang et al. (2015); however, the availability and comparability of surveys across countries and industries is rather limited.

[2]See for instance Barney and William (2015).

competitive advantage: low cost and differentiation. These two types of competitive advantage, combined with a firm's scope of activities generate two polar strategies: cost leadership and differentiation. Another popular typology of business strategy is Miles et al. (1978). They define two polar classes of business strategies that map reasonably well onto Porter's competitive strategy classification: defenders, which equates to a cost leadership strategy and prospectors, which equates to a differentiation strategy.

Furthermore, the management literature indicates that there is a close relationship between the type of business strategy that a firm implements and the intensity of adoption (imitation) and innovation activities. Empirical evidence, discussed in later sections, indicates that a differentiation (prospector) strategy is more intensive in innovation activities, and that the adoption of good practices and technologies is a critical component of a cost-leadership (defender) strategy.

To measure the extent to which a firm's strategy is a cost-leadership (defender) or differentiation (prospector), we build a dictionary of the words and n-grams associated with each strategy. To do this, we source the words used to describe these two strategies in Miles et al. (1978)[3] and the Palgrave Encyclopedia of Strategic Management (Augier and Teece, 2021). For the cost-leadership (defender) strategy, we select the keywords from chapter in Miles et al. (1978) on the defender class of businesses and combine them with the keywords from encyclopedia's definition of adoption. The innovation-led strategy is associated to words picked from the chapter on prospectors and the definition of innovation.

Based on the number of words and n-grams contained in each 20-F form, we compute an innovation-intensity strategy index that equals to the share of words that are associated with an innovation strategy relative to the sum of those identified with either innovation or adoption. We show that our innovation-intensity strategy index is positively correlated with indicators that are regularly used to capture the degree of innovation, R&D expenditure, both at the firm and at the country level. One advantage of our innovation-intensity strategy index is that it allows us to capture other dimensions of the innovation process not captured by traditional measures.

We show that our innovation-intensity strategy index is positively correlated with productivity

[3] Although our we use the terminology and definitions to classify strategies from both Porter (1980) and Miles et al. (1978), we construct the dictionary using the words from Miles et al. (1978) because it provides a more narrowly defined description than the description in Porter (1980).

at the firm level. Furthermore, our index is positively correlated with productivity levels even when we control for R&D expenditure efforts undertaken by firms. We interpret these results as evidence that our index captures innovation efforts not considered as part of R&D efforts. At the country level, we find that our aggregate innovation-intensity strategy index is correlated with economic development as captured by income per capita and, in particularly, as captured by productivity levels.

We provide empirical evidence suggesting that the strategy that maximizes productivity growth depends on the stage of development of the country in which the firm operates. More specifically, using our innovation-intensity strategy index, we show that adopting a more innovation-intensive business strategy increases productivity growth when firms are close to the world technology frontier, and that an adoption-based strategy delivers higher productivity growth when firms are far away from the frontier. These results do not hold when we use R&D expenditure as a proxy for the innovation intensity of the strategy implemented by a firm. We interpret this result as further evidence that our index is a better proxy than R&D and patent count figures of the innovation efforts undertaken by firms highlighted in the economic development literature.

Business strategies are implemented in a particular institutional context, and the type of business strategy implemented by a firm within a country can be seen as a transmission mechanism through which deeper determinants of economic growth operate. As Gerschenkron (1962) suggests, by introducing "appropriate institutions" relatively backward economies may be able to grow faster. The institutions introduced to stimulate this growth may cease to be appropriate, however, at later stages of development causing productivity growth to fall and the productivity differential with the frontier country to remain open. As discussed by Acemoglu et al. (2006), this implies that, as economies grow and move closer to the technological frontier, economic institutions must adjust in order to provide the environment and incentives for firms to switch from an adoption-based strategy to an innovation-intensive business strategy.

Consistent with this theoretical position, we present evidence showing that the competition intensity, financial market sophistication, and innovation capabilities of a country are key determinants of the kind of business strategy firms that operate in that country chose to implement. Less competitive environments, less sophisticated financial markets, and weaker innovation capabilities are associated with adoption-based strategy implementation; a more competitive environment, more sophisticated financial systems, and the existence of robust innovation capabilities are associated with innovation-based strategy implementation. This empirical analysis suggests that middle-income traps may occur when these institutional dimensions are not enhanced as a country moves closer to the technological frontier.

The results presented in this paper are consistent with previous empirical evidence showing that, at the country level, the interaction between economic institutions and distance to frontier is a key determinant of economic growth. And the results are novel in a key dimension; by taking advantage of our firm-level innovation-intensity strategy index, we show that an important mechanism through which economic institutions can affect economic growth is through their impact on adoption and innovation decisions by firms at different stages of development, as the theoretical model set out by Acemoglu et al. (2006) predicts.

The paper is organized as follows: The next section provides the theoretical framework that will guide our empirical analysis. Then, we discuss the construction of our innovation-intensity strategy index for firms, which is followed by our empirical results. We first discuss the connection between our innovation-intensity strategy index and other proxies for innovation-based strategy. We then relate our innovation-intensity strategy index with productivity levels at the firm level and with the components of income per capita relative to the frontier country (the US): physical capital intensity, human capital intensity and TFP. We explore the impact of business strategy on both firm- and country-level productivity growth and its dependence on the distance to the frontier. Finally, we provide an analysis on the institutional determinants of firm-level business strategies decisions.

2 Theoretical framework

Our theoretical framework is based on Acemoglu et al. (2006) who posit that firms have two ways of generating productivity improvements: they can imitate the technological frontier, or they can innovate on the previous local technology.[4]

Imitation is not an automatic process. As discussed by Howitt and Mayer-Foulkes (2005),

[4] See also Aghion and Howitt (2008).

a country imitating the world technology frontier cannot just take this technology off the shelf and implement it without costs. Firms must devote resources, such as investments in technology, training, and organizational capability to imitate and then master frontier technologies. Moreover, in order to innovate firms must implement a different set of business activities. And these activities may involve in-house R&D but also may include other activities, such as training related to the introduction of new products or processes, market research, and other procedures like design and production engineering.[5] We refer to the implementation of these kinds of activities as an innovation-based strategy.

In our theoretical framework, in a less developed economy, a firm's productivity growth can be maximized by imitating available frontier technologies with maximum operational efficiency and cost reduction. But when a firm gets closer to the technology frontier, it should switch to an innovation-intensive business strategy to enable the continued maximization of productivity growth and convergence to the frontier.

The switch from an adoption-based strategy to an innovation-based strategy will occur only if the firms are operating in an "appropriate" institutional environment for the particular stage of development. Acemoglu et al. (2006) argue that the set of economic institutions required to maximize productivity growth in the early stages of development may be different to the economic institutions that are required closer to the technology frontier. Therefore, if the institutional environment does not adjust to the different stages of development, countries may not converge to the frontier and may experience persistent disparities in productivity levels and income per capita levels compared to developed economies.

We now present the main elements of the theoretical framework that guides our empirical strategy. Additional details can be found in appendix A.1. In each country, a unique final good is produced by competitive firms using a continuum of intermediate inputs. In each intermediate sector i, production takes place through a monopolist firm that transforms one unit of the final good into one unit of the intermediate good with productivity A_{it}. The productivity level of the

[5]See Lopez-Rodriguez and Martinez-Lopez (2017) for an empirical study on the impact of non-R&D activities on productivity.

world frontier is given by $\bar{A}_t$. Frontier productivity growth is given by:

$$\bar{A}_t = (1+g)\bar{A}_{t-1}.$$

Firms in each intermediate sector can generate productivity growth in two ways: they can imitate the existing world technology frontier, or they can innovate on existing local technology. Thus,

$$A_{i,t} = \eta \bar{A}_{i,t-1} + \gamma A_{i,t-1},$$

where $\eta \leq 1$ and $\gamma > 1$. The equilibrium values for η and γ will depend on the business strategy that firms implement interacted with the institutional context of each country.

We assume that imitating existing frontier technologies requires the implementation of an adoption- based strategy. In this case, the set of activities firms undertake are oriented to increase the value of η. Note that activities related to an adoption-based strategy may also include efforts to increase barriers to entry, reflected in higher costs of production of potential entrants.[6] An innovation-based strategy implies the choice of a different set of activities that enable a firm to create a new version of an intermediate product that is more productive than the previous version. Hence, these activities are oriented to maximize the value of γ.

Integrating the previous equation over all the sectors of the economy, we obtain:

$$A_t = \eta \bar{A}_{t-1} + \gamma A_{t-1}. \tag{1}$$

Aggregate productivity in a country comes from the adoption of technologies at the frontier and innovation built on the knowledge stock of the country. The values for η and γ at the aggregate level will depend on the intensity of adoption-based and innovation-based strategies at the firm level. Dividing equation (1) by the level of productivity at the frontier country ($\bar{A}_t$), we obtain the productivity gap between domestic country and the frontier country, $a_t \equiv A_t/\bar{A}_t$, which is given by:

$$a_t = \left(\frac{1}{1+g}\right)\left(\eta + \gamma a_{t-1}\right). \tag{2}$$

[6]See appendix A.1.

Equation (2) indicates that for a country far away from the world technology frontier it is optimal to pursue an adoption-based strategy that maximizes the value of η because productivity growth is higher under an adoption-based strategy than under an innovation-based strategy when a country is in the early stages of development. Conversely, as a country gets closer to the technology frontier the implementation of an innovation-based strategy becomes more attractive and after a given threshold becomes the strategy that maximizes productive growth.[7]

As discussed by Acemoglu et al. (2006), the (optimal) intensity of η and γ will depend on the institutional context. And the type of economic institutions in a country can maximize the benefits of an adoption-based strategy or an innovation-based strategy, depending on the particular country's distance from the technology frontier. We assume that the productivity dynamic under economic institutions that maximize the effects of an adoption-based business strategy is given by:

$$a_t = \left(\frac{1}{1+g}\right)\left(\bar{\eta} + \underline{\gamma} a_{t-1}\right).$$

And the productivity dynamic under economic institutions that maximize the benefits of an innovation-based strategy is given by:

$$a_t = \left(\frac{1}{1+g}\right)\left(\underline{\eta} + \bar{\gamma} a_{t-1}\right)$$

where $\underline{\eta} < \bar{\eta}$, $\underline{\gamma} < \bar{\gamma}$, and $(1+g) = (\underline{\eta} + \bar{\gamma})$. Using these equations, it is straightforward to show that the business strategy that maximizes productivity growth for low values of a_{t-1} is an adoption-based one and that closer to the frontier, where the values of a_{t-1} are higher, an innovation-based strategy is the growth-maximizing choice. The cutoff value between the two business strategies is given by:

$$\widehat{a} = \frac{\bar{\eta} - \underline{\eta}}{\bar{\gamma} - \underline{\gamma}}.$$

At the cutoff value, firms should switch from an adoption-based strategy to an innovation-based strategy. In the growth-maximizing equilibrium, the optimal switching point occurs when the distance from the frontier in terms of productivity levels is $\widehat{a}$.

In the decentralized equilibrium, again examined in Acemoglu et al. (2006), the values of η and

[7] In a related approach to technological convergence, Barro and Sala-i Martin (1997) argue that followers converge towards leaders because copying is cheaper than innovation in a certain range. But as copying costs increase, the growth rates of followers decrease.

γ are determined by decentralized decisions made by economic agents that operate in a particular institutional environment. This dimension is crucial for our empirical strategy. In the centralized equilibrium, there is a direct equivalence between business strategies and distance from the frontier. In the decentralized equilibrium, the business strategy implemented by a firm depends on the institutional context. This allows us to identify the impact of business strategies on productivity growth conditional on the firm's distance to the frontier.

We now describe a simple environment to frame our empirical strategy. Despite its simplicity, it is flexible enough to guide our empirical analysis along the lines discussed previously. In our model, firms, managers, and owners all live two periods, after which they are replaced by new firms, managers, owners. In each period, both old and new firms, managers and owners exist. Owners must decide on the business strategy that their firm is going to implement. The two business strategies available are adoption-based (imitation) and innovation-based. The strategy is executed by managers. Following Acemoglu et al. (2006), we assume that managers can divert a fractionμ of the returns for their own use and never be prosecuted; μ measures the extent of the incentive problems or the severity of the credit market imperfections resulting from these incentive problems. Old managers –managers born in previous period– use retained earnings to keep their jobs, reducing the severity of the financial frictions.[8]

We assume that innovation efforts are relatively more difficult to monitor than adoption efforts. When implementing an innovation-based strategy, managers can divert a fraction μ^* of retained earnings, which allows us to capture the idea that financing innovation activities is more difficult if financial markets are less developed or that internal funds may be more relevant to finance innovation activities, or both. An old manager who has successfully implemented an innovation-based strategy will be able to accelerate the convergence to the frontier by using retained earnings to finance innovation-activities, reducing the severity of financial frictions.

Old managers have the advantage of experience, but experience is business strategy specific. Old managers with experience in implementing an adoption-based strategy are not effective if the owner decides to implement an innovation-based strategy. In this case, a switch in business

[8]There is a small difference between the setups in Acemoglu et al. (2006) and Aghion and Howitt (2008). For the latter, owners of firms select managers not the business strategy of the firm. For the former, only talented managers can innovate and old managers have the advantage of experience when imitating.

strategy is accompanied by a change in manager. Implementing an innovation-based strategy is risky. Of the firms that follow an innovation-intensive strategy, a fraction λ are successful.

The owner of a firm will decide to renew an old manager and continue implementing an adoption-based strategy if:

$$(1-\mu)(\eta+\epsilon)\widetilde{\pi}\bar{A}_{t-1} + \mu\pi\bar{A}_{t-2} \geq (1-\mu^*)(\eta+\lambda\gamma a_{t-1})\pi\bar{A}_{t-1} - \kappa\bar{A}_{t-1}$$

where π is the equilibrium profits for a monopolist firm in sector i, $(1-\mu)$ is the share of the profits that goes to the firm's owner, $(\eta+\epsilon)\widetilde{\pi}\bar{A}_{t-1}$ are the profits that firms get by keeping the current manager. Note that old managers generate additional profits if the firm retains their services and continues with an adoption-based strategy because of the old manager's experience (ϵ).

The knowledge of the local industry allows an old manager to implement actions that generate higher barriers of entry to the industry (therefore $\widetilde{\pi} > \pi$) and because the old manager contributes with their own retained earnings ($\mu\pi\bar{A}_{t-2}$). If the owner of the firm brings in a new manager, expected profits are given by $(1-\mu^*)(\eta+\lambda\gamma a_{t-1})\pi\bar{A}_{t-1}$, where $\mu^* > \mu$, which reflects that moral hazard concerns are more severe when delegating the implementation of a new business strategy. The term $\lambda\gamma a_{t-1}$ corresponds to the expected profit associated to the innovation-based strategy. In this setting λ can be interpreted as the probability that a new manager will be successful in implementing an innovation-based strategy, while the parameter γ represents the size of the innovation in terms of productivity. Finally, the term $\kappa\bar{A}_{t-1}$ summarizes the costs associated with hiring a new manager and the costs of implementing an innovation-based strategy.

In this context, the condition that triggers a change in business strategy is given by

$$a_{t-1} \leq a_r = \frac{(1-\mu)(\eta+\epsilon)\widetilde{\pi} + \frac{\mu\pi}{1+g} + \kappa - (1-\mu^*)\eta\pi}{(1-\mu^*)\lambda\gamma\pi},$$

where a_r represents the distance to the frontier at which firms will move from an adoption-based strategy to an innovation-based strategy. To simplify the analysis, we assume that once a firm switches to an innovation-based strategy it generates a positive externality for other firms because the country's economy becomes more familiar with innovation practices and monitoring costs for owners reduce. This assumption, as well as some conditions on the gains from experience associated with old managers, implies that once old firms switch to innovation-based strategies it is optimal for new firms to implement innovation-based strategies as soon as they begin to operate.

As discussed by Acemoglu et al. (2006) and Aghion and Howitt (2008), in this type of setup the difference between $\widehat{a}$, the optimal distance to the frontier for the switch from an adoption-based strategy to an innovation-based strategy, and a_r, the distance to the frontier that triggers a switch in the business strategy for a firm in the decentralized equilibrium, may lead to four types of equilibria. In three of these equilibria, firms switch from an adoption-based strategy to an innovation-based strategy at some point in time (in some cases before and in other cases after the growth-maximizing switching point). In these three cases, along the development path, the switch is guaranteed to occur at some point in the development process. In one equilibrium, however, the value of a_r is so high that the economy gets caught in a nonconvergence equilibrium trap and switches from an adoption-based strategy to an innovation-based strategy never occur.

The model suggests that we should expect an adoption-based strategy to generate higher rates of productivity growth further away from the frontier and that an innovation-based strategy generates higher productivity growth closer to the frontier. The interaction between the business strategy implemented by a firm and a firm's distance to the frontier will be the key variable in our empirical analysis of productivity growth at the firm level and the country level.

We now discuss the main elements of the institutional environment that may affect a_r and therefore the development paths of the countries that we consider in our empirical analysis.

- **Competition policy:** In the early stages of development, a firm's profits are a key factor that reduce incentive problems and foster productivity growth. If competition policy does not become more strict at more advanced stages of development, old managers may use their economic power to increase their market power (by generating higher barriers to entry, for example). This could lead to increased markups and reduced incentives to switch to an innovation-based strategy. Moreover, if the monopoly power associated with the continuation of an adoption-based strategy is large (higher $\widetilde{\pi}$ compared to π), , the cutoff value is higher. This implies that the implementation of an innovation-based strategy occurs later in the development process, if at all.

The following mechanisms link competition policy and business strategy but are not considered in our simple theoretical framework: As in Acemoglu et al. (2006), higher profits in the early stages of development may enable firms to run larger projects with higher productivity level;[9] competition may foster the implementation of an innovation-based strategy close to the technology frontier due to an escape-competition effect, as discussed in Acemoglu et al. (2006); and, more competition compels neck and neck firms to innovate in order to avoid a situation in which competition constraints profits. In the context of our analysis, the effect of the latter mechanism may be relevant in industries that are associated with tradable goods. Closer to the technology frontier, firms in tradable sectors in the local economy become global actors, and their competitors are therefore located in other countries that are closer to the frontier.

- **Financial market sophistication and imperfect contractual enforcement:** If financial markets are more sophisticated, we would expect lower values for μ and μ^* (as well as a smaller difference between them), which would reduce the severity of informational problems in the economy. Thus, we would expect to see more rapid growth in productivity in the early and later stages of development (closer to the frontier). Under the assumption that lenders have to pay higher costs to monitor innovation activities by managers, the switch towards innovation-based strategies will occur later in the development path of a country. In this scenario, the funding of innovation activities relies more heavily on a firm's internal funds than on external financing.

  Alternatively, we can assume that adoption (imitation) activity is more intensive in capital-intensive sectors because technological diffusion comes embedded in capital goods imported by developing (follower) economies from frontier countries with innovation activities being more intensive in human capital.[10] Financial systems more intensive in financial intermediaries should be more growth-enhancing in early stages of development; however, when the economy is closer to the frontier, financial markets should step up in order to finance

[9] In a different setup, Itskhoki and Moll (2019) study optimal, dynamic Ramsey policies in a standard growth model with financial frictions. They show that, in early stages of development, optimal policy intervention involves fostering entrepreneurial profits to accelerate wealth accumulation.

[10] See Rodriguez-Clare (1996).

relatively new innovation activities.[11].

Our approach here is also related to the work of Akcigit et al. (2021). In their model, an entrepreneur's managerial time is a fixed factor, which implies that production features decreasing returns and marginal profits decrease with firm size. These decreasing returns reduce the incentive to expand the size of the firm. Entrepreneurs can overcome the decreasing marginal returns by delegating the management of the firm to outside managers as their firms expand. But if the delegation efficiency is low, due to imperfect contractual enforcement or a lack of trust, for example, entrepreneurs have little incentive to adopt new technologies as they grow because they anticipate the costs of delegating decision-making power. We can reinterpret the model of Akcigit et al. (2021) as a setting in which the ability of entrepreneurs (firm owners in our setup) to monitor innovation-based activities is lower, which reduces the incentives to switch from a adoption-based to an innovation-based strategy.

- **Innovation capabilities:** Two critical factors associated with the implementation of an innovation-based strategy in our setup are the cost of implementing this strategy (captured by the parameter κ) and the expected return of innovation activities (captured by the parameter $\lambda\gamma$). Following Furman et al. (2002), we can link these parameters with factors that foster national innovation capabilities, which include adequate intellectual property rights, government spending on R&D, the number of engineers in a given country, and the quality of education in a given country, among others. The existence of national innovation capabilities is less relevant when the economy is far from the frontier but, as Cirera and Maloney (2017) find, it becomes more important when an economy is close to the frontier. Finally, regarding intellectual property rights (IPR), Chu et al. (2014) develop a model in which countries implement weak intellectual property rights at the early stages of development to facilitate the adoption (imitation) of frontier technologies, but at later stages of development countries must implement strong IPR to encourage domestic innovation.

As we have seen, the type of business strategy implemented by firms is a key transmission

[11] See Lin et al. (2020) for a discussion of the optimal financial structure in a model of distance to frontier

mechanism through which economic institutions –such as competition policy, financial market sophistication and innovation capabilities– affect economic development. In the next section we discuss how our innovation-intensity strategy index, that captures adoption-based and innovation-based strategies, is constructed.

3 Data, methodology and the innovation strategy index

3.1 Data and methodological aspects

We start our empirical analysis by defining and computing a novel innovation-intensity strategy index. The index quantifies a set of actions implemented by a firm aimed at either innovating or adopting technologies (or good practices, or both). Otherwise stated, it measures the degree to which a firm's business strategy is biased towards innovation or adoption efforts. To construct our innovation-intensity strategy index, we use textual analysis to extract the likely nature of the strategy employed by each firm in our sample using regulatory filings submitted by the firm to the US Securities and Exchange Commission (SEC). More specifically, we apply textual analysis to the particular item on the filing in which the firms describe their business.

As we have seen, business strategy is defined as the way firms organize themselves to compete in the market and given environment in which they operate. In order to compete, firms follow business models that put differing emphases on the resources they use, the products they sell, and the markets they serve. There are numerous business strategy typologies, the prevailing ones being Miles et al. (1978), Porter (1980), Abell (1980), Miller (1992), and Treacy and Wiersema (2007). Miles et al. (1978) characterize the way firms compete into three different classes: defenders, analyzers, and prospectors.[12] They argue that each class has a "particular configuration of technology, organizational structure, and process that is consistent with its market strategy." Defenders are firms that tend to focus on one market niche only and provide a limited range of products or services. Firms in this class try to hold on to their market by competing primarily on price and emphasizing operational efficiency and cost reduction. Prospector firms, the polar opposite of defender firms, constantly seek to develop new products, reach new markets, and even

[12] They consider a fourth category, reactors, but this, category is discarded because the strategy, technology, structure, and process are inconsistent.

create new markets themselves. In order to compete, prospector firms must engage in continuous and intensive innovation. In between the defender and prospector classes, Miles et al. (1978) define an analyzer class: firms that await new developments in their current markets. Analyzer strategies naturally share attributes with the other two classes. They do not create new markets or products but rather try to compete by segmenting markets and offering different varieties of the same good.

Because the analyzer class shares several attributes with the defender and prospector class, it is difficult to clearly identify the analyzer type as a pure business strategy using textual analysis. In addition, the tension between defender and prospector firms is better aligned with the trade-offs between adoption-based and innovation-based strategies highlighted in our theoretical framework. For these reasons, in our empirical implementation, we focus our analysis on the two polar classes –defenders and prospectors– when identifying the strategies of firms in the sample.

Miles et al. (1978) present defenders and prospectors as the pure strategy forms and argue that most firms will ultimately adopt one of them. Nevertheless, they recognize that in reality organizations are complex and that most firms display features of more than one class. Moreover, although many firms set their strategies early in their life cycle, strategies are not immutable and are likely to change in response to market, environmental or technological developments.

Despite some differences, the classes defined by Miles et al. (1978) map onto Porter (1980)'s competitive strategies reasonably well. Porter's cost-leadership strategy, differentiation strategy, and focus strategy equate to the defender class, the prospector class, and the analyzer class, respectively. The Miles et al. (1978) typology, however, provides a more detailed description of actions performed by firms under the different strategies, which is a significant advantage given the text analysis identification we perform. And compared to the Porter (1980)'s classification, which emphasizes many nuances and caveats, the Miles et al. (1978) typology is more narrowly defined, making it easier and less arbitrary to build a dictionary that captures the strategy followed by firms that we use to perform the textual analysis. Firms that can be categorized into these classes and strategy types generally coexist in the same sector and industry.

A critical point drawn from the management literature, as regards our empirical analysis, is that operational effectiveness and the adoption of best practices and leading technologies are key elements of a cost-leadership (defender) strategy. This literature also indicates that in mature and more competitive markets, the competitiveness of a firm essentially depends on its ability to differentiate its products and services from the competition. And that a key activity for this differentiation (prospector) strategy is innovation (see for example Porter (1990, 1996)). We conclude from this analysis that a cost-leadership (defender) strategy should be associated more intensively with activities such as the adoption of best practices and technologies and that a differentiation (prospector) strategy should be associated more intensively with innovation activities.

This does not mean that a cost-leadership (defender) business strategy excludes innovation efforts. But the intensity of innovation efforts under a differentiation (prospector) strategy is higher than under a cost-leadership (defender) business strategy. Zahra and Covin (1993) provide empirical evidence indicating that a differentiation strategy is an innovation-intensive strategy compared to a strategy based on cost leadership. Furthermore, Yang et al. (2015), using survey data from a large set of Canadian firms, provide evidence suggesting that firms with novelty as their top strategic priority are more likely to innovate than firms that prioritize low-cost. And additional case study evidence from Schnaars (1994) indicates better management of cost-drivers is a critical element for the success of firms that have undertaken imitation activities.

As discussed, we use textual analysis to construct the innovation-intensity strategy index. There is ample literature using textual analysis in the field of social sciences, including in finance and economics, where automated tools are applied to transform qualitative text found in large corpora into quantitative measures. Recent examples of textual analysis in economics and finance include Baker et al. (2016), Braun et al. (2020), Guzman and Li (2019), Hassan et al. (2019), Hoberg and Phillips (2016), Loughran and McDonald (2014). Machine-based textual analysis can be based on the use of a dictionary or it can rely on either supervised learning or unsupervised learning (Bauer, 2000; Loughran and McDonald, 2016). We deem the dictionary method to be more appropriate in our context because we have a clear idea of the categories we are looking for and a relatively nondiscretionary way of selecting words associated with these categories.

The dictionary method is conducted by mapping the concepts one is looking for –in this case, a class of business strategy– onto a list of words and n-grams, and then tallying their presence in the corpus of text under study. Word selection when applying this method is therefore critical. To identify the set of words associated with each strategy, we rely on the characterization of business strategies found in Miles et al. (1978) and the definitions of both innovation and adoption found in the Palgrave Encyclopedia of Strategic Management (Augier and Teece, 2021). More specifically, to characterize an adoption strategy we source words used in the chapter on defenders in Miles et al. (1978) and the entry for adoption in the encyclopedia. Similarly, the words to characterize an innovation strategy are sourced from the chapter on prospectors in Miles et al. (1978) and the definition of innovation in the encyclopedia. To ensure the word selection is less dependent on our judgement, we rely solely on keywords in those texts to generate the list of terms. The selection of words is listed in Tables 16 and Table 17 in the Appendix.

As with any strategy that creates a dictionary to capture a particular category, the crucial test for the index is its performance against observable variables with which it should be correlated. As we discuss later, our index fulfils this requirement satisfactorily.

The textual corpus under analysis is the set of annual filings –namely, the 20-F form– for each firm in our sample. Foreign firms listed in the US are required to file with the SEC. Under the SEC rules, a foreign private issuer must file an annual 20-F form within four months of the end of the fiscal year covered by the form. A foreign firm qualifies as foreign private issuer if any of the following conditions are met: US residents hold 50% or less of the firm's outstanding voting securities; a minority of the firm's executive officers or directors are US citizens or residents; less than 50% of the firm's assets are located in the US; or if the firm's business is principally administered outside the US.[13]

As comparability is a critical issue for cross-country analysis, one advantage of the corpus we use over other corpora, such as conference calls or letters to shareholders, is that the SEC requires firms to report in a standardized way. Firms must address nineteen different items: three correspond to the firm's financial statement, and the other items require detailed commentaries on relevant aspects of the company and the share offering. We restrict the textual analysis of the fillings to the item in which firms describe their business –namely, item 4 on the 20-F form, "information on the company." The required responses to items are not free-form commentaries, they are organized and split into several subcategories. And the reports are all in the English language,

[13] https://www.sec.gov/divisions/corpfin/internatl/foreign-private-issuers-overview.shtml

which eases any concerns that differences in grammar or the use of words might introduce noise. Moreover, in almost all cases, the submissions are reviewed by professional editors.[14]

With any business communication, there is always the possibility that the information conveyed is not entirely accurate, perhaps to shift audience perception on the particular matter. As the regulatory filings in our corpus are official documents filed with a regulatory body, they are subject to more scrutiny and therefore likely to be more accurate compared to other corpora. Yet, for the same reason, the reports –which are thoroughly analyzed by the firm's attorneys prior to filing– may be purposefully vague. And vague statements make identifying a firm's strategy more difficult and introduces downward bias in our estimates. Despite this concern, our empirical analysis finds support for the implications of our theoretical framework, which is evidence that the 20-F forms contain apposite information. A related issue is that firms may use an identical or similar description of their strategy every year. In this case, variation in our measure would be reduced and finding any effect would be less likely.

A sample consisting of foreign firms that choose to list their securities in the US does not constitute a random sample. These firms tend to be larger and more successful than the typical firm. They are also more internationally oriented, which is important when relating their strategy to local economic or institutional features. Although we do not observe every firm in its country of origin, we do not view this as a problem for our empirical analysis. Our objective is not to explain misallocation of productive resources within industries but rather to explain why –within each industry– some firms adopt strategies that are different from other firms located in different countries.

We complement our data with Compustat, our source for firm-level financial and accounting data, with country-level economic indicators from the World Bank's World Development Indicators, with expert assessment on the functioning of institutions from the Global Competitiveness Report and the Economist Intelligence Unit, and with development accounting computations from the Penn World Tables.

For each filing, the words present in Item 4.B, titled "Business Overview," of form 20-F are tallied and, using our innovation-intensity dictionary, the share of words for each type of strategy

[14] There are always some variations in style (see, for instance, Lundholm et al. (2014)).

Table 1: Data 20-F Report

	N. Obs	Mean	Standard deviation
Words	4300	18988	18355
Innovation intensive words	4300	329	284
Adoption intensive words	4300	908	805
Share of Innovation intensive	4300	1.944	.764
Share of Adoption intensive	4300	5.207	1.835
Innovation-Intensity Strategy Index	4300	.275	.088

over the total number of words is computed. [15] Our final sample comprises of 4,300 observations corresponding to 778 unique firms, headquartered in 34 different countries, during the period between 2003 and 2016. We removed observations if firms were headquartered in jurisdictions that are instrumental to listing or in tax havens.[16] We also excluded firms headquartered in the US that either could not produce a match on Compustat or when it was not possible to identify the section of the document that describes the firm's strategy. In the empirical analysis all values are winsorized, top and bottom, at the 1% level to reduce the impact of outliers. Table 1 provides summary statistics of the outcomes at this stage. It shows that firms use around 19,000 words on average to describe their business. The frequencies of words related to the innovation-based strategy and adoption-based strategy categories are 2.1% and 5.9%.

3.2 The innovation-intensity strategy index

The innovation-intensity strategy index measures how biased a firm's strategy is towards innovation as opposed to adoption (or imitation). To compute a continuous index, we calculate the share of innovation-intensive words over the sum of adoption-intensive words plus the innovation-intensive words found in the filing. The mean value of the index is 0.275.

Table 2, Table 3 and Table 4 present the countries, years and industries included in our sample. The tables contain the number of observations as well as the mean and the standard deviation of the innovation strategy index. Table 2 shows that the number of firms is not homogeneous across

[15] We exclude from the analysis fillings in which we couldn't identify the section describing the business of the firm.

[16] The list of countries include Bahamas, Bermuda, Macau, Cyprus, Luxembourg, Marshall Islands, Monaco, Panama, and Uruguay.

Table 2: Innovation-Intensity Strategy data by country

N.	Country	N. obs	mean	st. deviation	N.	Country	N. obs	mean	st. deviation
1	Argentina	126	0.234	0.041	18	Japan	197	0.230	0.059
2	Australia	64	0.354	0.151	19	Korea Rep.	82	0.243	0.060
3	Belgium	23	0.279	0.074	20	Mexico	134	0.244	0.056
4	Brazil	271	0.226	0.043	21	Netherlands	136	0.278	0.077
5	Canada	519	0.369	0.102	22	Norway	12	0.261	0.020
6	Chile	142	0.197	0.036	23	Papua New Guinea	7	0.315	0.035
7	China	822	0.253	0.064	24	Philippines	15	0.233	0.040
8	Colombia	19	0.200	0.033	25	Portugal	9	0.214	0.036
9	Denmark	12	0.303	0.080	26	Russian Federation	35	0.277	0.082
10	Finland	16	0.270	0.074	27	Singapore	32	0.254	0.073
11	France	112	0.323	0.060	28	South Africa	37	0.278	0.032
12	Germany	93	0.290	0.089	29	Spain	41	0.268	0.058
13	Greece	74	0.190	0.036	30	Sweden	10	0.256	0.059
14	India	72	0.289	0.033	31	Switzerland	66	0.333	0.072
15	Indonesia	5	0.213	0.012	32	Taiwan	129	0.218	0.048
16	Israel	719	0.294	0.093	33	Turkey	14	0.282	0.026
17	Italy	56	0.253	0.061	34	United Kingdom	199	0.293	0.078

countries: there are many more firms in Canada, China and Israel. This is taken into account when making implications at the country level. The number of observations across countries, however, has no systematic relation to the index score and productivity level , or with the degree of development in a particular economy (the correlation is insignificant in all cases). Wealthier countries tend to have higher index scores, as expected. It is therefore apparent that we are not simply mirroring the degree of economic development; there is also time variation in the index but we do not observe any particular trend or cyclical variation. Table 4 presents the data for industries following Fama and French (1997)'s 48 industry classification.

Looking at strategy decisions in terms of broad sectors, there are some industries, such as telecommunications, banking, and mining, where most firms follow cost-oriented strategies. On the other strategy pole, firms in the chemicals and business equipment sectors have the highest levels on the innovation-intensity strategy index –that is, the most innovation-based strategies. In the more disaggregated sectors, agriculture and banking have the lowest index levels, suggesting bias towards adoption-based strategy, and the chemicals and medical equipment sectors have, on average, the firms that are more biased towards innovation strategies. These are understandable results; however, we can also see that not every industry falls within the preconceived idea of in-

Table 3: Innovation-Intensity Strategy data by year

Year	Obs	Mean	Standard deviation
2003	277	0.262	0.080
2004	295	0.264	0.084
2005	307	0.270	0.084
2006	312	0.275	0.087
2007	320	0.276	0.092
2008	308	0.272	0.091
2009	307	0.272	0.092
2010	332	0.271	0.088
2011	337	0.271	0.086
2012	338	0.275	0.086
2013	313	0.283	0.087
2014	289	0.290	0.091
2015	309	0.290	0.092
2016	256	0.286	0.091
Total	4,300	0.275	0.088

novativeness. This indicates that our measure is picking up additional dimensions not previously explored in the literature.

Furthermore, it is apparent from the distribution of the index within sectors, as shown in Figure 5, that there is ample spread. This suggests that firms adopt different strategies and that their choice is not determined solely by technological matters. As we show in Section 4.4, the strategy a firm adopts is related to the institutional setting in which the company operates. The fact that the mean value of the index varies substantially across countries but less so within countries, as shown in Figure 6, is consistent with this idea.

A variance decomposition exercise, shown in Table 5, indicates that almost 90% of the variation in the measure is at the firm level, which indicates that firms differ significantly in terms of the strategy they follow. The variance decomposition also reveals that the index is not just capturing the fact that some industries are more innovative than others: close to 50% of the difference across firms is unrelated to a firm's sector. Yet, this difference across firms is also not entirely because firms are located in different countries: almost two-thirds of the variation is at the country-industry cluster. In other words, in a given sector, most of the business model variation at the firm level is because firms in different countries adopt dissimilar strategies. These are precisely the sort of differences we aim to understand. Unless otherwise stated, in the exercises that

Table 4: Innovation-Intensity Strategy data by industry

(sorted by Business Strategy Index)

Industry	Obs	Mean	St. dev.
Pharmaceutical Products	319	0.408	0.107
Precious Metals	142	0.385	0.079
Non-Metallic and Industrial Metal Mining	159	0.382	0.106
Printing and Publishing	29	0.326	0.071
Trading	104	0.325	0.081
Personal Services	53	0.319	0.033
Aircraft	13	0.319	0.021
Shipbuilding, Railroad Equipment	2	0.310	0.029
Recreation	5	0.305	0.014
Medical Equipment	84	0.300	0.063
Other Industries NES.	65	0.300	0.081
Petroleum and Natural Gas	175	0.295	0.084
Real Estate	51	0.294	0.074
Business Services	603	0.293	0.063
Chemicals	46	0.292	0.079
Construction	15	0.286	0.027
Computers	196	0.261	0.058
Measuring and Control Equipment	81	0.257	0.066
Entertainment	14	0.254	0.073
Communication	374	0.246	0.046
Electronic Equipment	449	0.244	0.056
Electrical Equipment	45	0.244	0.045
Healthcare	6	0.241	0.031
Restaurants, Hotels, Motels	30	0.240	0.049
Utilities	165	0.240	0.056
Consumer Goods	27	0.238	0.033
Food Products	23	0.234	0.043
Shipping Containers	1	0.232	0.088
Business Supplies	32	0.229	0.036
Automobiles and Trucks	51	0.226	0.047
Insurance	41	0.224	0.063
Agriculture	13	0.221	0.050
Wholesale	51	0.221	0.061
Apparel	20	0.219	0.056
Banking	240	0.218	0.039
Retail	89	0.217	0.037
Construction Materials	20	0.216	0.044
Candy & Soda	30	0.213	0.043
Machinery	103	0.213	0.050
Transportation	179	0.210	0.055
Rubber and Plastic Products	12	0.197	0.034
Steel Works Etc	94	0.197	0.044
Beer & Liquor	31	0.195	0.028
Tobacco Products	5	0.194	0.029
Coal	13	0.155	0.016
Total	4,300	0.275	0.088

Table 5: Variance decomposition

Controls	R^2
Year	.007
Country	.281
Industry	.426
Firm	.893
Country x Year	.454
Industry x Year	.310
Industry x Country	.671
N. obs	4300

follow we include year and industry fixed effects. We can therefore investigate why firms in the same sector differ from other firms across countries.

4 Results

4.1 The innovation-intensity strategy index and R&D expenditure

Our innovation-intensity strategy index is positively correlated with indicators that are regularly used to capture the degree of innovation, both at the firm and at the country level. Column 1 in Table 6 documents a strong correlation between the index and firm-level R&D expenditure (over assets). This relationship extends beyond a number of firms, and time-varying, characteristics traditionally associated with research activity. Moreover, column 2 in Table 6 shows that it is not differences across industries that explain the correlation between the index and firm-level R&D expenditure but rather, primarily, the within-industry variation of firms located across a wide range of countries. This shows that we are not just measuring the fact that R&D is more relevant in some industries than others.

Notably, as indicated by the regression R-squared, although R&D and our strategy index capture similar variation they are not completely equivalent. Indeed, and as emphasized in previous sections, one advantage of our innovation-intensity strategy index is that it allows us to capture other dimensions of the innovation process not captured by traditional measures. Innovation is usually associated with the development of new products and new technologies for production; thus, it is natural to associate innovation intensity with R&D efforts by firms and to the number of patents in an industry. Nonetheless, and as discussed by O'Connor (2019), innovation involves various distinct capabilities of which R&D is just one–that is, there is evidence that innovation goes beyond R&D expenditure.[17]

The ability of our innovation-intensity strategy index to capture other dimensions of the innovation process not captured by traditional measures is particularly relevant for our empirical strategy. The firms in our analysis come from a broad set of industries, and not only from industries where innovation activities have a direct relation to R&D expenditure. R&D expenditure data is available for just over half (55%) the number of firms included in the index. In terms of observations, the index has similar coverage in the manufacturing and business equipment sectors, but many more observations in consumer non-durable, utilities, and finance. Similarly, in Japan and Germany, the additional coverage of the index is relatively small, but the differences are stark in countries such as Chile, Canada and Greece.

Therefore, in the empirical analysis, our index allows us to consider an extensive set of firms, industries and countries compared to other studies that use R&D expenditure as the proxy of innovation efforts by firms.

Using R&D expenditure as a proxy for innovation efforts is not only problematic because of the lack of data. Some studies assume that a missing value for R&D expenditure means zero expenditure and others studies just record it as missing. The choice is not obvious. Koh and Reeb (2015), for instance, document that 10.5% of firms with a missing value for R&D expenditure file and receive patents, a proportion 14 times greater than firms that record zero R&D expenditure. What is more, the value reported differs across sources, as a review by Liu (2020) makes clear. Data on patents also suffer from this kind of problem. Arora et al. (2021) provide a good example of the difficulties involved in matching National Bureau of Economic Research (NBER) patent data to financial databases (like Compustat, Orbis, or SDC) due to issues such as changes in firm name or ownership structure.

By aggregating our measure of the innovativeness of the firm's strategy, we can see whether it

[17]Using data from the Manufacturing Performance Survey 2003 undertaken in Germany, Kinkel et al. (2005) show that companies that achieve innovative breakthroughs by intelligent product-service combinations or innovative techno- organizational processes, not related to R&D, can also generate a significant contribution to economic growth and employment. Santamaría et al. (2009) show that innovation in low- and medium-technology industries often involves internal experimentation and learning that are not necessarily rooted in formal R&D components.

Table 6: Innovation-Intensity Strategy and R&D

	R&D/A_t		R&D (% of GDP)		Patents per capita, log	
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Innovation-Intensity Strategy	0.172**	0.160**	0.414***		0.219	
	(0.064)	(0.063)	(0.124)		(0.177)	
(residual) Innovation-Intensity Strategy				0.427***		0.391**
				(0.143)		(0.159)
Sales (t-1),	-0.178**	-0.082				
	(0.086)	(0.092)				
ROA (t-1)	-0.214***	-0.209***				
	(0.069)	(0.070)				
Tangibility (t-1)	-0.255***	-0.184**				
	(0.062)	(0.067)				
Observations	1,813	1,813	32	32	32	32
R-squared	0.314	0.398	0.172	0.182	0.048	0.153
Year FE	✓	✓				
Industry FE	-	✓				

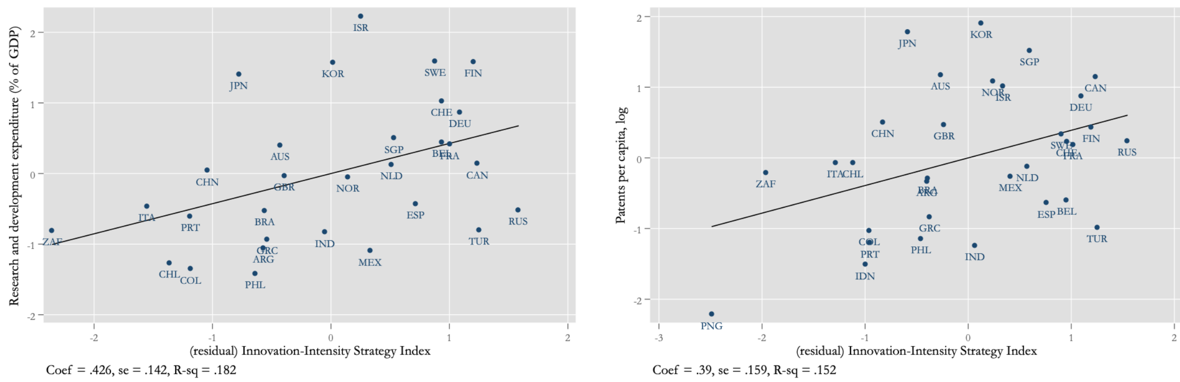
Note: Robust standard errors in parentheses. In columns 1 and 2 standard errors are clustered by country. *** p<0.01, ** p<0.05, * p<0.1

is related to other country-level measures that capture either the inputs or outputs of innovation processes. Columns 3 and 4 in Table 6 show a positive correlation between country (aggregated) innovation strategy and R&D expenditure over GDP, and columns 5 and 6 in Table 6 show the correlation between innovation strategy and the number of patents per capita. Simply aggregating the figures at the country level could be problematic. It would not be surprising to find that countries that have a large proportion of firms operating in sectors such as the pharmaceutical industry, which can be characterized as relatively more innovation intensive, are more innovative than countries that have a large proportion of firms operating in the coal sector, which is the most cost-oriented industry in our results. To control for differences in industrial composition across countries, we clean up this effect by computing the residual of a regression of the index on the set of year-industry fixed effects. Then, we take the country average over the sample period. Columns 4 and 6 in Table 6 show the results using this adjusted index: the coefficient for both R&D expenditure and patents is positive and significant.

Figure 1 depicts this result graphically. Figure 1a shows that countries where firms implement strategies that are more biased towards innovation, according to the index, have higher levels of

Figure 1: Innovation-Intensity Strategy and country characteristics

(a) R&D (b) Patents



innovation effort, measured as expenditure in R&D as a share of GDP, than countries where firms implement strategies that are more biased towards adoption. Similarly, Figure 1b shows a positive correlation between our innovation-intensity strategy index and innovation measured as patents per capita (in logs).

4.2 Innovation and adoption strategies and development

Our motivation is to better understand the mechanisms through which countries achieve higher levels of development by investigating the role of adoption-based and innovation-based business strategies in this process. Having an index that identifies innovation-intensive and adoption-intensive business strategies for firms in different industries and countries allows us to study empirically the relationship between business strategy and economic development.

In our theoretical framework, firms that are close to the technology frontier find it more profitable to adopt a more innovation-based strategy, and those far from the frontier benefit more if they focus more on imitation and cost-cutting, which are associated with an adoption-based strategy.

To explore whether the data, at the firm level, support the hypothesis that close to the technology frontier firms should follow an innovation-intensive business strategy and firms far from the frontier should follow an adoption-intensive business strategy, we look at the correlation between the innovation-intensity strategy index and firm TFP.[18] In the regression, we control for year and

[18] Total factor productivity at the firm level is measured as the residual of a regression between value added on the

industry fixed effects, and for lagged sales, return on assets (RoA), and tangibility of firm assets to account for the fact that bigger and more mature firms may partially explain the observed TFP. The estimates, shown in column 1 of Table 7, indicate that this relationship is positive and significant: an innovation-intensity strategy index score one standard deviation higher is associated with a 9% higher productivity level.

Table 7: Firm TFP, Development Accounting and Innovation-Intensity Strategy

	TFP	Income per capita		Human capital		Physical capital per capita		TFP	
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
IIS index	0.094**	0.367**		0.452***		0.135		0.353***	
	(0.044)	(0.149)		(0.152)		(0.176)		(0.126)	
(residual) IIS index			0.422***		0.467***		0.344**		0.329**
			(0.126)		(0.113)		(0.157)		(0.152)
Sales (t-1), log	0.277***								
	(0.053)								
ROA (t-1)	0.098***								
	(0.027)								
Tangibility (t-1)	-0.340***								
	(0.073)								
Observations	2,643	30	30	30	30	30	30	30	30
R-squared	0.365	0.135	0.178	0.204	0.218	0.018	0.118	0.125	0.108
Year FE	✓								
Industry FE	✓								

Note: We normalize all variables to have a mean of zero and standard deviation of one in each year. Robust standard errors in parentheses clustered by country. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

We then use our innovation-intensity strategy index at the country level to test whether it is positively correlated with a proxy for an economy's distance to frontier, measured as the economy's GDP per capita over the GDP per capita of the US. In Table 7, column 2 shows that there is a positive and significant correlation between income per capita differentials and the type of business strategy that firms follow in a particular country. Column 3 confirms this positive and significant correlation using the residual business strategy –that is, controlling for the variation in the industrial composition of activity across countries.

To understand the reasons behind this relationship, using data from the Penn World Table, we decompose each country's distance to the technology frontier into three different factors: (physical) capital intensity, human capital intensity, and TFP differentials. In our framework, the relation

number of employees and the value of property, plant and equipment (all variables in logs).

between country-level development and firm-level strategy comes from the fact that strategies with higher innovation-intensity strategy index scores are more productive. Accordingly, one would expect to find that the relationship with GDP per capita is primarily generated by differences in productivity, and this is indeed the case. As can be seen in Table 7, the relationship between the strategy index and the stock of physical capital is weak and insignificant, and the relationship between innovation intensity and TFP is large and strong. The economic magnitudes of these results are meaningful: being one standard deviation further from the frontier –roughly the difference between Chile and the UK– is associated with a degree of innovation-intensity that is 2.8 standard deviations lower. This is commensurate to the difference in innovation-intensity between the strategy of the average firm operating in the coal industry and one operating in the pharmaceutical industry.

The relationship between innovation-intensity and human capital is also strong. A well-educated work force is most likely correlative to the adoption of more advanced technologies. And we show that the availability of human capital in a country is a critical determinant of the degree of innovation-intensity of firms in the same country.

Our results are unaltered when we control for the larger presence of capital-intensive sectors in less developed countries. Overall, the evidence confirms the intuition of our theoretical framework: we observe increasing adoption of innovation-based business strategies as countries approach the world technology frontier.

A clear implication of our framework is that productivity improves as strategy becomes more innovation-based. And this mechanism –that is, the type of business strategy that firms implement– is a significant determinant of the productivity differentials across countries: an increase of one standard deviation in the level of a country's innovation-intensity strategy index equates to approximately 0.35 of a standard deviation increase in TFP.

It is important to stress that our results are based on a sample of firms that issue securities in the US, and the firms in the sample are therefore likely to be at the technology frontier in their respective countries. We are not exploiting differences within countries but rather within industries across countries. The differences captured in our regressions are not generated by resource misallocation across firms within sectors in a particular country. Our results provide a complementary explanation for the productivity differentials across countries arising from misallocation, documented in the seminal work of Hsieh and Klenow (2009) and Restuccia and Rogerson (2013).

Our analysis is also related to the work of Bloom et al. (2014), who provide evidence that around one-quarter of the cross-country and within-country TFP differentials can be accounted for by differences in management practices. The ability to excel in the implementation of a business strategy, which impacts firm profits through operational effectiveness and higher levels of productivity, fundamentally depends on a firm's management. Bloom et al. (2013) find that suitable management practices significantly raised productivity in large Indian textile firms through improved quality and efficiency and reduced inventory. Therefore, we hold that the explanation of productivity differentials based on differences in management practices is complementary to our business strategy explanation.

In subsection 4.3, we formally test whether the relationship between business strategies and productivity growth depends on the distance to the world technology frontier. Specifically, we test whether firms closer to the frontier adopt more innovative strategies. We then study the main determinants for the implementation of a particular business strategy.

4.3 Innovation and adoption strategies and productivity growth

We have shown that the degree to which firms in a country implement strategies that are more biased towards innovation is positively related to income per capita. However, despite the fact that more developed countries tend to have firms with more innovative strategies, it does not mean that for a country to climb the development ladder the firms in that country must implement innovation-based strategies during the entire development process. As discussed in our theoretical framework, the optimal strategy is dependent on the distance to the world technology frontier. In order to maximize productivity growth, imitation –or in our setup, the implementation of an adoption-based strategy– should be the predominant strategy for countries that are far from the frontier. An innovation-based strategy should be predominant in more advanced economies that are close to the frontier. To test this hypothesis we estimate the following regression:

$$g_{i,t} = \beta_{0,i} + \beta_1 a_{i,t-1} + \beta_2 BS_{i,t-1} + \beta_3 \left(BS_{i,t-1} \times a_{i,t-1}\right) + \epsilon_{i,t}$$

where $g_{i,t} = ln(A_{i,t}/A_{i,t-1})$ with A being TFP, and $a_{i,t-1} \equiv ln(\bar{A}_{i,t-1}) - ln(A_{i,t-1})$ is the distance to the frontier. Depending on the level of analysis, i could indicate either firms or countries.

The coefficients of interest are β_2, and the interaction between distance to frontier and business strategy is captured by β_3. A positive estimate of β_2 indicates that innovative firms have faster TFP growth, but there is a caveat: a negative estimate of β_3 implies that more innovation-intensive business strategies do relatively better when they are implemented closer to the frontier, which is what our framework predicts. This specification is similar to the one used by Acemoglu et al. (2006), but they explore the interaction of barriers to competition and distance to frontier at the country level. Our focus is to establish whether the firms' decision on adoption and innovation intensity efforts is a critical dimension of the development process and whether this dimension is indeed a transmission mechanism though which economic institutions affect economic growth, using firm-level data. After exploring the effect of business strategy on productivity, in subsection 4.4 we show how the business strategy adopted by a firm depends on the institutional environment in which it competes.

Table 8 shows the estimates for the relationship between productivity growth at the firm level and both the innovation-intensity strategy index and distance to the frontier. The positive coefficient for the distance to frontier, shown in column 1, implies that the further from the frontier, the faster productivity grows. This convergence effect means that in terms of productivity, absent other considerations, laggard firms will grow relatively faster, catching up with the leaders. In column 2 we add the innovation-intensity strategy index as a control and find that there is no statistical relationship between the index and firm productivity growth. This reinforces the core idea of our framework that the optimal strategy depends on the distance to the frontier. Column 3 directly tests the main prediction of the model by adding the interaction between distance to frontier and business strategy. The coefficient is statistically significant and negative. This means firms that adopt a more innovation-based business strategy grow faster if they adopt the strategy when close to the frontier. Put differently, when a firm is far from the frontier its productivity will grow faster if an adoption-based rather than an innovation-based strategy is implemented. Thus, firms seeking to maximize productivity should imitate and focus on lowering costs if they are technological laggards but innovate more when they are close to the technology frontier.

Table 8: Innovation-Intensity Strategy Index and Firm TFP Growth

	TFP growth		
VARIABLES	(1)	(2)	(3)
Distance to frontier	0.064***	0.067***	0.114***
	(0.006)	(0.007)	(0.024)
Innovation-Intensity Strategy		0.202	0.526**
		(0.157)	(0.176)
Distance to frontier x IIS			-0.181**
			(0.076)
Observations	636	636	636
R-squared	0.182	0.186	0.190
Year FE	✓	✓	✓
Industry FE	✓	✓	✓

Note: Dependent variable is firm TFP growth over 4-year periods, between 2004-2016. Robust standard errors in parentheses clustered by country. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

The interaction between the innovation-intensity strategy index and distance to frontier term is akin to a second derivative. One way to get a sense of its magnitude is as follows: if a firm far from the frontier (distance in the 90th percentile) were to change their strategy from an innovation-based (index score in the 90th percentile) to an adoption-based strategy (index score in the 10th percentile) its productivity would grow 0.8 percentage points (pp) faster per year. Similarly, firms that are close to the frontier (distance in the 10th percentile) could grow 6.1 pp faster per year by implementing an innovation-based strategy (index score in the 90th percentile) compared to an adoption-based, low-innovation strategy (index score in the 10th percentile).

When we use R&D expenditure as a proxy to capture the strategy implemented by firms, we do not find evidence to support the hypothesis that firms far from the technology frontier grow faster when implementing an adoption-based strategy and firms close to the frontier grow faster when implementing an innovation-based strategy (see Table 15, column 1).

Additionally, controlling for the impact of R&D expenditure in our core regressions does not change the qualitative or quantitative conclusions regarding the effect of our innovation-intensity strategy index (see Table 15, column 3). These results also hold when we use country-level data. Overall, the results indicate that R&D expenditure may be an incomplete proxy to capture a firm's innovation-intensity for two main reasons: First, as discussed previously, activities that lead to innovation go beyond R&D efforts, and our sample considers industries for which this nuance may be significant. Second, as discussed by Griffith et al. (2004), R&D has two "faces." In addition to the conventional role of stimulating innovation, R&D enhances technology transfer by improving the ability of firms to learn about advances in leading edge technology –the concept of absorptive capacity. Therefore, a given level of R&D expenditure by a firm may be associated with an adoption-based strategy instead of an innovation-based strategy. Our sample considers a significant number of firms located in developing economies for whom this distinction may be quite relevant.

We compute the distance to the technology frontier for each country using the relative value of TFP from the Penn World Tables. The results shown in Table 9 suggest that there is convergence: being further from the most advanced countries tends to be an advantage for less productive countries. The estimates also suggest that in countries where firms predominantly implement innovation-based strategies productivity does not always grow significantly faster than in others. The coefficient for the interaction between distance to frontier and business strategy (see Table 9, column 3) suggests that innovation-based strategies are most helpful when a country is sufficiently close to a technology leader. Countries that are further from the most technologically-advanced economies grow more slowly if the firms based there are more inclined to implement innovation-based strategies. This is, again, consistent with what our theoretical framework predicts. To illustrate this with a concrete example, the degree of innovation-intensity implemented in the business strategies of firms in Spain is lower than it should be given its distance from the technology frontier. If firms in Spain were to implement the degree of innovation-intensity found in the strategies adopted by an average Swiss firm, Spain's economic productivity growth rate would increase by 0.32% per year. On the other hand, if firms in Colombia, a country further from the frontier, implemented the kinds of strategies observed in Switzerland, its productivity would decline by 1% per year.

4.4 The determinants of innovation and adoption strategies

Our theoretical framework posits that barriers to competition, a lack of financial market sophistication, and the absence of innovation capabilities can hinder productivity growth. Following Porter (1980), in order to adopt a business strategy, firms need some basic elements and institutions, such

Table 9: Innovation-Intensity Strategy and Country TFP growth

	TFP growth		
VARIABLES	(1)	(2)	(3)
Distance to frontier	0.031***	0.034***	0.115**
	(0.008)	(0.008)	(0.046)
Innovation-Intensity Strategy		0.026	0.124**
		(0.029)	(0.048)
Distance to frontier x IIS			-0.316*
			(0.177)
Observations	84	84	84
R-squared	0.286	0.293	0.331
Year FE	✓	✓	✓

Robust standard errors clustered by country in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Note: Dependent variable is country TFP growth over 4-year periods, between 2004-2016. Robust standard errors in parentheses clustered by country. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

as property rights, an efficient government, security, basic infrastructure, macroeconomic stability, and a healthy population. For innovation-based strategies to be a viable option, other efficiency enhancers are required, such as a good standard of education and well-functioning goods and labor markets, among other aspects. Fewer barriers to competition, more sophisticated financial markets, and the presence of country-level innovation capabilities are critical factors that influence a firm's decision to switch from an adoption-based to an innovation-based business strategy. For example, Aghion et al. (2005) postulate that the reason why firms innovate is that they are trying to escape competition. In this subsection we explore whether a firm's choice of strategy is determined by these country-level attributes.

We first look at the relationship between firm business strategy and the financial sophistication of countries. Adoption-based strategies are generally easier to finance because they are more intensive in physical capital that can be used as collateral, whereas skill-intensive, innovation-based strategies require a more sophisticated financial system that is able to resolve information asymmetry issues and finance projects not wholly based on hard assets. Braun (2003) shows that as financial systems develop firms that do not naturally have good collateral perform better. Of course, financial development not only refers to the ability of firms to obtain external finance (as in Rajan and Zingales (1998)), but it is also a proxy for the ability to enter into more sophisticated

Table 10: Innovation-Intensity Strategy and Financial Development

VARIABLES	Innovation-Intensity Strategy Index (1)	(2)	(3)	(4)	(5)	(6)
Domestic credit to private sector by banks (% of GDP)	0.020					-0.038
	(0.055)					(0.051)
Domestic credit provided by financial sector (% of GDP)		0.057				0.041
		(0.071)				(0.058)
Market capitalization of listed domestic companies (% of GDP)			0.096**			0.015
			(0.045)			(0.038)
Number of listed companies per 1,000,000 people				0.243***		0.209***
				(0.056)		(0.066)
Financial market development (GRC)					0.166***	0.041
					(0.048)	(0.048)
Observations	4,044	4,044	4,044	4,044	4,166	4,037
R-squared	0.477	0.479	0.485	0.517	0.499	0.519
Within R-squared	0	.004	.014	.076	.037	.078
F-test	.13	.647	4.481	18.61	12.189	7.153

Note: Robust standard errors in parentheses clustered by country. All regressions control for year x industry fixed effects.. *** p<0.01, ** p<0.05, * p<0.1.

contracts.

In Table 10 we correlate the innovation-intensity strategy index of firms with different proxies for the development and sophistication of financial markets. As expected, the results, presented in columns 1 to 6, show that the different indicators for the development of credit and capital markets, although not always statistically significant, are all positively related to the implementation of more innovation-based strategies. There is, of course, a great deal of correlation between explanatory variables, but some indicators seem to be more relevant than others. When all variables are considered, the number of firms listed in their local stock exchange stands out. This suggests that, irrespective of the degree of sophistication and size of the banking industry in a country, the financing of very innovative firms seems to require more developed equity markets. This is notable because most innovation leaders in the US are primarily financed by equity, and the US arguably has the most developed equity markets in the world.

The ability to finance innovation is critical but not all firms are driven by the same incentives to implement innovation-based business strategies. If competition is not fostered, market incumbents are able to sustain their economic rents, which reduces the incentive to switch to an innovation-based strategy. Furthermore (although not incorporated into our model), firms may

Table 11: Innovation-Intensity Strategy and Competition Promotion

	Innovation-Intensity Strategy Index										
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Freedom to compete (EIU)	0.051										-0.252***
	(0.062)										(0.060)
Promotion of competition (EIU)		0.150**									-0.011
		(0.070)									(0.079)
Policy towards private enterprise (EIU)			0.185***								0.506***
			(0.052)								(0.131)
Domestic competition (GCR)				0.144**							0.115
				(0.057)							(0.087)
Foreign competition (GCR)					0.097**						-0.051
					(0.045)						(0.060)
Intensity of local competition (WEF EOS)						0.033					-0.053
						(0.031)					(0.045)
Extent of market dominance (WEF EOS)							0.061				0.050
							(0.042)				(0.050)
Regulatory Quality (WB)								0.175***			-0.145
								(0.052)			(0.121)
ROA (country mean)									-0.236***		
									(0.038)		
Markup (country mean)										-0.188***	
										(0.047)	
Observations	4,166	4,166	4,166	4,162	4,162	4,162	4,162	4,173	4,173	4,173	4,162
R-squared	0.481	0.496	0.505	0.493	0.486	0.480	0.482	0.501	0.516	0.499	0.534
Within R-squared	.004	.032	.049	.026	.013	.001	.005	.044	.072	.039	.099
F-test	.676	4.639	12.484	6.4	4.764	1.159	2.098	11.52	38.606	16.141	7.531

innovate to escape competition when they get close to the technological frontier.

We explore this competition hypothesis in Table 11 using different indices that measure the extent of competition in each country, based on expert assessment from the Economist Intelligence Unit (EIU), the Global Competitiveness Report (GCR), and some subindices prepared by the World Economic Forum (WEF) for the Global Competitiveness Report (GCR). Although not always significant, the overall picture that emerges is quite clear: firms adopt more innovation-intensive strategies in countries that are judged to have more competitive environments by the experts. In column 8 we consider regulatory quality, one of the governance indicators designed by the World Bank, and find it has a positive and statistically significant relationship with innovation. This relationship is also present when using more objective indicators. In columns 9 and 10, we consider proxies for the actual economic rents that firms enjoy in each country: the (country-average) RoA and markups. The estimates shown in columns 9 and 10 indicate that firms tend to adopt an innovation-based strategy in countries when the typical firm obtains rents.

Next, we explore the relationship between firm business strategy and the innovation capabilities present in each country. In Table 12, columns 1 and 2 show that human capital is critical: firms are more innovative in places where the population is more educated. This result is consistent with the theoretical work of Nelson and Phelps (1966) and with the empirical evidence presented by Benhabib and Spiegel (1994). We then explore the empirical relationship between firm business strategy and five indices that measure different aspects of the innovation environment in each country. Columns 3 and 4 show that protecting intellectual property (based on the EIU and WEF's expert surveys) is necessary to generate incentives to innovate. Firms have little incentive to innovate if the processes and products generated can be appropriated by others. The degree of collaboration between universities and industries, and the availability of scientists and engineers, is the next aspect of the innovation environment under study, and this aspect is also positively related to the firm-level implementation of innovation-based business strategies. Indeed, innovating is not a stand-alone process. It is part of a system that fosters knowledge generation and the development of applications based on this knowledge. This process generally occurs in higher education institutions and must be transferred to industry thereafter. Column 7 shows a composite index that attempts to identify the existence of innovation ecosystems with comparable characteristics in each country (CGR). This composite index is strongly correlated with our innovation-intensity strategy index. Finally, in column 8, we aggregate all the variables, and this shows that the percentage of the adult population who have completed tertiary level studies and the index of intellectual property protection (from the EIU) appear to have a strong correlation with our innovation-intensity strategy index.

Our results suggest that in order to create the conditions for more innovation-intensive firms, a country must have a sophisticated financial system, strong innovation capabilities, and few barriers to competition. In each case we rely on several indicators that proxy for different aspects of each concept. To have a sense of the overall impact of these three attributes that promote innovation, we compute indices at the country level that summarize the different variables shown in Tables 10, 11 and 12 using principal components analysis. The results in columns 1 to 3 in Table 13 show that these aggregate indices are strong determinants of the business strategy adopted by firms. Column 4 shows the impact of an overall index of a country's institutional environment. The relationship between the all institutional factors index and strategy implies that if a country in the bottom 10% in the all institutional factors index, such as Colombia, had an institutional

Table 12: Innovation-Intensity Strategy and Innovation Capabilities

	Innovation-Intensity Strategy Index							
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Years of schooling (CSL)	0.188***							-0.079
	(0.053)							(0.088)
Percentage of Tertiary Complete (CSL)		0.194***						0.187**
		(0.057)						(0.086)
Intellectual property protection (EIU)			0.211***					0.199***
			(0.060)					(0.050)
Intellectual property protection (WEF EOS)				0.189***				-0.019
				(0.047)				(0.070)
University-industry collaboration in R&D (WEF EOS)					0.133***			0.032
					(0.046)			(0.079)
Availability of scientists and engineers (WEF EOS)						0.152***		0.045
						(0.053)		(0.068)
Innovation and sophistication factors (GCR)							0.148***	-0.051
							(0.043)	(0.132)
Observations	4,037	4,044	4,166	4,162	4,162	4,162	4,162	4,033
R-squared	0.508	0.510	0.513	0.506	0.493	0.499	0.497	0.528
Within R-squared	.051	.057	.059	.045	.021	.032	.028	.09
F-test	12.814	11.771	12.309	15.999	8.523	8.334	11.591	7.909

Note: Robust standard errors in parentheses clustered by country. All regressions control for year x industry fixed effects.. *** p<0.01, ** p<0.05, * p<0.1.

environment comparable to the Republic of Korea, which is in the top 10% of the all institutional factors index, firms in Colombia would adopt business strategies that would be 30% more oriented towards innovation.

Previous empirical evidence on the impact of institutions on economic growth, conditional on the distance to frontier, has been studied at the country level. Using the number of regulatory procedures to open a new business as a proxy to characterize low-barrier and high-barrier countries, Acemoglu et al. (2006) find evidence indicating that the closer high-barrier countries get to the technology frontier, the more their growth in income per capita slows down over time. Vandenbussche et al. (2006) show that primary and secondary education may be particularly relevant in early stages of development, and that tertiary education may be more relevant for technological progress. Here, taking advantage of our novel innovation-intensity strategy index, we provide evidence on the role of institutions on economic development using firm-level data. We have shown that a key mechanism through which barriers to entry, different types of education, and other economic institutions may affect economic growth is through their impact on adoption and innovation decisions by firms at different stages of development, as predicted by the theoretical

Table 13: Innovation-Intensity Strategy and its institutional determinants

VARIABLES	Innovation-Intensity Strategy Index (1)	(2)	(3)	(4)	(5)
Financial Development Index	0.156**				0.056
	(0.053)				(0.076)
Competition Promotion Index		0.163**			-0.063
		(0.061)			(0.096)
Innovation Environment Index			0.214***		0.234***
			(0.049)		(0.078)
All Institutional Factors index				0.205***	
				(0.054)	
Observations	4,032	4,032	4,032	4,032	4,032
R-squared	0.494	0.497	0.509	0.510	0.506
Within R-squared	.031	.037	.059	.062	.054
F-test	8.698	6.578	19.492	6.368	14.379

Note: Robust standard errors in parentheses clustered by country. All regressions control for year x industry fixed effects.. *** p<0.01, ** p<0.05, * p<0.1.

model delineated by Acemoglu et al. (2006).

Finally, Griffith et al. (2004) raise a crucial question why nonfrontier countries do not invest more in R&D since the social return is higher than at the frontier.[19] We hold that the low investment in R&D in countries that have moved closer to the frontier but are still in the convergence process may be explained by low investment in innovation capabilities at the country level, less sophisticated financial markets, and more barriers to competition. And we also hold that this explains why firms do not switch from an adoption-based strategy to an innovation-based business strategy. Thus, the salient question is why the institutional environment is not reformed to maximize productivity growth. Reasons related to political economy, as discussed in Acemoglu et al. (2006), may illuminate this conundrum. Special interest groups that benefit from the existing institutional setup may block the kind of institutional change required to maximize economic growth. Indeed, Braun and Raddatz (2008) provide evidence related to one of our key institutional variables: financial sophistication. It suggests that financial development will not occur if the political power of industries that do not benefit from financial development is superior to the political

[19] Cirera and Maloney (2017) have referred to this situation as an innovation paradox in developing countries.

power of industries that do benefit. The evidence we present here suggests that nonconvergence traps may occur if competition policy, innovation capabilities, and financial market sophistication are not enhanced as a country moves closer to the technology frontier

5 Conclusions

Productivity is the driving force behind long-term growth. Firms are at the core of economic development because their business decisions determine how resources are used in a firm and, therefore, the productivity of the firm. But a firm's business strategy choice depends on the environment in which the firm is located. Governments make policy decisions that are dependent on firm choices but, at the same time, directly affect them. The business strategies of firms in a country and that country's stage of development therefore are closely intertwined. In this paper, we document this relationship and show how institutions and development are linked through business decisions on strategy.

To do this, we build a novel measure of the degree to which the strategy followed by a firm is more biased towards innovation or adoption (imitation), using a textual analysis of regulatory filings for a large number of firms across developed and developing countries. Our results are easily summarized. We show that business strategy is not solely dependent on where a firm is located or on the sector in which it competes but rather that there is ample variation in strategy across firms.

The degree to which the strategy of the firms in a country is innovation-based explains part of the variation in its degree of development, particularly the TFP component. The optimal growth strategy for a country depends on its stage of development: the productivity of firms that implement innovation-based strategies grows more quickly when they are close to the technology frontier, but firms that follow adoption-based strategies grow faster when they are far from frontier. The existence of a sophisticated financial system, competition, and innovation capabilities in a country appear to be the main determinants in the decision to implement an innovation-based business strategy. In this context, nonconvergence traps may occur. If competition policy, innovation capabilities and financial market sophistication are not enhanced as a country moves closer to the technology frontier, countries may become mired in a middle-income trap.

Several issues that merit further research are raised by the results shown in this paper. Among them, the role of government in each economic development stage, the need for industrial policy and innovation clusters, and how political economy considerations affect the implementation of optimal policy. We leave those questions for future investigations.

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A Appendix

A.1 Model details

Final good production: In each country, a unique final good is produced by competitive firms using a continuum of intermediate inputs. The final good serves as numéraire. Production function of the final good in each country is given by

$$Y_t = \int_0^1 A_{i,t}^{1-\alpha} x_{i,t}^{\alpha} di,$$

where A_{it} is the productivity in sector i at time t, x_{it} represents the purchases of intermediate good i at time t. Additionally, $\alpha \in [0, 1]$.

Intermediate sector: In each intermediate sector i, production takes place through a monopolist firm that transforms one unit of the final good into one unit of the intermediate good with productivity A_{it}. In each sector, there is a fringe of additional firms that can produce with the same productivity level A_{it} but with higher costs of production. In particular, the fringe needs $\chi > 1$ units of the final good to produce one unit of the intermediate good. We assume the same conditions discussed in AAZ, which ensures that the fringe firms will not be active in equilibrium and the price of the intermediate good will be equal to $pi_{it} = \chi$. Given this price for each intermediate good and the demand for each intermediate good, equilibrium profits for the monopolist firm in sector i is given by:

$$\pi_{it} = \pi A_{it},$$

where $\pi \equiv (\chi - 1)(a/\chi)^{1/(1-\alpha)}$. The average productivity in the country at time t being denoted by,

$$A_t \equiv \int_0^1 A_{i,t} di.$$

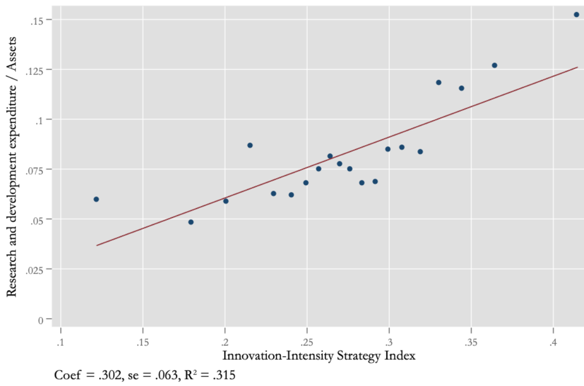
The productivity level of the world frontier is given by $\bar{A}_t$ while frontier productivity growth is given by:

$$\bar{A}_t = (1 + g)\bar{A}_{t-1}$$

Let $a_t = A_t/\bar{A}_t$ denotes the inverse measure of the country's distance to the technological frontier at date t.

Figure 2: R&D and Innovation-Intensity Strategy

(a) R&D over Assets



(b) R&D over Sales

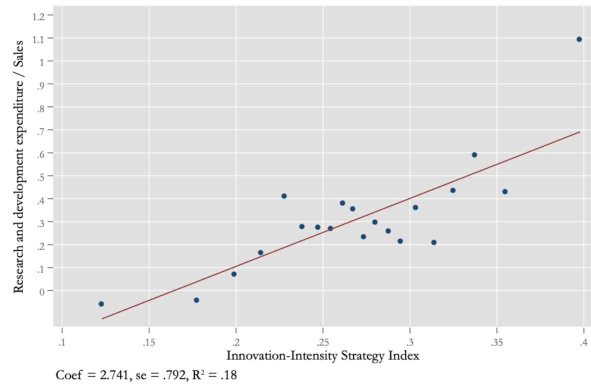
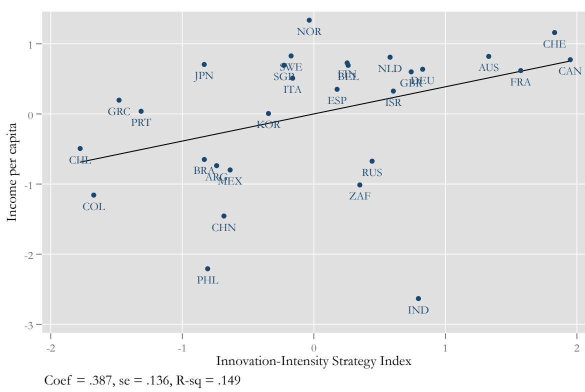
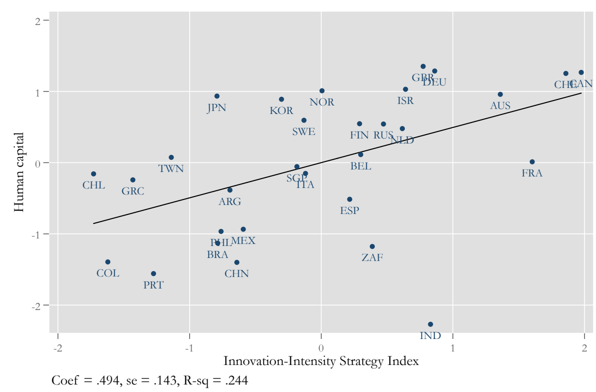


Figure 3: Development accounting and Innovation-Intensity Strategy

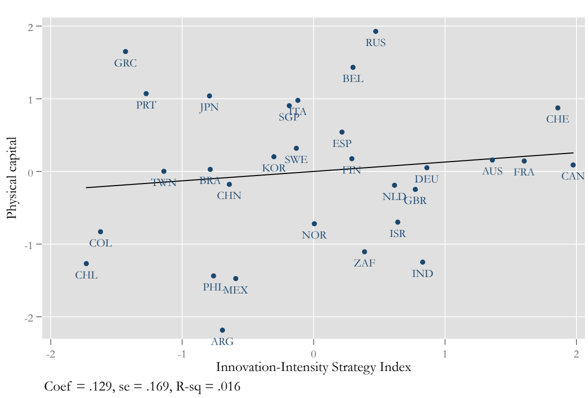
(a) Income per capita



(b) Human capital



(c) Physical capital per capita



(d) TFP

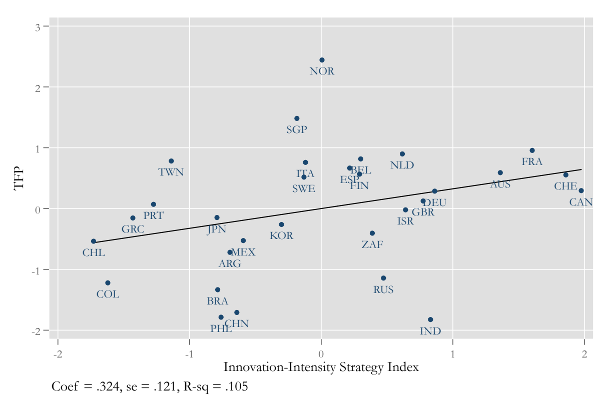
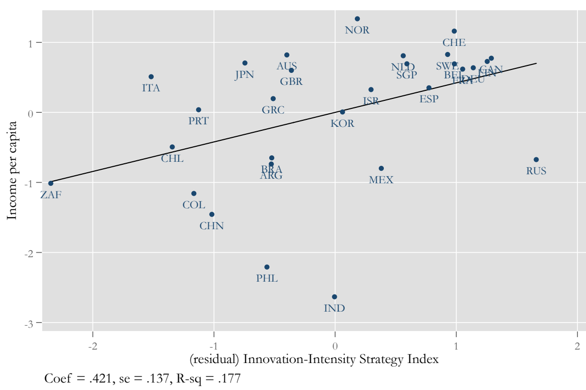
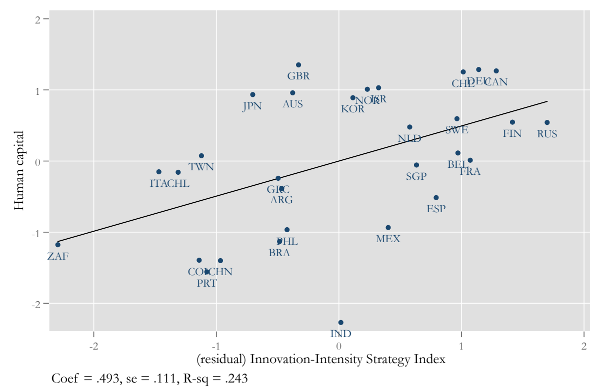


Figure 4: Development accounting and Innovation-Intensity Strategy (residual)

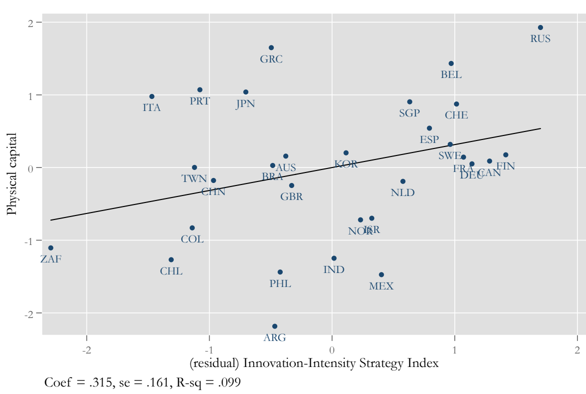
(a) Income per capita



(b) Human capital



(c) Physical capital per capita



(d) TFP

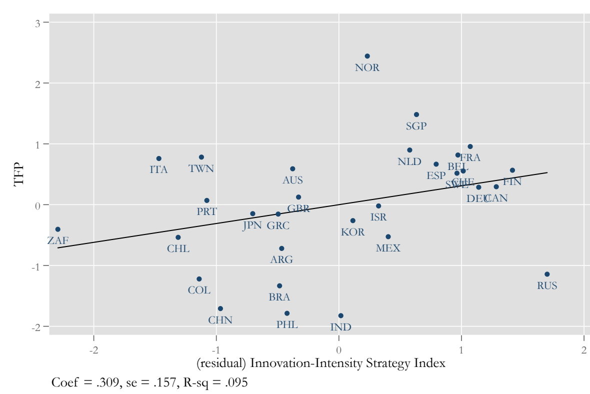


Figure 5: Distribution of Innovation-Intensity Strategy by sector

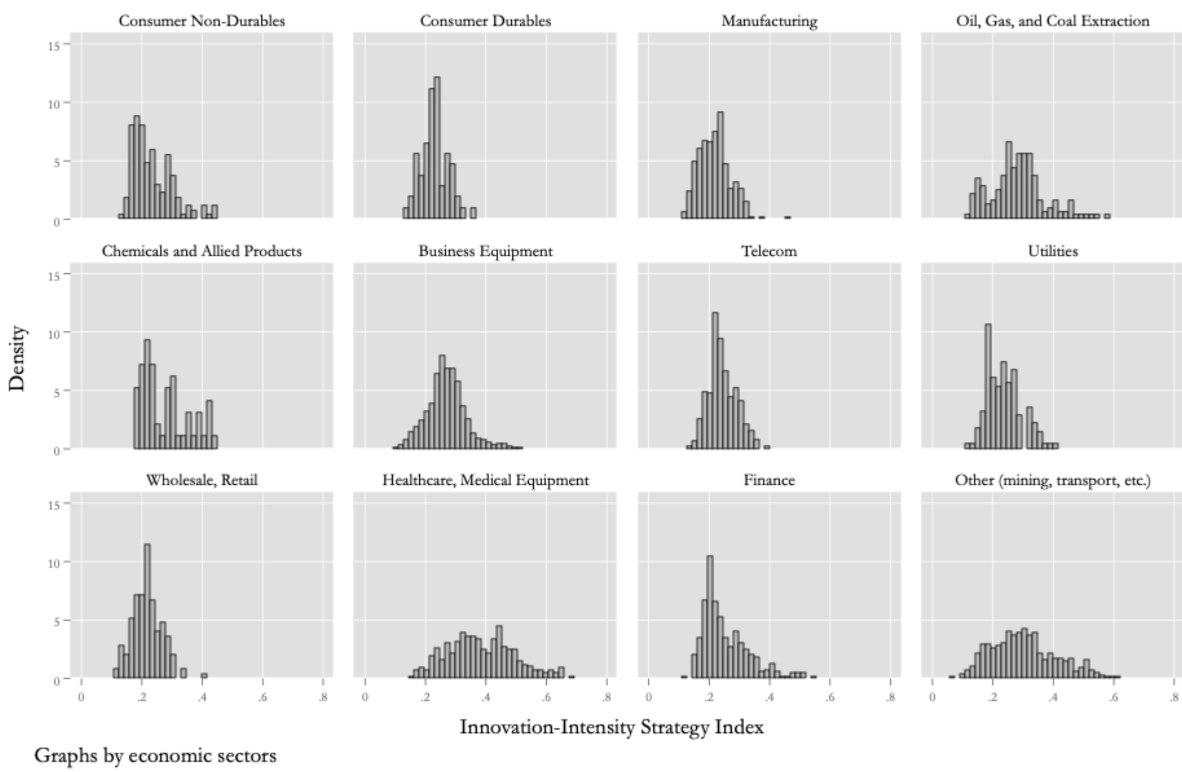


Figure 6: Distribution of Innovation-Intensity Strategy by Country

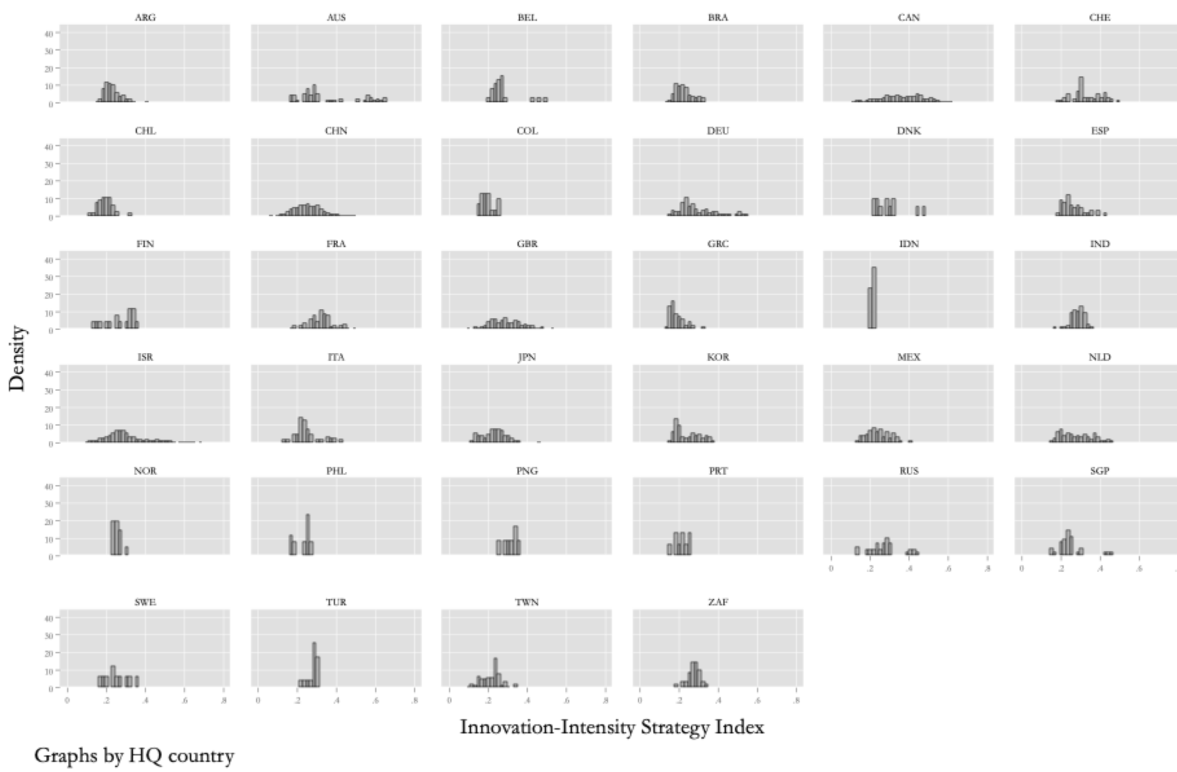


Table 14: Innovation-Intensity Strategy, R&D and TFP

VARIABLES	(1) TFP	(2) TFP	(3) TFP
Innovation-Intensity Strategy	0.157**		0.109**
	(0.061)		(0.041)
R&D/Assets		0.327***	0.311***
		(0.063)	(0.055)
Sales (t-1), log	0.405***	0.437***	0.433***
	(0.080)	(0.065)	(0.059)
ROA (t-1)	0.116***	0.179***	0.182***
	(0.035)	(0.037)	(0.036)
Tangibility (t-1)	-0.483***	-0.448***	-0.428***
	(0.083)	(0.075)	(0.076)
Observations	1,818	1,818	1,818
R-squared	0.405	0.458	0.465
Year FE	✓	✓	✓
Industry FE	✓	✓	✓

Note: Dependent variable is firm TFP. Robust standard errors in parentheses clustered by country. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 15: Innovation-Intensity Strategy, R&D and TFP growth

		TFP growth	
VARIABLES	(1)	(2)	(3)
Distance to frontier	0.065***	0.134***	0.133***
	(0.005)	(0.020)	(0.019)
R&D/Assets	0.021		0.010
	(0.013)		(0.011)
Distance to frontier x R&D/Assets	-0.008***		-0.003
	(0.001)		(0.002)
Innovation-Intensity Strategy		0.629***	0.605***
		(0.151)	(0.149)
Distance to frontier x IIS		-0.252***	-0.245***
		(0.069)	(0.068)
Observations	410	410	410
R-squared	0.184	0.192	0.193
Year FE	✓	✓	✓
Industry FE	✓	✓	✓

Note: Dependent variable is firm TFP growth over 4-year periods, between 2004-2016. Robust standard errors in parentheses clustered by country. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 16: Innovation intensive words

Rank	Word	Freq	Rank	Word	Freq	Rank	Word	Freq
1	new	35.462	43	improved	2.047	85	seeks	0.624
2	development	26.143	44	changed	1.941	86	novel	0.490
3	results	12.158	45	adjustment	1.899	87	patented	0.478
4	project	12.004	46	create	1.861	88	uncertain	0.478
5	exploration	11.407	47	found	1.624	89	find	0.448
6	future	11.227	48	extend	1.565	90	dynamic	0.446
7	environmental	11.019	49	knowledge	1.517	91	diversity	0.373
8	growth	10.073	50	professional	1.509	92	finding	0.342
9	acquired	9.199	51	enhanced	1.491	93	exploring	0.331
10	effective	8.819	52	improving	1.485	94	innovations	0.308
11	research	8.555	53	grow	1.409	95	horizontal	0.287
12	changes	7.924	54	innovative	1.407	96	creative	0.260
13	potential	6.882	55	discovery	1.395	97	invention	0.222
14	change	6.459	56	discontinued	1.346	98	inventions	0.210
15	technical	6.367	57	effectiveness	1.329	99	investigate	0.184
16	developed	6.364	58	university	1.326	100	quick	0.156
17	design	5.790	59	seeking	1.318	101	contingency	0.143
18	venture	5.572	60	emerging	1.313	102	prototype	0.098
19	different	5.364	61	opportunity	1.294	103	autonomy	0.061
20	develop	5.343	62	beyond	1.214	104	decentralized	0.031
21	environment	4.684	63	search	1.200	105	discontinue	0.031
22	patent	4.659	64	laboratory	1.080	106	experimental	0.029
23	added	4.269	65	innovation	1.068	107	scientists	0.028
24	wide	3.795	66	rapid	1.047	108	innovator	0.016
25	acquire	3.651	67	opinion	1.031	109	ideas	0.015
26	advanced	3.541	68	actively	0.999	110	transformed	0.014
27	improve	3.513	69	discretion	0.940			
28	developing	3.488	70	rapidly	0.926			
29	open	3.469	71	add	0.889			
30	study	3.318	72	changing	0.855			
31	patents	3.282	73	creating	0.830			
32	expand	3.124	74	investigation	0.810			
33	team	2.715	75	prospect	0.802			
34	seek	2.707	76	science	0.729			
35	external	2.685	77	diverse	0.720			
36	studies	2.662	78	uncertainty	0.699			
37	multiple	2.620	79	scientific	0.681			
38	individuals	2.565	80	prospecting	0.677			
39	people	2.553	81	quickly	0.672			
40	complex	2.473	82	explore	0.670			
41	growing	2.181	83	edge	0.658			
42	broad	2.122	84	define	0.637			

Table 17: Adoption intensive words

Rank	Word	Freq	Rank	Word	Freq	Rank	Word	Freq
1	sales	29.075	43	efficiency	2.997	85	strict	0.686
2	management	28.582	44	previous	2.879	86	alliances	0.680
3	production	26.376	45	method	2.851	87	internally	0.671
4	following	18.601	46	staff	2.843	88	engineers	0.661
5	costs	16.622	47	planning	2.367	89	efficiently	0.626
6	price	15.799	48	actions	2.312	90	convert	0.617
7	technology	15.606	49	response	2.275	91	canon	0.547
8	limited	15.102	50	organization	2.231	92	simple	0.528
9	equipment	14.156	51	practices	2.212	93	comparison	0.505
10	distribution	14.091	52	licensing	2.003	94	conventions	0.502
11	process	12.876	53	protect	1.901	95	coordination	0.474
12	control	12.066	54	labor	1.875	96	attention	0.456
13	current	11.499	55	expertise	1.859	97	incremental	0.445
14	line	10.699	56	guidelines	1.769	98	assuming	0.443
15	manufacturing	10.010	57	inventory	1.695	99	sourcing	0.436
16	resources	8.961	58	convention	1.688	100	salaries	0.427
17	competition	7.991	59	methods	1.687	101	guide	0.401
18	operation	7.828	60	index	1.482	102	codes	0.364
19	standards	7.680	61	decisions	1.451	103	standardized	0.358
20	employees	7.584	62	converted	1.434	104	narrow	0.348
21	central	6.849	63	convertible	1.414	105	modify	0.344
22	plans	6.770	64	function	1.280	106	controller	0.302
23	materials	6.170	65	adoption	1.272	107	benchmark	0.292
24	finance	5.949	66	machines	1.257	108	coordinate	0.283
25	competitive	5.820	67	schedule	1.116	109	adapt	0.276
26	low	5.469	68	goal	1.090	110	adopting	0.253
27	structure	5.405	69	stable	1.073	111	converting	0.249
28	competitors	4.999	70	specifications	0.974	112	adjusting	0.237
29	maintenance	4.965	71	turnover	0.965	113	scheduling	0.234
30	internal	4.921	72	conventional	0.936	114	references	0.223
31	administrative	4.762	73	transfers	0.925	115	defend	0.215
32	administration	4.743	74	budget	0.906	116	standardization	0.206
33	defined	4.531	75	vertical	0.801	117	wages	0.201
34	reduce	4.404	76	stability	0.736	118	technique	0.196
35	portion	4.272	77	respond	0.728	119	adapted	0.122
36	standard	4.207	78	exploitation	0.727	120	indices	0.120
37	processing	4.151	79	formal	0.720	121	centrally	0.110
38	single	4.142	80	alteration	0.710	122	specification	0.089
39	past	3.903	81	functional	0.707	123	administrator	0.045
40	code	3.512	82	goals	0.702	124	hierarchy	0.043
41	chief	3.340	83	centralized	0.693	125	standardised	0.034
42	engineering	3.017	84	restrict	0.689			