

Government as Landscape Designer:
A Behavioral View of Industrial Policy*

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Abstract

The *strategic management* literature has built rich and behaviorally plausible models of firms, yet the *industrial policy* literature has overlooked nuances in firm behavior. This paper bridges these two literatures by incorporating increased micro-level realism to examine how industrial policy affects firms. More specifically, we develop a formal model to study how commonly held results on the effects of two prominent types of industrial policy—regulations and incentives—change when we account for the behavioral aspects considered in strategic management. We specify conditions under which, contra results in the industrial policy literature: (i) policy instability can be beneficial (through what we term the “training” and “dislodging” effects) and (ii) firm performance can benefit from the industrial policy of a government with limited ability for identifying and enacting optimal policies. We also show how environmental complexity, an understudied factor in that literature, is a strong moderator of the effect of industrial policy. Managers can use these results to devise better means of coping with and leveraging the effects of industrial policy. Our findings also have implications for organizational search and R&D governance.

Keywords: industrial policy; behavioral theory of the firm; NK models; search; firm performance

1 Introduction

Industrial policy—government intervention that aims to facilitate economic growth by promoting selective sectors or practices (Lazzarini 2015)—has resurged in the past decade (Stiglitz et al. 2013). Widely observed examples of this resurgence include: the World Bank, once a strong promoter of free markets, hosting round tables on “New Thinking in Industrial Policy” (Stiglitz et al. 2013); Germany, historically known for its liberal investment climate, increasing government intervention in foreign investments (Ulmer 2018); and McKinsey expanding to offer governments consulting services on policy making (Rodrik 2010).

Examples of the influence of industrial policy on firms include Denmark’s wind energy subsidies, which promoted the development of wind turbines as efficient as coal plants (Cooke 2017), and Massachusetts’ regulations on toxic chemical disposal, which spurred firms to discover cost-saving process innovations (King 1999, Lenox and Chatterji 2018:81). Of course, industrial policy does not always produce positive outcomes. For instance, US agricultural subsidies have induced farmers to plant crops that fit poorly with their land (Winters 2016).

The growing prevalence of industrial policy and its prominent influence on firms suggest it is increasingly important for managers to understand how exactly industrial policy would affect firm performance. Only then can firms properly prepare for, cope with, and benefit from industrial policy, thereby creating a source of competitive advantage.

The scholarly literature features several approaches to addressing industrial policy. Welfare economists analyze it as a solution to market failures, political economists delve into the motivations behind it, and political scientists examine the games played between firms and government. Even though these approaches have yielded fruitful insights, caution must be exercised when translating them into firm-level implications.

Such caution stems from the micro-level assumptions employed in the existing industrial policy literature. More specifically, while research from the various approaches has proposed refined perspectives on government—questioning its intention (e.g., Stigler 1975a), recognizing its bounded rationality (e.g., Lindblom 1959), and dissecting its structure (e.g., Lieberthal and

Oksenberg 1988)—it has paid limited attention to the behavioral nuances of firms, typically assuming firms to be omniscient optimizers operating in a simple environment. Such view of firms contrasts with the behavioral conceptualization of firms adopted by the strategy and organizations literatures, which incorporates more realistic assumptions about firms and is rooted in the Carnegie tradition (Simon 1947, March and Simon 1958, Cyert and March 1963). Under this latter conceptualization, firm behavior results not from optimization but rather from a boundedly rational and adaptive search process that depends strongly on the complexity of the firm’s environment (Simon 1996:53). In short, the micro-level assumptions underlying the macro-level predictions of the industrial policy literature are at odds with the assumptions of other literatures that study firm behavior. That mismatch has motivated calls by Coen et al. (2010:14) and Ostrom (2010:659) to advance the industrial policy literature by improving its micro-level realism.

In this paper we adopt micro-level assumptions customary in the strategy and organizations literatures toward the end of improving our knowledge of how industrial policy affects firms. We develop a parsimonious yet behaviorally realistic model of how industrial policy affects firm behavior and performance, and we explore how results common to the industrial policy literature depend on micro-level mechanisms. Our model builds on previous work addressing firm search (Levinthal 1997) and subsequent research on NK models (for a review, see Ganco and Hoetker 2009). We augment that literature by allowing the firms’ search landscape to be modified by the two main types of industrial policy: regulations and incentives. In a nutshell, we model regulations as restricting the search area and incentives as deforming the landscape.

We study the effect of industrial policy on firm performance under three main contingencies: (i) government ability (i.e., how likely is the government to identify and enact the optimal policy), (ii) policy stability (how frequently the government changes its policy), and (iii) complexity (how interdependent firm decisions are). The first two contingencies have been highlighted by the industrial policy literature as fundamental conditions for beneficial intervention (Alesina and Perotti 1996, Kohli 2004). Complexity, the third contingency, is

the main contingency in the literature on boundedly rational search but has received scant attention in the industrial policy literature (Colander and Kupers 2014:6).

Our paper contributes three novel findings. First, we identify conditions under which policy instability is not harmful, but can improve firm performance. We find two mechanisms at work in this dynamic, which we term “training” and “dislodging.” Second, we characterize situations in which the industrial policy promulgated by an imperfect government can yield better outcomes (for the firm) than no intervention at all, as when such policy spurs firms’ exploration. Third, we find that environmental complexity is a strong moderator of industrial policy effects: increasing complexity raises the intervention intensity required for a government intervention to be effectual and also limits the detrimental effects of an inept government. By bringing insights from the strategy and organizations literatures to the study of industrial policy, we answer calls in the industrial policy literature to increase micro-level realism and develop insights unlikely to be derived under the neoclassical view of firms that has prevailed in the industrial policy literature.

This research also offers four more general contributions to the strategy and organizations literatures. First, we contribute to a better understanding of how government affects firm performance. Despite extensive research on firms’ nonmarket strategy (e.g., Hillman 2005), state ownership (e.g., Inoue et al. 2013), and the broad institutional environment (e.g., Martin et al. 2010, Ahuja and Yayavaram 2011), the strategy literature has paid limited attention to the influence of a government’s industrial policy. We help fill this gap by identifying situations where industrial policy can benefit (or harm) firm performance and by suggesting when firms should follow (or ignore) government incentives. Second, we describe a new way of thinking about how government and firms interact. By interpreting regulations and incentives as (respectively) restricting where firms can search and deforming the search landscape, our work expands the search literature to start capturing the influence of the government on firms’ search. Third, we further the idea that government can act as an exploration booster (Porter 1991) by fleshing out the factors—including policy type, frequency of policy change,

and environmental complexity—that affect the success of such initiatives. Fourth, we advance the literature on landscape design (Levinthal and Warglien 1999) by suggesting levers that a landscape designer can use to improve search. In particular, our insights can be applied to within-organization contexts in which managers use incentives and regulation-like rules to guide R&D. Our results inform how managers can improve R&D effectiveness by choosing the rules’ type, intensity, and frequency of change.

The paper proceeds as follows. We begin by briefly reviewing the industrial policy literature and the boundedly-rational search literature, focusing on how the latter offers new considerations regarding commonly-held results in the former. Next, we describe how the model is set up. This is followed by presenting our main results and findings. Finally, we discuss broader implications of our results and suggest possible areas for future research.

2 Theoretical Motivation

This section sets the stage for our theory by: (i) defining industrial policy, (ii) summarizing commonly-held results in the industrial policy literature, and (iii) introducing considerations from the boundedly-rational search literature into the discussion of industrial policy.

2.1 Defining industrial policy

Industrial policy refers to government intervention that attempts to promote certain sectors or practices to facilitate economic growth in a way that would not occur in a market free of such intervention (Lazzarini 2015). The ultimate goal of industrial policy is to increase social welfare (Amsden 1989:49). A defining feature of industrial policy is its specificity and attention to substantive matters (Johnson 1982:19); that is, unlike other ways of government intervention that target the broad business environment, industrial policy targets the micro-level practices of firms.¹ It follows that industrial policy has pervasive effects on the firm:

¹Other types of government intervention include macroeconomic policies and neo-corporatism (Coen et al. 2010:22–24). Macroeconomic policies such as Keynesian demand management focus on maintaining long-term

in addition to expressing government's preferences for particular practices, it also infiltrates firms' everyday decision making by setting up external incentive structures and regulatory prescriptions.

There are two main types of industrial policy: incentives and regulations (Vedung 1998). *Incentives* are economic inducements—such as subsidies, taxes, and tariffs—that make some choices cheaper (or more expensive) for firms. *Regulations* are rules stipulating what firms can and cannot do; examples include antitrust laws, pollution control acts, and production standards. A key difference between incentives and regulations is their level of coerciveness: although a firm need not take advantage of government incentives, it is required to follow all laws and regulations.

Industrial policy can differ not only in terms of its type, as just described, but also in terms of its intensity of intervention. That intensity can be of two forms, which we call “span” and “premium.” *Span* captures how broadly the government intervenes in firm decisions. Its variation is illustrated by contrasting South Korea during the rule of Park Chung Hee (1963–1979) with Brazil during the Old Republic (1889–1930): whereas intervention extended throughout South Korea's entire economy, intervention in Brazil was restricted to only parts of the economy (Kohli 2004). *Premium* captures how strongly the government encourages firms to enact its preferences. Its variation is illustrated by the size of government subsidies, where larger amounts correspond to stronger encouragement. Thus, for example, subsidies in Austria and Denmark are nearly 10 times larger than US and UK subsidies (Buigues and Sekkat 2009). Note that while span applies to both incentives and regulations, premium applies only to incentives (since regulations are presumably nonnegotiable).

financial stability of the whole economy; neo-corporatism such as in Scandinavian countries in the 1960s and 1970s focuses on fostering social partnerships between unions and firms. Unlike macroeconomic policies and neo-corporatism, industrial policy is “designed to be specific” (Landesmann 1992:245).

2.2 Commonly held results in the industrial policy literature

The industrial policy literature tends to agree that performance-enhancing industrial policy requires that the government be an able one and that policy instability be avoided. We discuss these two results next.

First, it is widely believed that the economy will suffer from intervention formulated by a low ability, inept government. The notion of government ability—also referred to as “governmental capability” (Lazzarini 2015) or “capacity” (Guillén and Capron 2016, Skocpol 1985)—broadly refers to the extent to which a government can identify and enact the optimal policy. This ability encompasses two aspects of the government: its competence and its benevolence. The competence of a government is its ability to identify the optimal policy, which depends on how well-educated and informed is its bureaucracy (see Pack and Saggi 2006 for a discussion of the information challenges faced by governments). In turn, the benevolence of a government depends on its ability to resist the influence of self-interested politicians and special interest groups (e.g., to avoid regulatory capture attempts effected through lobbying, bribery, and threatening; Dal Bó 2006, Krueger 1990). Large-sample studies have documented wide variation in government ability around the world (see, e.g., La Porta et al. 1999, Hanson and Sigman 2013).²

A government with limited ability is generally presumed to be detrimental. For instance, Kohli (2004) contrasts the wide disparity across civil servants in South Korea and Nigeria and argues that successful intervention requires an able government. The “government failure” argument (e.g., Stigler 1975b), which posits that incompetent or nonbenevolent governments should *refrain* from industrial policy interventions, also implicitly assumes that intervention can be beneficial only when government ability is high.

²While there is concern about governments being incompetent and nonbenevolent, it is incorrect to make the sweeping assumption that all governments share these problems. In terms of competence, Chang (1994) points out that governments have the capacity to establish sophisticated information networks (e.g., statistics bureaus) and to access more information that is less subject to local biases. In terms of benevolence, Kohli (2004) shows that some governments are much more successful than others in committing to economic development.

The second commonly held result in this literature is that policy instability stunts economic growth, where by “policy instability” is meant the frequency with which government policies change. A medium or high level of policy instability can result from political turbulence and social upheaval (as in Brazil from the 1930s until the 1980s; Banuri and Amadeo 1991), from policy re-definition due to periodic shifts in political regimes and agendas (as in the United States; Baumgartner and Jones 1993), and from the deliberate alternation of development priorities (as in South Korea during 1962–1991; Chang 1994). The industrial policy literature tends to agree that a highly unstable policy is detrimental to the economy, arguing that instability increases uncertainty and so deters investment. In their examination of more than 50 countries worldwide, Alesina and Perotti (1996) and Roe and Siegel (2011) document the negative effects of high political instability on both investment and development.

2.3 Considerations from the literature on boundedly rational search

Despite the rich insights generated, the industrial policy literature has focused on characterizing the government and the broad economy, paying limited attention to the nuances in firm behavior. In contrast, the literature on boundedly rational search (as advanced in the strategy and organizations literatures) *has* developed a nuanced understanding of firm behavior. Here we summarize how the literature on boundedly rational search views the firm and then discuss how considerations from that literature may alter commonly held results in the industrial policy literature.

The boundedly-rational search literature posits that decision making within firms is the result not of optimization but rather of adaptive search. Works in this tradition often conceptualize firms as searching for high “peaks” on a “fitness landscape” (Levinthal 1997). This literature has devoted considerable attention to three factors that affect search performance: environmental complexity, decision-maker accuracy, and environmental instability.

Environmental complexity refers to the level of interdependence among firm decisions. Complexity determines the “ruggedness” of the landscape and thus has a strong effect on

search: higher complexity corresponds to more peaks on the search landscape, which increases the likelihood of firms getting “stuck” on a local peak. Research in this area has shown that complexity is a key contingency that influences almost every aspect of firm behavior, including organizational structure (Rivkin and Siggelkow 2003), imitation (Csaszar and Siggelkow 2010, Rivkin 2000), and industry shakeouts (Lenox et al. 2007). So notwithstanding the limited attention it has received in the industrial policy literature (Colander and Kupers 2014:6), the search literature suggests that complexity—by affecting firms’ search process—should also affect the relation between industrial policy and firm performance.³

The second key factor highlighted by this literature, *decision-maker accuracy*, refers to the decision maker’s correct perception of that landscape. Research in this area has shown that inaccuracy can actually be beneficial (Knudsen and Levinthal 2007, Csaszar and Levinthal 2016, Martignoni et al. 2016). For example, using simulations, Csaszar and Levinthal (2016) find that managers’ inaccurate understanding of the strategic context prevents firms from locking on local peaks and increases their chance of finding the global peak. Thus, the search literature suggests something that runs counter to the conventional wisdom in the industrial policy literature: that when the firms’ bounded rationality and the environment’s complexity are considered, there may be cases where policy by a low ability, inept government can produce favorable outcomes.

The third key factor in the literature on boundedly rational search, *environmental instability*, refers to how frequently the payoff from firms’ choices changes as a result of external shocks. The search literature suggests that some instability can be beneficial: although environmental instability makes it more difficult for firms to adapt (March 1991, Siggelkow and Rivkin 2005, Posen and Levinthal 2012), it also creates opportunities for the firm to dislodge itself from suboptimal local peaks. Policy instability can certainly be

³In the industrial policy literature, a concept related to complexity is cross-industry linkages (Hirschman 1958), which refer to transactions across industries (e.g., between the tire and the automobile industries). In the search literature, complexity stems from *any* interdependence across decisions (not just transactions across industries). This latter, more comprehensive view of complexity, affects firm performance in ways not currently studied by the industrial policy literature.

viewed as a type of environmental instability; after all, a changed government policy alters the payoffs from firms' choices and thus alters the landscape on which firms search. Thus, the search literature suggests that policy instability may not always hurt firm performance.

In sum, this section suggests it is worth exploring whether and under what conditions the results from the industrial policy literature change when one accounts for boundedly-rational search considerations. In particular, the literature on search suggests that: (i) complexity plays a role in the effectiveness of industrial policy; (ii) firms may benefit from intervention by a government with limited ability; and (iii) policy instability need not reduce firm performance. The model we describe next will be used to examine whether (and when) these three conjectures hold.

3 Model

Our model extends the conventional NK model, enabling it to examine the influence of industrial policy on firm behavior and performance while taking into account firms' bounded rationality and the environment's complexity. We begin by describing the conventional NK model, which we then extend to accommodate industrial policy considerations.

3.1 Conventional NK model

Following the conception of firms as systems of interdependent decisions (Levinthal 1997), each firm is assumed to make N binary decisions. Hence a vector $\mathbf{d} = (d_1, d_2, \dots, d_N)$, where the d_i 's are each either 0 or 1, represents a firm's configuration of decisions. The fitness—or performance—of a configuration depends on the contribution of all decisions, each of which typically interacts with some other decisions. In other words: each decision d_i contributes a value c_i to the overall fitness, and c_i depends not only on the focal decision d_i but also on K

other interacting decisions. Formally,

$$c_i = f_i(d_i; K \text{ other } d_j\text{'s}). \quad (1)$$

Here K captures the *complexity* of the environment—how interdependent decisions are in generating the payoff. The overall fitness of a configuration \mathbf{d} is the average of its N contributions; that is, $\text{fitness}(\mathbf{d}) = \frac{1}{N} \sum_{i=1}^N c_i(\cdot)$. Standard practice is for the K decisions that interact with the focal decision to be randomly chosen and for the values taken by $c_i(\cdot)$ to be randomly drawn from a 0–1 uniform distribution. (Since $c_i(\cdot)$ depends on $K + 1$ binary decisions, $c_i(\cdot)$ can take 2^{K+1} values.)

This way of mapping firm decisions to fitness is often metaphorically described as a fitness *landscape*. A position on the landscape represents a vector of decisions that a firm could make (i.e., \mathbf{d}), and the “height” of that position represents the firm’s fitness. Each firm’s goal is to find a high position on the landscape—a specific set of decisions that generates high overall fitness.

Since firms are only boundedly rational, they identify high positions through local search; this is usually modeled as firms being able to “see” only neighboring positions on the landscape. More specifically: in each period, a firm evaluates choice configurations that vary from the current configuration by only one decision and then pick the configuration with the highest fitness. Complexity K has a strong influence on the success of local search. The reason is that, as K increases, the landscape becomes more rugged and multi-peaked (see Figure 1); therefore, an increase in K makes it more likely that firms settle on a local peak than on the global maximum.

3.2 Modeling industrial policy

We extend the conventional NK model by conceptualizing industrial policy as modifying the landscape on which firms search. Simply put, we model incentives as raising part of the

(a) Low complexity (b) High complexity

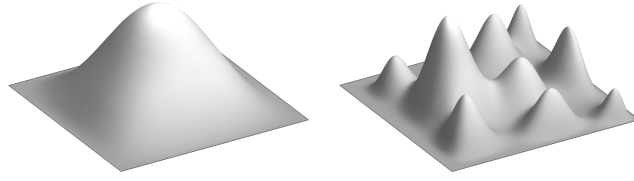


Figure 1: Landscapes of low and high complexity.

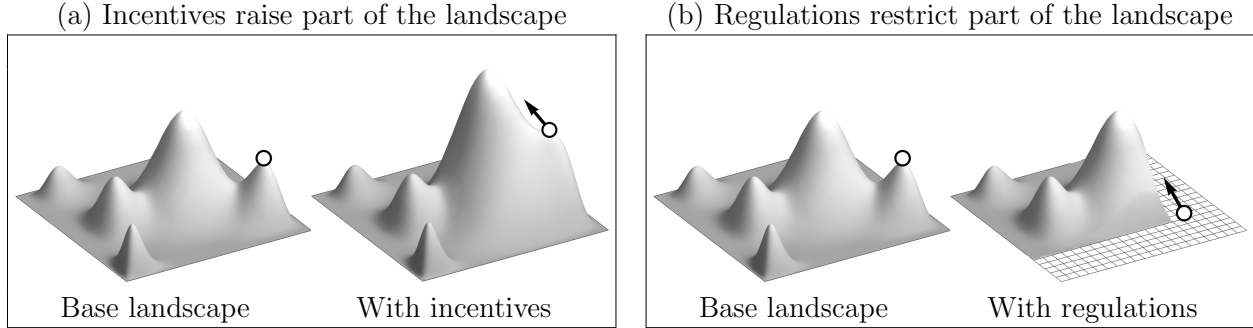


Figure 2: Illustration of how we model incentives and regulations.

landscape (as in Figure 2a) and model regulations as restricting firms’ search to a sub-area of the landscape (Figure 2b). We model incentives as raising part of the landscape because when certain decisions are incentivized by the government, firms adopting these decisions receive higher payoffs. We model regulations as restricting search to a sub-area of the landscape because government, when it regulates, reduces the potential search area by forbidding certain decisions.

The panels in Figure 2 illustrate the gist of our approach. In both panels, the firm (represented by the white dot) is initially stuck at a local peak (see the “base landscape” on the left side of each panel). In panel (a), incentives alter the payoffs of neighboring positions and so a local peak becomes a stepping stone to the global peak. In panel (b), regulations ban the area where a local peak resides, forcing firms to move elsewhere.⁴ Below we provide a formal description of how industrial policy is modeled.

⁴Two examples mentioned in the Introduction help illustrate Figure 2’s panels. Panel (a) could correspond to Denmark’s subsidies on wind energy, which incentivized firms to move away from the local peak of fossil fuel technologies. Panel (b) could correspond to Massachusetts’ regulations on toxic chemical disposal, which forced firms to change their production processes.

In our model, an industrial policy is described by two components: its content and its type. Policy *content* specifies which part of the landscape is modified by the government, whereas policy *type* specifies how the landscape is modified (i.e., through incentives or regulations).

We model policy content as a vector that expresses the government’s preference with regard to each firm decision.⁵ We denote that government preference as an N -length vector \mathbf{g} , where each element g_i can take the value 0, 1, or $\#$. Values 0 and 1 mean that the government intervenes in decision i and favors 0 or 1 respectively; whereas value $\#$ means that the government does *not* intervene in that decision and so is indifferent concerning that decision being 0 or 1. Suppose, for instance, that automobile firms must make these three decisions: a car’s power source (gas-powered or electric), plant location (domestic or overseas), and size (compact or full-size). In this case the government might issue a policy $\mathbf{g} = (\textit{electric}, \textit{domestic}, \#)$, thereby indicating its preference for electric cars and domestic plants as well as its indifference to the size of cars.

We call the number of decisions for which the government has expressed a preference (i.e., the number of non- $\#$ elements in \mathbf{g}) the *span* (S) of government intervention. Span S captures how broadly the government intervenes in firm decisions (in the preceding car example, $S = 2$). As we shall illustrate, a larger S indicates that a larger area on the landscape is modified by industrial policy. Because we are interested in understanding the overall effect of S , the particular elements that are chosen to be non- $\#$ are randomly determined.

Recall that policy type can be either incentives or regulations and that we model the former as raising part of the landscape. Specifically, incentives raise the landscape by giving firms a premium for each decision they make that aligns with governmental preferences. More formally, under incentives, instead of using c_i as the contribution function of decision i , we

⁵This approach accords with the literature’s view of industrial policy’s defining feature: its specificity regarding the particular choices firms make (Johnson 1982:19).

use c'_i , which is defined as

$$c'_i = \begin{cases} c_i + P & \text{if } d_i = g_i; \\ c_i & \text{otherwise.} \end{cases} \quad (2)$$

Here P is the *government premium*, or the firm’s additional payoff for each of its government-favored decisions. The government’s policy in our car example was $\mathbf{g} = (\textit{electric}, \textit{domestic}, \#)$; hence firm $\mathbf{d} = (\textit{gas-powered}, \textit{overseas}, \textit{compact})$ would receive no government premium whereas firm $\mathbf{d} = (\textit{electric}, \textit{domestic}, \textit{compact})$ would receive two “units” of premium (i.e., $2P$).

Regulations are modeled as restricting firms’ search to a sub-area of the landscape. Toward that end, we require firms to adopt government-favored decisions and allow firms to make their own decisions only where the government declines to intervene (i.e., in those decisions where the government’s policy contains $\#$ ’s). Returning again to our car example, if $\mathbf{g} = (\textit{electric}, \textit{domestic}, \#)$ is the government’s policy, using regulations means that all firms must produce electric cars and must do so domestically; they have no freedom of choice except as regards their decision about car size.

3.3 Modeling industrial policy contingencies

We incorporate the contingencies highlighted by the industrial policy literature—government ability and policy instability—as follows.

We model a government’s ability as its capacity to predict where the global peak is; so for each decision in which the government intervenes, its preferred decision will correspond to the global peak with probability A . More formally, let \mathbf{d}^* denote the configuration of the global peak, where d_i^* represents the optimal decision on each dimension. The government sets $g_i = d_i^*$ with probability A and sets $g_i = 1 - d_i^*$ with probability $1 - A$. Continuing with our car example, suppose the global peak was $\mathbf{d}^* = (\textit{electric}, \textit{overseas}, \textit{compact})$. If the government has an ability of (say) 0.8, then in this case there is an 80% probability that it

chooses to favor electric cars and the same probability that it will favor overseas production.⁶

In essence, the probability A expresses the likelihood that the landscape area raised (under incentives) or “fenced in” (under regulations) by government intervention actually contains the global peak. Consistent with literature on government capability, we use A as an encompassing measure that reflects multiple aspects of a government. First, it can indicate the cognitive competence of a government to solve a problem. Note that this competence may depend on not only the skills and knowledge of policymakers but also the difficulty of the problem they face; for example, identifying the global peak is arguably much harder in the nascent robot industry than in the traditional oil industry. In this sense, A can be understood as a measure of the government’s bounded rationality. One may say that the government’s bounded rationality could alternatively be modeled by having the government search on a “policy landscape”; we do not follow that approach, because our paper focuses on the consequences (rather than the process) of government’s search, and that approach would render the model more difficult to understand yet without a commensurate increase in insight toward our end. Second, the parameter A can also reflect the benevolence of a government. Therefore, we allow for the possibility that corruption or lobbying by private sectors causes the government to prefer a non-global-peak area.⁷

Several examples may help illustrate the government ability parameter. A government with high A can be exemplified by the South Korean government in the 1960s and 1970s, which recruited well-educated bureaucrats and was growth-oriented (Kohli 2004). In contrast, a government with lower A can be exemplified by the Nigerian government in the 1950s staffed with incompetent bureaucrats (Nicolson 1969) and the Philippine government from

⁶Note that A is a “per-decision” measure. This implies that the government’s likelihood of a totally accurate prediction (about the global peak’s position) is smaller—and possibly much smaller—than the value of A . For example, if ability $A = 0.8$ and span $S = 9$, then the government has only a 13% ($= 0.8^9$) chance of getting everything correct.

⁷In some settings, government ability and environmental complexity could be correlated. For example, in a highly complex environment such as a high-technology industry, government’s predictive accuracy could be hampered. We model complexity and government ability as two separate parameters because complexity affects, but does not determine, government ability. In fact, research has shown wide variation in the ability of different governments to deal with the same industry (see, e.g., Kremer 2002, Redmond 2004).

the 1940s to the 1970s, which allowed large family conglomerates to control its policy making through bribery and cronyism (Kang 2002).

We use the *policy instability* parameter I to capture how frequently the government changes its policy. In each time period, the government changes its policy with probability I . Therefore, $I = 0$ signifies that government policy remains stable and $I = 1$ that government policy is respecified every period; intermediate values of I interpolate between these two extremes. When the government policy is respecified, the following happens: (a) the government selects a random set of S dimensions to intervene in (i.e., it decides which elements in \mathbf{g} should be non-#’s) and (b) it decides which decisions to prefer for the selected dimensions (i.e., whether it prefers 0 or 1 for each non-# decision).

3.4 Performance measure

Following previous research, we measure performance in terms of the firm’s “height” at each period. To ensure comparability across simulations, we scale the fitness of the underlying landscape (before incentives or regulations are applied) such that the search landscape’s global peak has a fitness of 1 and its lowest position has a fitness of 0.

We measure *performance* as follows. In the case of regulations, performance is identical to fitness. In the case of incentives, we measure fitness “net of incentives”—that is, fitness minus any incentives received. We do this, as incentives are simply cash or resources transferred from the government. One can think of this performance measure as capturing firms’ value creation (Brandenburger and Stuart 1996).

One benefit of using value creation as our performance measure is that value creation is relevant both to the government and the firms. For the government, increasing value creation by firms is consistent with the welfare goal of industrial policy. This is because increasing value creation means increasing willingness-to-pay (i.e., quality) or decreasing cost, which generally increases social welfare.⁸ For firms, value creation is also important because

⁸Social welfare (i.e., the sum of consumers’ and producers’ surpluses; Tirole 1988:9) increases as the wedge

increasing willingness-to-pay or decreasing cost is a necessary condition for sustainable profits. Moreover, unlike increased profits due to cash transfers from the government, increased value creation is likely to persist even after the government incentive is removed. Another benefit of using value creation as the performance measure (i.e., not including government transfers in the performance measure) is that it makes the performance of incentives and regulations comparable.

In summary, the model allows us to study how performance is contingent on five parameters. Four of these (the span S of intervention, government premium P , government ability A , and policy instability I) characterize industrial policy, and the fifth (complexity K) characterizes the environment.⁹ Table 1 summarizes the notation used to describe the model. We use this model to explore how the effect of incentives and regulations on performance depends on the values of these parameters.

4 Results

We report our results in graphical plots that offer an intuitive and precise display of the model’s behavior as the contingent parameters are varied. Each graph plots firm performance (under incentives and regulations) as a function of span S under particular values of complexity K , premium P , government ability A , and policy instability I . The particular values used to generate these plots were chosen after exhaustively exploring the model and verifying that the selected plots are representative of the full behavior of the model.

We fix the total number of decisions that each firm makes at $N = 10$, since changing this value has no qualitative effect on the results (provided K is scaled proportionally to N). We test three values (low, medium, and high) for complexity ($K = 3, 5, 7$) and also for instability

between willingness-to-pay and cost increases, as long as any potential inefficiency (e.g., due to monopoly power) does not outweigh the increased value creation. This assumption is representative of settings where there is sufficient competition or reasonable regulations limiting inefficiency.

⁹Of course, the effect of industrial policy on firm performance may also depend on other characteristics. We focus on the effect of five parameters that are particularly relevant in the literature (as mentioned in Section 2) and that can be well-studied using a model. In Section 5.3 we discuss several ways in which further work—both theoretical and empirical—could extend our research.

Symbol	Description	Landscape metaphor	Plotted values
\mathbf{d}	Vector denoting a firm's configuration of decisions, with d_i being 0 or 1	A position on the landscape	
\mathbf{d}^*	Vector denoting the configuration of decisions that yields the maximum fitness	The global peak of the landscape	
\mathbf{g}	Vector denoting the government's preference toward each firm decision, with g_i being 0, 1, or # (# means indifference)	The area on the landscape that is modified by the government	
N	Number of decisions each firm makes (i.e., number of elements in \mathbf{d})	Dimensionality of the landscape	10
K (Complexity)	Degree of interdependence among firm decisions in determining fitness	Ruggedness of the landscape	3, 5, 7
S (Span)	Number of decisions the government intervenes in (i.e., number of non-# elements in \mathbf{g})	How large is the area that is modified by the government	$0, \dots, 10$
P (Premium)	Additional payoff a firm receives for each government-favored decision (a parameter only for incentives but not regulations)	How high is the area raised by government incentives	0.9
A (Government ability)	Probability that a government-favored decision corresponds to the global peak (i.e., probability that $g_i = d_i^*$)	How likely is that the area raised (under incentives) or "fenced in" (under regulations) contains the global peak	0.5, 0.8, 0.95, 1
I (Policy instability)	Probability in each period that the government respecifies its policy	How frequently the government changes which area to modify	0, 0.4, 0.8

Table 1: Summary of the notation.

($I = 0, 0.4, 0.8$); government ability (i.e., the accuracy of its global peak predictions) takes low, medium, high, and perfect values ($A = 0.5, 0.8, 0.95, 1$). Because the premium P has a straightforward monotonic effect, we fix its value at $P = 0.9$. This value means that the total fitness of a configuration of decisions can be increased at most by 0.09 if $S = 1$ and at most by 0.9 if $S = 10$ (depending on how many government-favored decisions the configuration contains).

On each graph’s x -axis, the span S ranges from 0 (no intervention) to 10 (maximal intervention). On the y -axis of each graph we report average performance after firms have searched for 20 periods—because firm performance reaches a steady state by that time. Performance is averaged across 40,000 runs of simulations to ensure results are not sample dependent.

To develop an understanding of the model’s behavior, we start by analyzing the simplest case of a government with perfect ability with respect to global peak predictions ($A = 1$). Thereafter we explore, in turn, the effects of varying premium P , ability A , complexity K , and instability I .

4.1 Baseline: Government with perfect ability

Figure 3 illustrates the effects of incentives and regulations on average firm performance under perfect ability ($A = 1$)—that is, when the government correctly guides firms to search in an area that includes the global peak—while keeping fixed both the premium P and complexity K and allowing for no policy instability (i.e., $I = 0$). Although perfect ability is not realistic in most situations, we discuss this case in order to establish a baseline understanding about the way incentives and regulations operate.

A first observation from Figure 3 is that performance increases with span S for both incentives and regulations. This is a straightforward consequence of the perfect ability assumption, which implies that a larger S allows the government to more effectively influence firms to move in the right direction, thereby increasing the likelihood of firms reaching

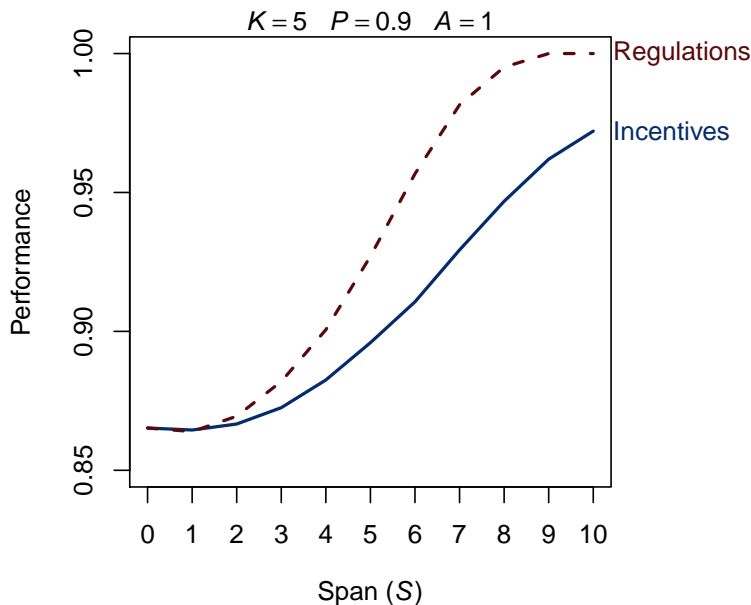


Figure 3: Firm performance under a government with perfect ability.

the global peak. In terms of the firm’s search landscape, increasing S under *incentives* is equivalent to modifying a *larger* area of the landscape so as to render more salient the government’s favored decisions—which coincide (when $A = 1$) with those of the global peak. Under *regulations*, increasing S corresponds to the government setting up more restrictions and thus leaving a *smaller* area for firms to search; the result is that firms are forced to search the area in which the government knows (again provided $A = 1$) the global peak is located.

Second, this figure reveals that regulations are better than incentives at improving firm performance, especially when S is large. This difference stems from the different mechanisms underlying incentives and regulations: while incentives work through motivating firms, regulations work through restricting them. In other words: while under regulations firms can only move within the restricted area, when it comes to incentives, it is not guaranteed that the intervention will successfully induce changes in firm decisions.

Another way to understand how incentives and regulations operate is in terms of how they affect the complexity of the landscape on which firms search. Incentives reduce complexity by “smoothing” the landscape—in effect, laying a smooth landscape over the base landscape.¹⁰

¹⁰The overlaid incentives correspond to a $K = 0$ landscape, since each decision can either provide or not

Regulations reduce complexity by cutting out part of the rugged landscape, “erasing” the complexity of the forbidden area. Whereas eliminating some of the landscape can reliably reduce complexity, overlaying a smooth landscape has a less certain effect. Overall, then, if the government is infallible then regulations are more effective than incentives at improving firm performance. That is, if $A = 1$ then regulations urge firms more *forcefully* toward the government’s favored search area. As we shall see, this advantage of regulations over incentives changes with decreasing government ability.

We now briefly address the role of premium P because its effect is straightforward and discussing it here will simplify later discussions. As the government premium P rises, performance under incentives increases and approaches the performance under regulations. This dynamic follows because higher premiums make the incentives more forceful—to the extent that incentives increasingly produce an effect similar to that of regulations. In the limit, incentives can be just as effective as regulations; however, they would be much less ideal owing to the payment incurred by the government. Likewise, the effect of incentives declines as the premium falls. In the limit, when $P = 0$, incentives become irrelevant and this is equivalent to the case of no intervention. In the remaining analyses, we keep P fixed at 0.9 (as in Figure 3) because the effect of changing it is entirely predictable.

4.2 Effects of less-than-perfect government ability

Figure 4 shows how performance changes with span S under four different levels of government ability A . To help distinguish trends, we plot incentives and regulations separately in panels (a) and (b). Observe first of all that performance declines with decreasing A . The reason for this result is straightforward: decreased ability means that the government is less able to guide firms in the right direction.

A second observation from Figure 4 is that the effect of S varies with A : while increasing S improves performance when A is high, it impairs performance when A is low (the darker

provide a premium.

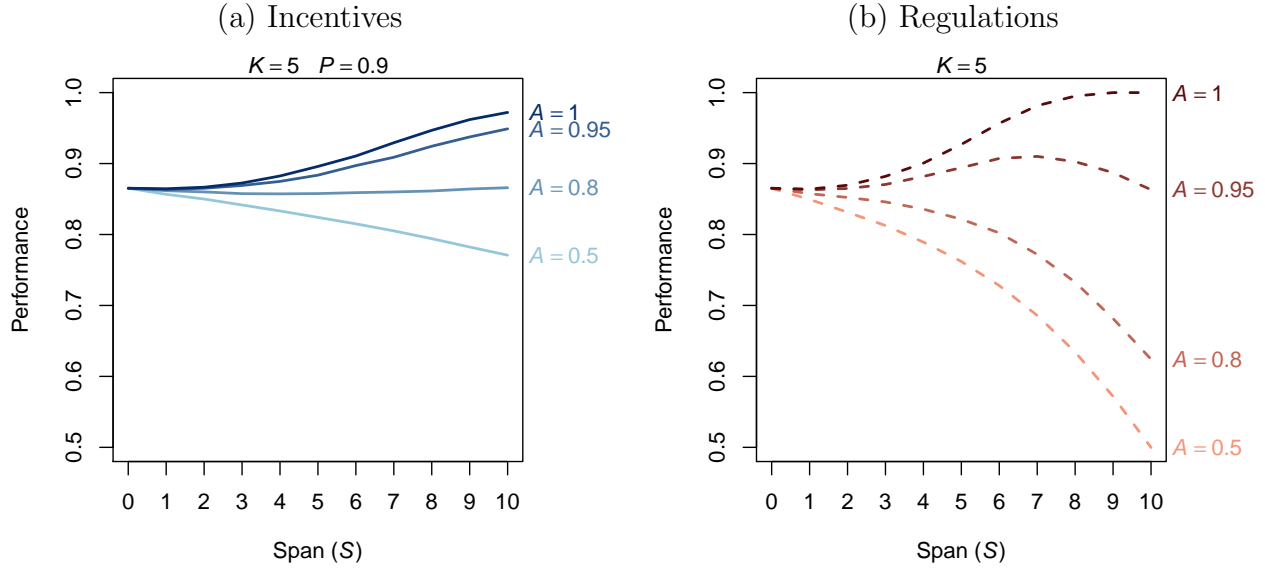


Figure 4: Effects of the government ability (A).

lines have positive slopes while the lighter lines have negative slopes). This relation can be explained as follows. A large span allows the government to more effectively guide firms to a specific position. Therefore, increasing the span of a competent government’s interventions helps ensure that firms arrive at the global peak; if the government is inept, however, then a higher S serves mainly to lock firms more securely into what is likely a bad position. This result is consistent with the industrial policy literature’s “government failure” argument, which concludes that inept governments should refrain from market interventions.

An instructive comparison is that between incentives and regulations under high span (see the right halves of panels (a) and (b) in Figure 4): unlike incentives, high-span regulations are rarely beneficial (except under extremely high government ability) and hurt performance much more severely than incentives when government ability is low. This difference arises because regulations with a large span restrict firms to a small area, leaving firms with almost no leeway to search. Therefore, unless the government is extremely accurate in predicting the global peak, firms are very likely to remain stuck in some wrong place (i.e., at a suboptimal position) with no other choice. An implication is that unless the government has extremely high ability, it should avoid using high-span regulations. This finding matches Killick’s (1978)

description of the Ghanaian government instructing factories to be set up at unreasonable locations and demanding production that was a poor fit with local geographical features and market demands. Our results here suggest that, had the Ghanaian government used incentives rather than regulations, its intervention would have done less harm to the economy.

We can summarize the results so far in this way. Comparing incentives and regulations reveals that, although regulations are more powerful when government ability is high, they could lead to severely negative outcomes when government predictions are inaccurate and span is large. In short: regulations are a high-risk, high-return proposition.

4.3 Effect of complexity

So far we have explored the effects of span, premium, and government ability while keeping complexity K fixed; we now look at the effects of varying K . Figure 5 presents the cases of low K ($K = 3$) in the upper row and those of high K ($K = 7$) in the lower row (note that Figure 4 would fit as a middle row here).

The key observation from Figure 5 is that complexity strongly moderates the effect of industrial policy in that higher complexity delays the “fanning out” of the performance curves. More specifically: whereas the performance curves under low K (figures 5a and 5b) start fanning out at $S = 1$, the curves under high K (figures 5c and 5d) do not really start to fan out until $S = 3$. The contrast would become even sharper were K to take more extreme values.

This delaying effect of high complexity suggests that, the higher the complexity, the higher the minimal level of intensity needed for government intervention to be effective (i.e., to produce a noticeable effect). The reason for such a pattern is as follows. When K is high, a policy with low span is unlikely to change search outcomes: under regulations, it “fences out” only a small part of the landscape and still leaves a large area for firms to search in, resulting in firms easily getting stuck at a new local peak; under incentives, overlaying a small area of smooth slope on top of a highly rugged landscape can hardly smoothen the

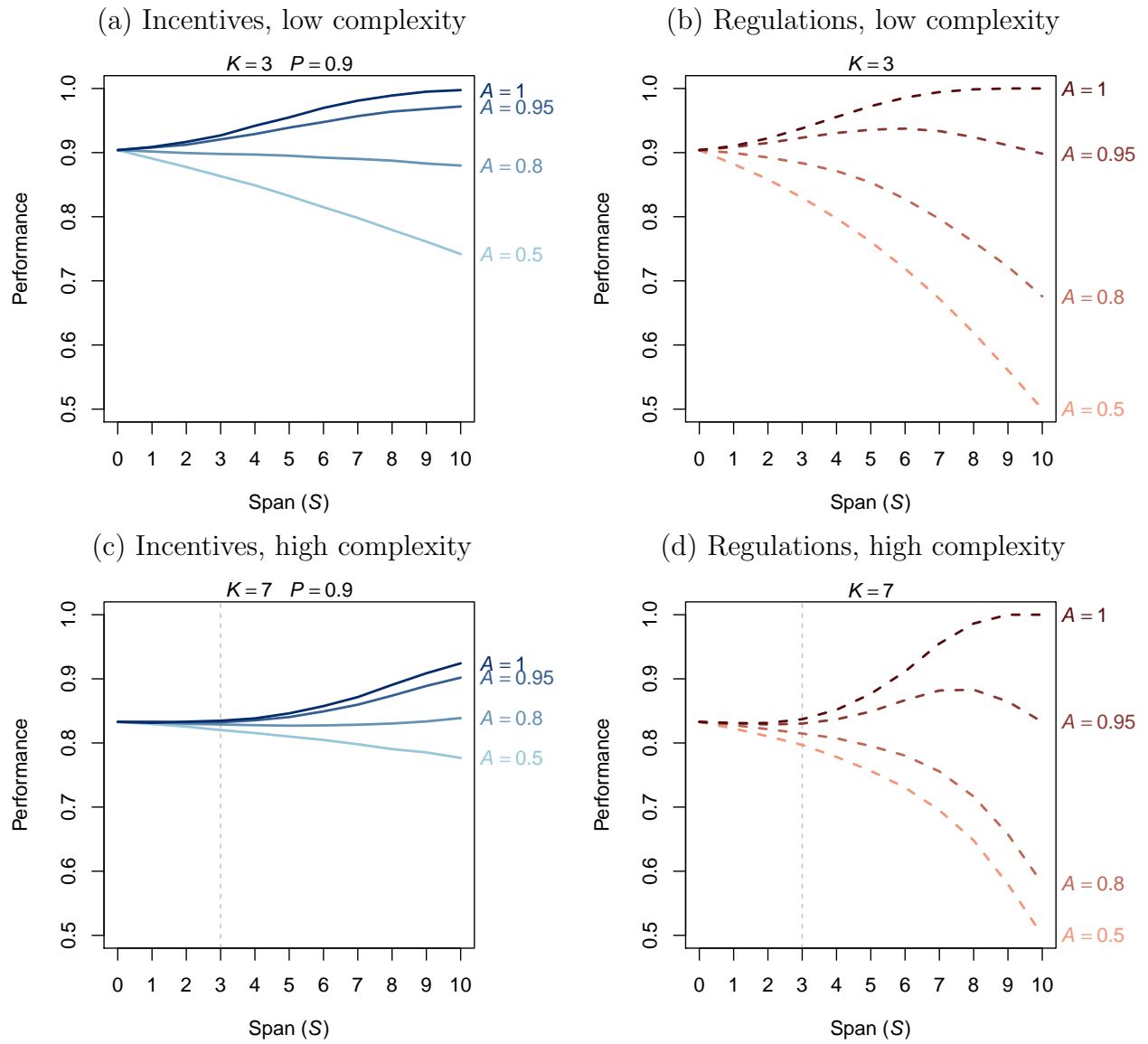


Figure 5: Effects of environmental complexity (K).

landscape, resulting in firms remaining stuck at the local peak rather than being moved. Therefore, when K is high, the effect of government intervention becomes noticeable only if the span is sufficiently large and when a fair number of local peaks have been excluded or smoothed out.¹¹

One implication of K 's delaying effect is that, when complexity is high, a successful intervention depends on the government ensuring that the *scale* of the intervention is large enough—for example, by intervening in multiple firm decisions simultaneously or (if incentives are used) by assigning incentives of sufficient size. Yet the converse implication also applies; that is, low complexity makes it easier for an inept government to impair firm performance. Thus, in Figure 5, the lowest lines begin to drop at about $S = 1$ under low complexity (upper row) but not until about $S = 3$ under high complexity (lower row). We therefore conclude that, under low complexity, even a small-scale policy may be detrimental if it is devised by a low-ability government.

4.4 Effect of policy instability

Our analyses have so far focused on stable government interventions. In this section we explore the effect of policy instability I , our measure of how frequently the government changes policy. In Figure 6, the lighter the line, the more frequently the policy changes. We present results for both high (upper row of the figure) and medium (lower row) values for A . We omit the case of low A because it simply amounts to a further performance decrease from our results for medium A .

A striking observation from Figure 6 is that there are conditions under which increasing policy instability actually improves firm performance (in figures 6a, 6c and part of 6b, the lighter a line is, the higher its performance). This result goes against the conventional view in the industrial policy literature, so it is paramount that we understand the mechanisms

¹¹Since premium P is another measure of intervention intensity, the result that complexity increases the intensity needed for government intervention to be effective also applies to increasing premium (results available from the authors upon request).

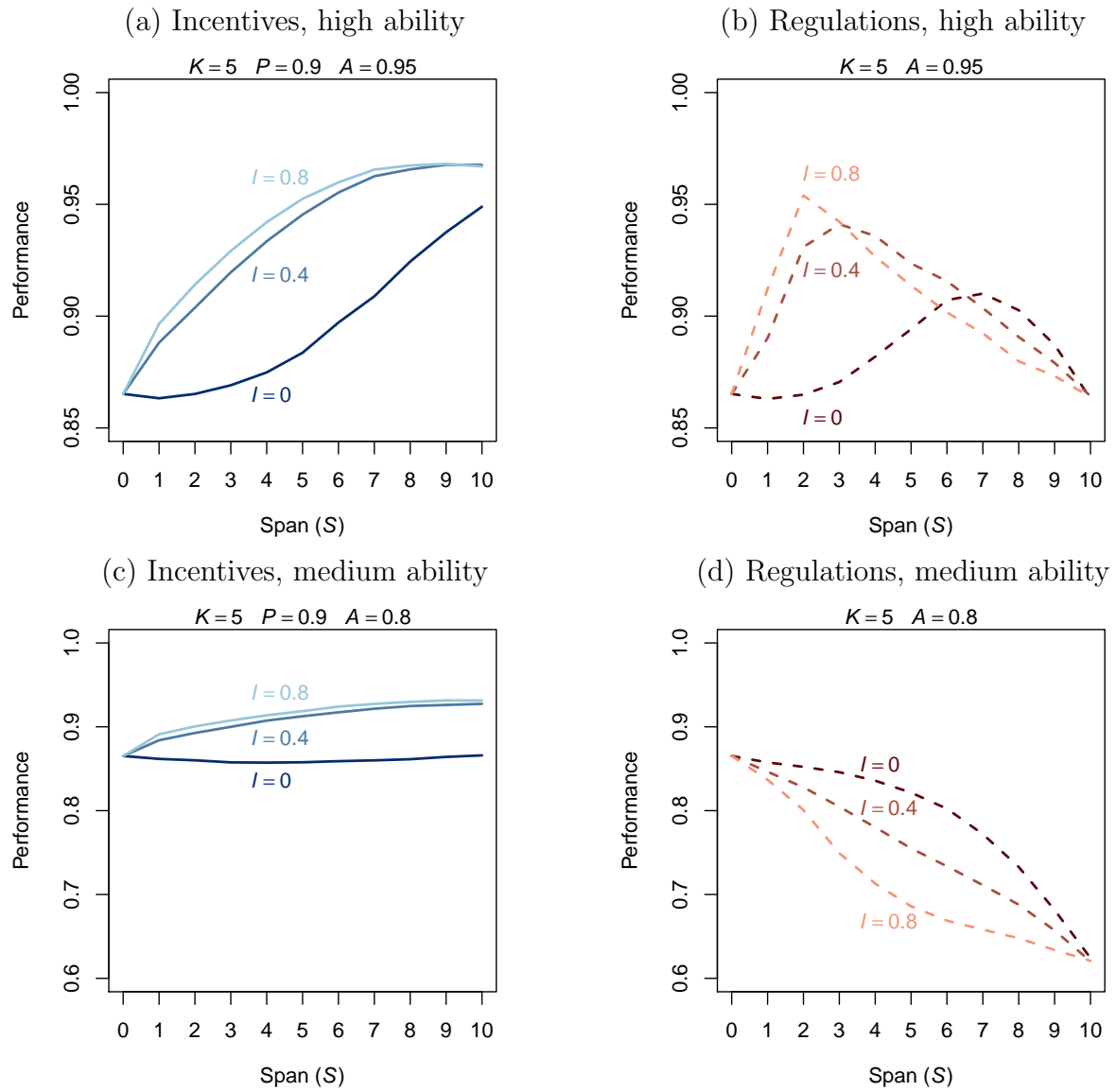


Figure 6: Effects of policy instability (I).

that underlie it. In what follows, we discuss the cases of high and medium ability separately because their respective underlying mechanisms differ.

High government ability. When government ability is high (see the upper panels in Figure 6), the government has valuable knowledge about firms’ optimal decisions. So by re-determining which policies to intervene in, the government has additional opportunities for transferring knowledge to firms. We label this phenomenon the “training effect” in analogy to how management trainee programs increase participants’ knowledge by rotating them across different functions.

The training effect works under incentives regardless of the span of government intervention (i.e., performance increases with I throughout panel (a)). In contrast, under regulations, the training effect only works under low spans of intervention (performance increases with I only in the left half of panel (b)). This happens because, as discussed in the context of Figure 4, high-span regulations under less-than-perfect accuracy can lock firms in a wrong place. Hence, for the “training effect” to work under regulations, it requires a lower span than under incentives.

Because small-span policies tend to be cheaper and more manageable than large-span policies, one implication of the training effect is that the government can implement a small-span policy and then boost its effect by periodically reshuffling what is targeted by the policy; in Figure 6(a), for example, the same performance is achieved by an $I = 0$ policy and large S as by an $I = 0.4$ policy and a medium S . This implication is consistent with the South Korean government’s practice, from 1962 to 1991, of implementing consecutive five-year plans—each prioritizing a different set of industries (Chang 1994). Changing the target industries in this way enabled the South Korean government to intervene widely in the economy while keeping the scale of intervention manageable. By highlighting the knowledge transfer from government to firms, the training effect echoes the motto of Chilean president Pedro Aguirre Cerda during the 1930s: “To govern is to educate.”

Medium government ability. Next we turn to explaining how increasing policy instability

can be beneficial also when incentives are offered by a government of medium ability; see Figure 6(c). (Recall that A is a per-decision measure; hence, $A = 0.8$ is substantially lower than $A = 0.95$, particularly as S increases.) In this case, despite the government’s inaccurate predictions, the government occasionally changing what is incentivized allows firms to dislodge themselves from local peaks and thereby increase their odds of finding the global maximum; we label this phenomenon the “dislodging effect.” This effect applies only in the case of incentives, not regulations, because dislodging requires that firms be able to search broadly—a process that is restricted by regulations.¹²

A crucial implication of the dislodging effect is that the industrial policy advanced by a government of medium ability may also improve performance, creating better outcomes than would no intervention at all. That is, intervention by a government that is neither particularly capable nor stable can still increase firm value. One could argue that many democratic governments exemplify this case. Elections among multiple parties create semi-random changes in policy, which allow for the dislodging of firms and the creation of beneficial outcomes without requiring much ability from either party. Perhaps an upside of democratic government is precisely that firms need to periodically adapt to changing policies due to changes in government.

To sum up, our results here suggest that policy instability can improve firm performance through two different mechanisms. When government ability is high, periodically changing its policy gives the government additional chances to transfer knowledge to firms; this is our training effect. When government ability is lower, periodically changing the policy facilitates the dislodging of firms from their current local peaks—the dislodging effect—and thus makes search efforts more likely to succeed.¹³

¹²The finding that the dislodging effect happens for incentives but not regulations corroborates Porter and van der Linde’s (1995) view that government’s environmental policies, when accompanied by sufficient freedom for firms to search, stimulate innovation.

¹³The observation that policy instability can improve performance concurs, although via different mechanisms, with Nickerson and Zenger’s (2002) positive view on organizational vacillation. Their mechanism is the alternation between discrete states so as to approximate an optimal configuration; our mechanisms are the training and dislodging effects.

5 Discussion

In this paper we have developed a model for studying effects on firm performance of the two main types of industrial policy—incentives and regulations—while accounting for key considerations from the literatures on industrial policy and boundedly rational search. Next we discuss (i) implications regarding how industrial policy affects firms, (ii) broader implications for the strategic management literature, and (iii) avenues for further research.

5.1 Implications for how industrial policy affects firms

Here we summarize our main results and discuss their implications for how industrial policy affects firms. A first finding is that, unlike the common wisdom presented in the industrial policy literature, policy instability does not always harm the firm’s performance; we find that, instead, policy instability can be beneficial through mechanisms we term the training effect and the dislodging effect. The training effect captures the notion that policy instability gives the government additional opportunities to transfer knowledge to firms; the dislodging effect captures that policy instability increases firms’ exploration. These effects, in turn, yield two implications regarding how the government influences firms: (a) the government may be able to intervene more effectively by using a small-scale policy and reshuffling it periodically and (b) if policy instability is unavoidable, then the government should use incentives rather than regulations.

A second finding is that industrial policy by a government that does not have high ability can indeed improve firm performance. Our results show in particular that, when the government uses incentives and periodically reshuffles its policy, intervention with even a modicum of predictive accuracy achieves better performance than no intervention at all. This result implies that, if the government’s ability is limited—owing to an insufficiency of competence or benevolence—then using incentives and not regulations, while periodically adjusting policy, can create more favorable outcomes than a hands-off approach.

Third, we find that complexity moderates the effect of industrial policy in important ways: it raises the minimum level of intervention intensity required for the policy to be effective, and it limits the detrimental effects of a government’s lack of ability. In practical terms, this finding suggests that the government should care about different elements depending on the level of complexity. On the one hand, for high-complexity industries the government must ensure that its policy’s scale is large enough (e.g., by intervening in multiple firm decisions simultaneously and/or increasing subsidy amounts) to produce a noticeable effect. On the other hand, for low-complexity industries the government must ensure that its landscape predictions are accurate—because in this case even a small-scale policy can be detrimental if not well formulated.

5.2 Illuminating the strategy literature

Our research also provides four more general contributions to the strategy literature. A first contribution is the development of an understudied aspect of how the government affects firm performance. The strategy literature has studied government influence from the perspectives of nonmarket strategy, state ownership, and the institutional environment, but it has devoted little attention to industrial policy. Yet as industrial policy becomes increasingly more pervasive, a thorough understanding of its effects helps firms to prepare for, cope with, and benefit from its effects and thereby to create a competitive advantage. More specifically, our results on the effects of government incentives can inform decisions about whether or not to ignore those incentives. For instance, it is advisable for firms to take advantage of incentives offered by a government with medium or high ability and that adjusts its policy periodically. However, firms are better-off *ignoring* incentives when the government has low ability (see Figure 4). Although such incentives may improve firm profits in the short run, they are likely to derail search in the long run. Our results also inform decisions about entering foreign markets. For instance, entering a market where the government is of high ability and periodically adjusts incentives can increase firms’ exploration and performance; in

contrast, performance can be jeopardized by entering a market where the government is of low-ability and relies mainly on regulations to affect its industrial policy.

Second, this paper offers a novel way to think about how the government affects firm behavior. In particular, we connect government intervention with firms' search; in this view incentives as deforming and regulations as restricting firms' search landscape. This way of thinking enables a better understanding of how government intervention affects firms' performance by influencing their search process. For example, our analyses show how stable regulations by an inept government severely harms the performance of firms by trapping them in areas far from the global peak. We also explain how the periodic changing of incentives by a government with moderate ability can improve firms' performance because it allows for dislodging from local peaks. This way of thinking also allows us to identify environmental complexity as an important moderator of the success of government intervention.

Third, our work advances research that recognizes the government's role as a booster of exploration. Lazzarini (2015:100) discusses how industrial policy can encourage "resource churning"—increasing firms' exploration by inducing them to make different decisions and to re-allocate resources. Along the same lines, Porter (1991) proposes that environmental policies, despite their high compliance costs, can enhance firms' competitiveness by spurring innovation (for a review, see Ambec et al. 2013). Our research furthers this line of thought by fleshing out contingencies that determine how effectively the government can influence exploration. For example, we show that industrial policy can enhance firms' exploration and performance if the government is at least of medium ability, uses incentives (but not regulations), and periodically reshuffles what the policy incentivizes. We also show that greater environmental complexity requires government to increase the scale of its policy in order to influence exploration effectively.

Finally, this paper deepens our understanding of how search landscapes can be "designed" or "shaped" to improve firm performance. Among studies that model firms as searching on a fitness landscape, most assume the landscape to be exogenously given; yet there is a

stream of research that considers how the landscape can be purposefully altered. For instance, Levinthal and Warglien (1999) discuss how managers can manipulate the search landscape’s ruggedness, and Gavetti et al. (2017) explore how firms can alter its payoff structure by “reshaping” their business contexts (e.g., by developing new technology or changing consumers’ perceptions). By viewing government as a landscape designer, our study considers industrial policy as another means of shaping the search landscape. Moreover, we identify and assess how such shaping depends on “tunable” levers such as policy type, intervention intensity, and frequency of change.¹⁴

From this perspective of landscape design, our model can be used to generate insights in contexts other than industrial policy. In a within-organization context, this model can shed light on the governance of R&D activities. Consider, for example, whether Microsoft’s R&D lab should guide its staff’s R&D activities by way of incentives (e.g., extra funding for research in certain areas) or through regulation-like rules (e.g. allowing research to proceed only in certain areas). Our study offers guidance on how the lab should choose among these governance means. In particular, our results suggest that, when the lab faces a new technology area and so its managers’ understanding of the landscape is only moderate, periodically adjusting incentives can help increase exploration and improve R&D results. Our model can be applied also to cross-organizational contexts, such as managed ecosystems (Gulati et al. 2012:580). For instance, our results suggest that Google should periodically adjust incentives for external app developers; our paper (as discussed in the context of Figure 5) also suggests that Google should tailor its policy depending on the complexity of app development (e.g., increase the size of the perks offered in its Developer Community Program for app development of higher complexity).

¹⁴Our view that government can act as a landscape designer also furthers Amsden’s (1989) perspective on how government can facilitate economic development. She points out that government may deliberately distort the market in order to incentivize firms; such distortion is reflected in our model as the government altering the landscape. Our model helps identify the most effective way to distort the market under different contingencies.

5.3 A research agenda for behavioral industrial policy

By modeling the government as shaping the landscape where firms search, this paper provides an approach to study how firms and governments interact while taking into account the behavioral nuances of firms and governments. This behavioral approach to industrial policy opens up a number of research opportunities. Below we organize ideas for future research in terms of those that (i) validate our model empirically and (ii) extend our model to investigate additional processes.¹⁵

In terms of empirical work, future work could test our model’s predictions. For convenience, Table 2 states our major predictions as testable propositions. Take Proposition 5 as an example. Future research could use a measure of interdependence (e.g., like the one used by Lenox et al. 2010) to study whether the impact of incentives decreases as industry interdependence increases. Future research could also incorporate contingencies that are not part of our model but are likely to be relevant. For instance, it could examine the extent to which firm differences—such as firm size, organizational structure, and board composition—affect the predictions of our model.

China offers a promising “fruit fly” type of setting to carry out the abovementioned analyses. China’s decentralized political system (Xu 2011, Chang and Wu 2014) and frequent use of policy experimentation (Heilmann 2008) provide much variation in government interventions within and across its 34 regions (in fact, Chan et al. 2010 show that regional differences are much larger in China than in the US).

In terms of investigating additional processes, future work could add several mechanisms to our model. Below we propose five possible ways of doing this.

Competition. Future work could combine our model with an economic model of firm competition. Doing so could allow for measuring not just value creation but value capture and, hence, examining more directly how profits and social welfare are affected by industrial

¹⁵The authors thank the Senior Editor and two anonymous reviewers for several research ideas discussed below.

Testable propositions	Source
1. When government ability is high, the more intensively the government intervenes, the higher the performance of firms.	Figure 3
2. When government ability is high, using regulations yields better firm performance than using incentives.	Figure 3
3. The lower the government ability, the lower the performance of firms.	Figure 4
4. When a low-ability government intervenes intensively, using regulations yields lower firm performance than using incentives.	Figure 4
5. The impact of government intervention decreases as complexity increases.	Figure 5
6. Under incentives, the higher the policy instability, the higher the performance of firms.	Figures 6a and 6c
7. A medium-ability government that uses subsidies and periodically reshuffles what is incentivized yields better firm performance than a medium-ability government that does not intervene.	Figure 6d

Table 2: Some testable propositions that follow from our model. All propositions here pertain to average firm performance and assume other factors are held constant.

policy. For ways of incorporating competition, see Lenox et al. (2006) and Adner et al. (2014), who respectively add Cournot and Lancasterian competition to NK models.

Regulatory compliance. While our model assumes perfect enforcement of government policy, future research could explore cases where there is selective or lax enforcement (Stigler 1975b) and where firms are able to choose strategically whether or not to comply with regulations (Short and Toffel 2008). For instance, one could examine how firm compliance depends on the likelihood of being detected and the size of the penalty (Becker 1968) and how these contingencies affect firms’ search and value creation.

The role of firms in shaping the environment. An assumption of our model is that the external environment is exogenous to firms. Future research could relax this assumption and study how firms may actively shape the environment; that is, change the payoff structure of the environment (for one way of modeling this, see Gavetti et al. 2017). Our modeling approach suggests that there are two fundamentally different shaping activities: those that shape the “base landscape” versus those that shape the government-modified landscape (i.e.,

modifying the actual technological landscape *vis-à-vis* modifying just what the firms perceive; or in terms of Figure 2, changing the left- versus the right-hand side of each panel). An example of shaping the base landscape is the creation of a standard (e.g., the 5G standard created a new peak in the telecommunications industry landscape by reducing costs and increasing demand; Xia 2017, Contreras 2014). An example of shaping the government-modified landscape is regulatory capture (e.g., how South Korean *chaebols* influenced policy making through bribery; Kang 2002). In this case, firms do not change the base landscape but influence which areas of the landscape are restricted or raised by the government.

Environmental change. While our paper assumes a static technological environment, future work could study the effect of environmental turbulence (which occurs, e.g., when there is technological change and industry convergence; for one way of modeling turbulence, see Siggelkow and Rivkin 2005). Because governments vary in their ability to detect and act on environmental changes, one could further refine this line of research by analyzing the effect of sensing and acting lags.

Information-based policy. While our paper focuses on incentives and regulations, another component of industrial policy that future research could study is information-based policy—government intervention that uses information to influence firm behaviors (Bowen and Panagiotopoulos 2018). Since information-based policy works through various mechanisms, we propose three possible ways to model it. One type of information-based policy allows firms to access new information (e.g., distributing booklets that introduce a new technology; Vedung 1998). This could be modeled as providing more accurate information about distant parts of the landscape. Another type of information-based policy creates transparency (e.g., the US Department of Agriculture establishment of an organic foods label, which alleviated information asymmetry and increased demand for organic foods; Lenox and Chatterji 2018:127). This could be modeled as raising the parts of the landscape that are made more transparent. A third type of information-based policy creates a platform for firms to learn from and collaborate with each other (e.g., R&D consortia; Doz et al. 2000). This

could be modeled as facilitating imitation across firms in the landscape (akin to how Csaszar and Siggelkow 2010 model imitative jumps).

5.4 Concluding remarks

In this paper we developed a formal model to study the effect of industrial policy on firm performance while recognizing key behavioral nuances of firms; in doing so, we brought together the fields of industrial policy and strategic management. Our results provide novel insights on how industrial policy affects firms—and how it allows firms to gain a competitive advantage by more effectively coping with and leveraging governmental influence.

An interesting pattern emerges when we look at the historical relationship between the fields of industrial policy and strategic management. The field of strategic management, which was originally known as “business policy,” drew ideas from economic theories devised to answer industrial policy questions. In fact, some of the earliest answers to the question of how firms can sustain high profitability—along with notions such as strategic groups and mobility barriers—were based on the structure–conduct–performance paradigm developed to guide industrial policy (see Porter 1981). Subsequently, strategic management departed from industrial policy by representing firms with increased behavioral plausibility. Almost 40 years since that departure, strategic management may now be in a position to contribute back by helping advance a behavioral industrial policy—an approach to study industrial policy that takes into account the behavioral nuances of firms and the government. This paper takes a step in that direction, and it thereby contributes not only to the industrial policy literature but also to a deeper understanding of how firms and the government interact.

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