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Industrial Policy in an Imperfect World

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Abstract

Theoretical analyses of industrial policy normally restrict the range of possible outcomes by abstracting from either market or government failures. This paper thus studies industrial policy and its effectiveness in a model that includes both market and government imperfections. We introduce a public agency responsible for industrial policy into the model of Hausmann and Rodrik (2003), and assume that this agency has limited information and is partly politically motivated. We further extend the model to allow the public agency to communicate with entrepreneurs and the entrepreneurs to engage in rent seeking. We find that industrial policies are ineffective if the public agency is poorly informed, but that they are not necessarily ineffective if the public agency is highly politically motivated. Given a highly politically motivated public agency, industrial policies are effective if and only if the institutional setting ensures that such policies are modest e.g. by restricting the public agency's budget. Moreover, our model helps us to understand why the same industrial policies that have failed elsewhere have been relatively successful in South Korea and Taiwan.

Keywords: Industrial Policy, Market and Government Failures, Political Economy

JEL-Classification: L52, L53, H25, O20

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1 Introduction

Some economists suggest that industrial policies[1] should be used in developing countries to circumvent market failures that hinder development. Others believe that industrial policies themselves hinder development because of government failures. Most of the evidence from the post-World War II era supports the latter view.[2] However, there are some East Asian countries, most notably South Korea and Taiwan, that have used industrial policies widely and that have developed extraordinarily fast.[3] There is no consensus, but it is plausible that industrial policies have contributed to these countries' extraordinary performance.[4] Two related questions therefore arise: Why have industrial policies been relatively successful in South Korea and Taiwan while they have failed elsewhere? And, what institutional setting makes industrial policies effective?

In their search for answers, many studies in the vast literature on industrial policies focus on the relatively successful industrial policies of South Korea and Taiwan (e.g. Pack and Westphal 1986, Amsden 1989, Wade 1990, Chang 1994, and Rodrik 1995a) or compare the industrial policies of these countries with the less successful industrial policies of others (e.g. Datta-Chaudhuri 1990, Evans 1995, and Rodrik 1995b). These studies find that the industrial policies of South Korea and Taiwan were characterized by competent bureaucrats, intensive communication between bureaucrats and entrepreneurs, social cohesion, and hard, autonomous states ready to cut public support for unprofitable projects.

There is also a large theoretical literature on industrial policies. Most

[1] In line with most of the literature, we define industrial policies as selective government interventions targeted at certain industries or firms. Industrial policies can take the form of e.g. subsidies, tax concessions, soft loans, preferential procurement policies, import restrictions or export promotions.

[2] Krueger (1995) reviews government interventions in developing countries after World War II and independence as well as the dismal effects these interventions generally had. For a good illustration of how government interventions can go wrong, see e.g. Killick's (1978) report on Ghana.

[3] Japan is another well-known example of an East Asian country with extensive industrial policies and rapid growth. We focus primarily on South Korea and Taiwan because they still had similar income levels as most African countries around 1950 while Japan was already more than twice as rich (Maddison 1995).

[4] Appendix A provides a brief summary of the debate about the role played by industrial policies in the rapidly growing East Asian countries.

theoretical contributions are however based on models that abstract from either market or government failures, which in general restricts the range of possible outcomes: If there are no market failures, industrial policies can by assumption not do much good, and if there are no government failures, industrial policies can by assumption not be mismanaged or misused. To our knowledge, the only contribution analyzing industrial policies in a setting with market and government failures is Ades and Di Tella (1997) showing that the direct positive effects of industrial policies on investment are substantially mitigated by an increase in corruption.[5] But since their model serves primarily to motivate their empirical analysis, it is kept fairly simple. We attempt a further step towards an industrial policy model that allows for both market and government failures and that is sufficiently rich to answer the questions posed above.

Our industrial policy model builds on Hausmann and Rodrik (2003). In their model, the profitability of various activities is uncertain and the social returns on discovering a profitable activity exceed private returns since other entrepreneurs can easily copy the entrepreneur who discovered that a certain activity is profitable in the given economy. As a result, too few entrepreneurs engage in the costly search for profitable activities under laissez-faire such that industrial policies targeted at entrepreneurs searching for profitable activities could potentially increase welfare and foster development. We introduce a public agency into a simplified version of the Hausmann-Rodrik model and equip this agency with an industrial policy instrument. Since "governments are not omniscient, selfless social guardians" (Krueger 1990, p.11), as critics of industrial policies rightly claim, we assume that this public agency has limited information and that it does not only care about social welfare, but also about political motives which lead it to support entrepreneurs who are politically close rather than those who are more distant. This relates our model to the seminal contribution of Grossman and Helpman (1994), which analyzes trade policies under the assumption that public authorities care about social welfare and about certain political motives.[6]

[5]Models with both market and government failures are not only scarce in the industrial policy literature, but much more generally. Notable exceptions include Laffont and Tirole (1991), Gradstein (1993), Banerjee (1997), and Acemoglu and Verdier (2000).

[6]Our results and those of Grossman and Helpman (1994) are independent of whether or not public authorities care about social welfare because they are partly benevolent or

The main findings from our industrial policy model are that if the public agency is poorly informed, industrial policies are ineffective or even harmful, but that this is not necessarily so if the public agency is highly politically motivated. Given a highly politically motivated public agency, industrial policies increase welfare and foster development if and only if the public agency has a small budget (or a relatively hostile attitude towards entrepreneurs). Politically motivated agencies are thus not a reason to abstain from industrial policies altogether, but a reason for an institutional setting that ensures that such policies are modest.

Several other findings help in understanding why industrial policies have been relatively successful in South Korea and Taiwan. First, we find that highly competent bureaucrats, as observed in these two countries, raise the effectiveness of industrial policies by increasing the support for projects that are expected to be profitable as well as the share of projects that are expected to be profitable and that turn out to be so. The reason for the former is that higher competence and better information make it more costly for the public agency - in terms of foregone welfare - to support close entrepreneurs with projects it expects to be unprofitable. Second, we find that industrial policies are more effective, the lower the variability in the entrepreneurs' distances from the public agency. The ethnic homogeneity in South Korea and also in Taiwan may thus have contributed to the success of these countries' industrial policies.

We extend our model in two directions: First, we investigate what happens when the public agency can talk to entrepreneurs about their projects. We find that communication enables the public agency to learn more about the different projects even if entrepreneurs with unprofitable projects can often convince the public agency that their projects are profitable. A benevolent public agency thus communicates with entrepreneurs, which raises the effectiveness of industrial policies, while a purely politically motivated public agency has no incentive to do so. Second, we investigate what happens when entrepreneurs can engage in costly rent seeking activities to come closer to the public agency. We find that rent seeking can lead to a socially superior allocation of the public agency's budget if this budget is small or if bene-

because the probability of staying in office increases in social welfare.

fits from public support are low for entrepreneurs with unprofitable projects. The former implies that the potential presence of rent seeking is yet another reason for ensuring that industrial policies are modest.

The remainder of the paper is structured as follows: Section 2 introduces and solves the baseline industrial policy model. Section 3 extends this model and allows the public agency to communicate with entrepreneurs. Section 4 allows for rent seeking. Results indicating why industrial policies may have been more successful in South Korea and Taiwan than elsewhere are directly discussed in these sections. The normative question about the optimal institutional setting is answered in section 5. Section 6 concludes.

2 The Industrial Policy Model

This section presents the baseline model: Section 2.1 introduces the setting. Section 2.2 looks at the laissez-faire case and the industrial policy of a benevolent public agency. Section 2.3 solves the model for the more realistic case in which the public agency is at least partly politically motivated.

2.1 The Setting

There is an "industrial policy agency" (henceforth IPA) and a continuum of risk-neutral entrepreneurs with mass one. Each entrepreneur is associated with one project that is new in the given economy. It is common knowledge that $\alpha \in (0,1)$ projects are profitable. These projects lead to private returns with net present value $\pi > 0$ and to social returns with net present value $\Pi \geq \pi$. The other $1-\alpha$ projects are unprofitable and lead to zero private and social returns. Entrepreneurs and the IPA have imperfect information about each single project's profitability (see below), and an investment is required to discover whether or not a certain project is indeed profitable.[7]

[7]The uncertainty about the different projects' profitability and social returns that exceed private returns are the key features of the model of Hausmann and Rodrik (2003). They argue that it is highly uncertain which "modern-sector activities" are profitable in a given developing country and that the social returns to discovering that e.g. cutting flowers, producing soccer balls or programming software is profitable exceed the private returns because other entrepreneurs can easily copy the entrepreneur who discovered that such an activity is profitable (as there are no patents for an entrepreneur who discovered that such an activity is profitable in the given country).

Each entrepreneur can pay the investment costs to discover the profitability of her project herself. Alternatively, the investment can be financed by the IPA whose budget allows it to support at most $\Omega \in [0,1]$ projects. The budget Ω is set by the government, which may be influenced by international donors. The investment costs to discover a project's profitability are c_e if paid by the entrepreneur, and c_g if paid by the IPA. c_g could exceed c_e because administration and surveillance may be costly or because industrial policy may require distortionary taxation, while c_e could exceed c_g because entrepreneurs may have to borrow capital at (excessively) high interest rates due to their projects' riskiness or due to capital market imperfections.

This possibility that the IPA can finance the investment costs to discover the profitability of the projects of some entrepreneurs is the industrial policy instrument available in our model. It is fairly general and therefore well-suited for our analysis.[8] It corresponds to offering subsidies if no repayment is required, and to providing venture capital if entrepreneurs must repay the investment costs or parts of their private returns in case of success.[9] It is appropriate to investigate cross-country differences in the effectiveness of industrial policy with a model with a single policy instrument since "the differences between Japan, Korea, and Taiwan, on the one side, and most less successful industrializing countries, on the other side, are not to be found in the use of different policy instruments. The differences are to be found instead in different ways of using the same policy instruments" (Pack and Westphal 1986, p. 102-103).[10]

As mentioned earlier, entrepreneurs and the IPA have imperfect information about the different projects' profitability (before they invest to discover a project's true profitability). In particular, we assume that for each project the corresponding entrepreneur e and the IPA g receive either a good signal s_i^π or a bad signal s_i^0, where $i = e, g$. The conditional probability that a project is profitable given s_i^π is

$$p\left(\pi|s_i^\pi\right) = q_i + (1 - q_i)\alpha, \tag{1}$$

[8] We do not, however, claim that there cannot be any better industrial policy instrument in the given framework.

[9] The given industrial policy instrument can also account for import restrictions and export promotions, which have effects similar to those of subsidies. In this case, c_g might have to include social costs due to price distortions.

[10] See also Rodrik (1995c).

where $q_i \in (0,1)$ measures the signals' quality. The higher q_i, the more information signals contain. For simplicity, we assume $p\left(s_i^{\pi}\right) = p\left(\pi\right)$. Bayes' law and basic algebra then imply

$$p\left(s_i^{\pi}|\pi\right) = p\left(\pi|s_i^{\pi}\right) = q_i + (1-q_i)\alpha, \tag{2}$$

$$p\left(s_i^{0}|\pi\right) = p\left(0|s_i^{\pi}\right) = (1-\alpha)(1-q_i), \tag{3}$$

$$p\left(s_i^{\pi}|0\right) = p\left(\pi|s_i^{0}\right) = (1-q_i)\alpha, \tag{4}$$

$$p\left(s_i^{0}|0\right) = p\left(0|s_i^{0}\right) = 1-(1-q_i)\alpha. \tag{5}$$

It remains to describe how industrial policy affects aggregate welfare and the IPA's utility. Given that no entrepreneur would invest in the absence of industrial policy, the aggregate welfare effect of industrial policy is

$$W = \int_e w_j(s_g)de, \tag{6}$$

where the expected effect of supporting an entrepreneur is

$$w_1(s_g) = p\left(\pi|s_g\right)\Pi - c_g \tag{7}$$

and the effect of not supporting her is $w_0(s_g) = 0$.[11] Since private returns π are included in the social returns Π and, hence, in the welfare calculation, W is independent of whether supported entrepreneurs with profitable projects must repay parts of the investment costs or of the private returns.

We assume that the IPA is generally influenced by welfare considerations as well as by political motives when deciding which entrepreneurs to support. In particular, we assume that it maximizes its utility

$$U = \int_e u_j de, \tag{8}$$

where the utility from supporting an entrepreneur is

$$u_1 = \lambda w_1(s_g) + (1-\lambda)\theta \tag{9}$$

and the utility from not supporting her is $u_0 = 0$. The IPA's decision on whether to support the project of a certain entrepreneur thus depends not

[11] If some entrepreneurs did invest in the absence of industrial policy and if entrepreneurs could make their investment decisions after the IPA, industrial policy would have an additional welfare effect by influencing the entrepreneurs' investment decisions (as those receiving no public support would update their beliefs that their projects are profitable).

only on the expected welfare effect $w_1(s_g)$, but also on the IPA's benevolence $\lambda \in [0,1]$ and the entrepreneur's political closeness to the IPA θ: The higher λ, the more the IPA cares about social welfare and the less it cares about supporting close entrepreneurs. The higher θ, the closer an entrepreneur is to the IPA and therefore the more likely she is to receive public support (given $\lambda < 1$). For purely political motives, the IPA would like to support any entrepreneur with $\theta > 0$. Political closeness θ is independent of the type of project and of the associated signals, and uniformly distributed in $[\underline{\theta}, \overline{\theta}] = [\mu_\theta - \sigma_\theta/2, \mu_\theta + \sigma_\theta/2]$.[12] μ_θ measures how friendly the IPA's attitude towards entrepreneurs is in general, and σ_θ the variability in the entrepreneurs' political closenesses to the IPA.

To make the analysis interesting, we moreover assume

$$\alpha\Pi < \min\{c_e, c_g\} < \Pi \tag{10}$$

such that paying the costs to discover the type of a project can increase welfare, but that paying the total costs to discover the type of all projects must lower welfare.

2.2 Laissez-Faire and Benevolent Industrial Policy

In this section, we first analyze under what conditions some entrepreneurs would invest in their projects under laissez-faire, i.e. in the absence of government interventions. We then consider under what conditions a benevolent IPA can use industrial policy to increase welfare given that there would be no investment under laissez-faire.

An entrepreneur pays the investment costs c_e to discover whether her project is profitable if and only if the expected private net return is positive, i.e. if and only if[13]

$$p\left(\pi|s_e\right)\pi - c_e > 0. \tag{11}$$

Entrepreneurs receiving bad signals s_e^0 never invest because $p\left(\pi|s_e^0\right)\pi \leq \alpha\pi \leq \alpha\Pi < c_e$. Equation (1) and condition (11) imply that entrepreneurs receiving good signals s_e^π invest if and only if

$$q_e > q_e' \equiv \frac{c_e - \alpha\pi}{(1-\alpha)\pi}. \tag{12}$$

[12] In section 4, entrepreneurs can engage in rent seeking to get closer to the IPA. Closeness θ may thus become endogenous and potentially dependent on the type of project.

[13] We assume that entrepreneurs and the IPA never invest if they are indifferent.

Note that $q'_e > 0$ because $\alpha\pi < c_e$, that $q'_e < 1$ if and only if $\pi > c_e$, and that $q'_e \in (0,1)$ increases in c_e, but decreases in α and π. It follows

Proposition 1 *Under laissez-faire, all entrepreneurs with good signals s_e^π invest if $q_e > q'_e$, but no entrepreneur invests otherwise.*

The likelihood that no entrepreneur invests in a new project and, consequently, that there is no development under laissez-faire thus decreases in the quality q_e of their signals, in the share α of profitable projects and in the private returns π on these projects, but increases in the entrepreneurs' investment costs c_e.

We next analyze under what conditions a benevolent IPA, i.e. an IPA with $\lambda = 1$, increases welfare and fosters development given that there would be no investment under laissez-faire, i.e. given $q_e \leq q'_e$. Equation (7) implies that the expected welfare effect of supporting an average project is $E(w_1) = \alpha\Pi - c_g$, which is negative by assumption (10).

Equations (4) and (7) imply that the expected welfare effect of supporting a project for which the IPA has received a bad signal s_g^0 is

$$w_1(s_g^0) = p\left(\pi|s_g^0\right)\Pi - c_g = (1-q_g)\,\alpha\Pi - c_g, \tag{13}$$

which must be negative since $p\left(\pi|s_g^0\right) \leq \alpha$ and $E(w_1) < 0$. That is, the expected welfare effect of supporting projects with s_g^0 must be negative since even supporting an average project is in expectation welfare decreasing.

Equations (1) and (7) imply that the expected welfare effect of supporting a project for which the IPA has received a good signal s_g^π is

$$w_1\left(s_g^\pi\right) = p\left(\pi|s_g^\pi\right)\Pi - c_g = \left[q_g + (1-q_g)\alpha\right]\Pi - c_g, \tag{14}$$

which is positive if and only if

$$q_g > q'_g \equiv \frac{c_g - \alpha\Pi}{(1-\alpha)\Pi}. \tag{15}$$

Note that $q'_g > 0$ because $\alpha\Pi < c_g$, that $q'_g < 1$ if and only if $\Pi > c_g$, and that $q'_g \in (0,1)$ increases in c_g, but decreases in α and Π. It follows

Proposition 2 *Given no investment under laissez-faire, a benevolent IPA invests in as many projects with good signals s_g^π as possible, i.e. in* $\min(\alpha, \Omega)$ *such projects, if $q_g > q'_g$, but in no project otherwise.*

Hence, industrial policy cannot increase welfare if the quality q_g of the IPA's signals is not sufficiently high, i.e. if the IPA is not sufficiently well-informed. Proposition 2 further implies that signals must be of higher quality, the higher the IPA's investment costs c_g and the lower the share α of profitable projects and the social returns Π on these projects.

Propositions 1 and 2 jointly imply that it is more likely that a benevolent IPA can increase welfare and foster development in a country that would not develop otherwise, the higher q_g relative to q_e, the higher Π relative to π and the lower c_g relative to c_e. Hence, a benevolent IPA may be able to increase welfare even if its signals s_g are of considerably lower quality than the entrepreneurs' signals s_e given that c_g is substantially lower than c_e or Π substantially higher than π.

Before discussing the more interesting case in which the IPA is at least partly politically motivated, we comment briefly on the relationship between benevolent industrial policy, welfare and development. Suppose there are two countries, A and B: Condition (12) is violated in A, but holds in B e.g. because of a higher share α of profitable projects. Given that condition (15) holds, a benevolent IPA can increase welfare in A, but perhaps not in B.[14] Welfare and aggregate investments may nevertheless be lower in A than in B e.g. because there are fewer profitable projects. This leads to

Corollary 1 *Countries that perform badly may optimally have more active industrial policy than countries that perform well.*

A negative relationship between industrial policy and development therefore does not necessarily imply that industrial policy is lowering welfare and hindering development. Hence, this corollary warns that results from cross-country regressions of, say, growth rates on (industrial) policy variables must be interpreted very cautiously.

We subsequently focus our discussion on the case in which market failures are sufficiently severe to retard development under laissez-faire, but in which industrial policy could potentially increase welfare and foster development. That is, we assume that condition (15) holds while condition (12) does *not* hold.

[14] A benevolent IPA may not be able to increase welfare in B if $c_g > c_e$ or $q_g < q_e$.

2.3 Industrial Policy by a Politically Motivated Agency

In this section, we derive the industrial policy that maximizes the utility U of an IPA which is at least partly politically motivated. We further analyze how this industrial policy affects welfare W, and we discuss how our findings can help to explain why industrial policies have been relatively successful in South Korea and Taiwan while they have failed in many other developing countries.

Following on from discussing the case of a completely benevolent IPA, we now first look at the other boundary case: If the IPA is entirely politically motivated, i.e. if $\lambda = 0$, it uses industrial policy exclusively to support close entrepreneurs. In particular, it supports all entrepreneurs with $\theta > 0$ if its budget Ω is not binding, i.e. if $\Omega > (\overline{\theta} - 0)/(\overline{\theta} - \underline{\theta}) = \overline{\theta}/\sigma_\theta$, and the Ω closest entrepreneurs otherwise. Since an entrepreneur's closeness θ is independent of her project's type and the associated signals, the average expected welfare effect of a supported project equals $E(w_1)$. Since $E(w_1) < 0$, it follows that $W < 0$ if $\lambda = 0$. Hence, industrial policy pursued by an entirely politically motivated IPA is socially harmful even if there is no investment and no development under laissez-faire.

The remainder of this section focuses on the intermediate case $\lambda \in (0, 1)$ in which the IPA's behavior is influenced by welfare considerations as well as by political motives. We first analyze the case in which the IPA's budget Ω is binding. We then briefly discuss the case in which the IPA can support all the entrepreneurs it wants to support because Ω is not binding.

Case 1: Binding budget

The budget Ω is binding when the IPA cannot support all the entrepreneurs it would like to support.[15] The IPA supports in this case those Ω entrepreneurs that yield the highest utility u_1. To find out which entrepreneurs these are, we first look at how the IPA would decide if it could only support one out of two entrepreneurs it would like to support.

If the IPA must decide between two entrepreneurs for which it has received the same signal, it supports the closer. Even though this may seem unfair, it does not affect welfare W as political closeness θ is independent of the

[15] Condition (23) will state precisely when Ω is (not) binding.

project's type and the associated signals.

Now suppose that the IPA must decide between an entrepreneur with signal s_g^π and closeness $\theta_{s_g^\pi}$ and an entrepreneur with s_g^0 and $\theta_{s_g^0}$. It follows from the utility function (9) that the IPA prefers to support the former if and only if[16]

$$\theta_{s_g^0} - \theta_{s_g^\pi} < \left[w_1\left(s_g^\pi\right) - w_1\left(s_g^0\right)\right]\tilde{\lambda} = q_g\tilde{\lambda}\Pi \tag{16}$$

with $\tilde{\lambda} \equiv \lambda/(1-\lambda)$, where the equality follows from equations (13) and (14).

Given $\Omega < \alpha$, the closest Ω entrepreneurs with projects for which the IPA has received a good signal s_g^π are characterized by

$$\frac{\overline{\theta} - \theta}{\overline{\theta} - \underline{\theta}} \leq \frac{\Omega}{\alpha} \quad \Leftrightarrow \quad \theta \geq \overline{\theta} - \frac{\Omega\sigma_\theta}{\alpha}. \tag{17}$$

It follows from conditions (16) and (17) that the IPA supports only projects with s_g^π if $\Omega < \alpha$ and $\overline{\theta} - (\overline{\theta} - \Omega\sigma_\theta/\alpha) < q_g\tilde{\lambda}\Pi$, i.e. if

$$\Omega < \Omega' \equiv \alpha \min\left\{q_g\tilde{\lambda}\Pi/\sigma_\theta, 1\right\}. \tag{18}$$

Since θ is uniformly distributed, the IPA uses financial resources exceeding Ω' to support projects with good signals s_g^π and projects with bad signals s_g^0 proportionally unless no project with s_g^π remains. That is, if $\Omega \geq \Omega'$, the IPA supports $\alpha' \equiv \min\{\Omega' + \alpha\left(\Omega - \Omega'\right), \alpha\} \leq \alpha$ projects with s_g^π and $\Omega - \alpha'$ projects with s_g^0.

It follows[17]

Proposition 3 *The share of supported projects with good signals s_g^π increases in the IPA's benevolence λ, the quality q_g of its signals, the share α of profitable projects and the social returns Π, but decreases in the IPA's budget Ω and the variability in the entrepreneurs' closenesses σ_θ.*

Some results to which we will refer at the end of this section deserve a brief discussion: First, higher quality signals increase the support for projects with good signals s_g^π (relative to the support for projects with s_g^0) since they make it more costly for the IPA - in terms of forgone welfare - to support close entrepreneurs with bad signals s_g^0. In addition, higher quality signals also

[16]We assume that the IPA supports the closer entrepreneur if it is indifferent.

[17]Subsequently, increasing and decreasing stand for monotonically increasing and monotonically decreasing, respectively.

directly increase the support for profitable projects as the share of profitable projects with good signals increases. Second, an increase in the variability in the entrepreneurs' closenesses σ_θ has the same effect as a decrease in the IPA's benevolence λ since it also increases the importance of political considerations for the IPA.

We next investigate how the industrial policy described affects welfare. If $\Omega < \Omega'$, the IPA behaves as if it were benevolent and supports only projects with good signals s_g^π. Hence, the aggregate welfare effect of industrial policy is

$$W(\Omega < \Omega') = \Omega w_1(s_g^\pi). \tag{19}$$

Since condition (15) guarantees that $w_1(s_g^\pi) > 0$, $W(\Omega < \Omega')$ is positive and increasing in the IPA's budget Ω. It follows from equation (14) that $W(\Omega < \Omega')$ further increases in q_g, α and Π while it decreases in c_g.

If $\Omega \geq \Omega'$, the IPA supports α' projects with s_g^π and $\Omega - \alpha'$ projects with s_g^0. The aggregate welfare effect of industrial policy is thus

$$W(\Omega \geq \Omega') = \alpha' w_1(s_g^\pi) + (\Omega - \alpha') w_1(s_g^0), \tag{20}$$

which can be positive or negative. Again, it increases in q_g, α and Π, but decreases in c_g. Since $W(\Omega \geq \Omega')$ also increases in Ω', it is moreover increasing in λ and decreasing in σ_θ. The welfare effect of a marginal increase in the IPA's budget Ω is

$$\frac{\partial W(\Omega \geq \Omega')}{\partial \Omega} \leq \alpha w_1(s_g^\pi) + (1-\alpha) w_1(s_g^0) = E(w_1) < 0. \tag{21}$$

That is, welfare decreases in Ω if $\Omega \geq \Omega'$ since the support for projects with s_g^π increases at most proportionally to the support for projects with s_g^0 (the first inequality) and because even raising the support for both project types proportionally lowers welfare (the second inequality).

It follows

Proposition 4 *If the IPA is partly politically motivated and if the IPA's budget Ω is binding, the welfare effect W of industrial policy is a hump-shaped function of Ω: It is positive and increasing in Ω if $\Omega < \Omega'$, but starts decreasing and eventually becomes negative if $\Omega \geq \Omega'$. The turning point Ω' and W itself both increase in the IPA's benevolence λ, the quality q_g of its signals, the share α of profitable projects and the social returns Π, but*

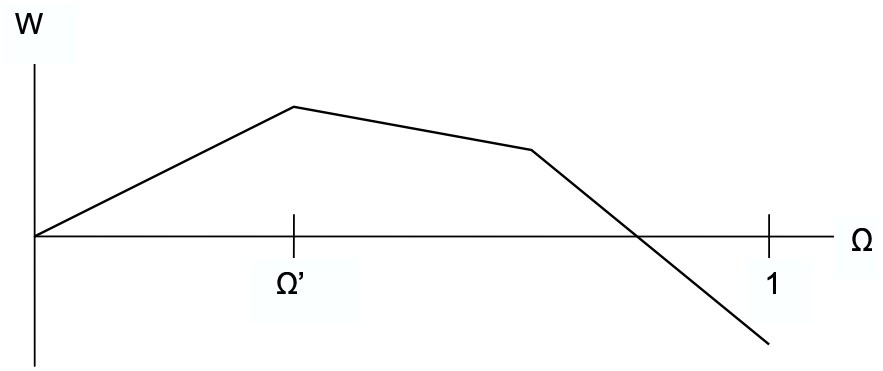

Figure 1: Welfare W and the IPA's budget Ω

decrease in the variability in the entrepreneurs' closenesses σ_θ. W further decreases in the investment costs c_g.

The hump-shaped relationship between W and Ω is illustrated in Figure 1.

Proposition 4 implies that industrial policy increases welfare W even if the IPA is highly politically motivated given that the IPA's budget Ω is sufficiently small.[18] The reason is that if the IPA cares at least marginally about social welfare, it always prefers to support projects it expects to be profitable when having the choice between different projects of equally close entrepreneurs. Even a highly (but not entirely) politically motivated IPA supports therefore first projects it expects to be profitable such that industrial policy increases welfare whenever the budget Ω allows only supporting a few projects. Moreover, proposition 4 implies that the welfare-maximizing budget Ω' exceeds zero whenever $\lambda > 0$, and that it is the larger, the higher λ, q_g, α and Π and the lower σ_θ. We will come back to these results when presenting policy and institutional implications in section 5.

We next discuss how our baseline model can help in understanding why industrial policies have been successful in some countries, most notably South Korea and Taiwan, while they have failed elsewhere. We have firstly seen that it is impossible for public agencies with poor information to conduct welfare-increasing industrial policies. This is already sufficient to explain why industrial policies have failed in certain countries where public agencies are known to lack competence.

[18]This result is not driven by the continuity of the distribution of θ. If this distribution were discrete and if $\beta > 0$ entrepreneurs were in the closest group, the welfare-maximizing budget Ω would be at least $\alpha\beta$ whenever $\lambda > 0$.

But even if public agencies are sufficiently competent to enable industrial policies to work, the effectiveness of such policies still increases in the competence and the benevolence of these agencies. Observers of South Korea and Taiwan often highlight that the industrial policies in these countries were conducted by unusually competent bureaucrats (e.g. Pack and Westphal 1986, and Wade 1990): This could hence be a reason why industrial policies have been relatively effective in these countries. Whether public agencies were also more benevolent in East Asia than elsewhere is, however, debatable.[19]

Moreover, our model shows that a low variability in the entrepreneurs' closenesses to the relevant public agencies (i.e. a low σ_θ) has the same positive effect on the effectiveness of industrial policies as a low political motivation of these agencies (i.e. a high λ). Since political closeness may well depend on ethnicity, its variability can be expected to increase in ethnic fractionalization. The model then predicts that industrial policies tend to be more effective, the less ethnically fractionalized a country is. The indices of ethnic fractionalization[20] compiled by Alesina et al. (2003) imply that South Korea and Japan are the two least ethnically fractionalized countries in the world (besides Comoros). In Taiwan, ethnic fractionalization is somewhat higher - but still relatively low - since the population includes both islanders (about 6/7 of the population) and mainlanders. However, Wade (1990, p. 340) highlights the homogeneity within the Taiwanese population and the small differences between entrepreneurs from the island and the mainland. Industrial policies may thus have been relatively effective in these three countries because the ethnic homogeneity has lead to a low variability in the entrepreneurs' closenesses to the relevant public agencies and because this low variability has reduced the importance of political considerations for these agencies.[21]

We next illustrate that ethnic fractionalization may not only help to explain why industrial policies have succeeded in some countries, but also why the have failed in others. Evans (1995) analyzes industrial policies in Brazil,

[19] For anecdotal evidence of South Korean public agencies far from benevolent see e.g. Ades and Di Tella (1997).

[20] The index of ethnic fractionalization measures the probability that two randomly selected individuals of a certain country belong to different ethnic groups.

[21] Similarly, it has been argued that social cohesion was important for enabling industrial policies to work in South Korea and Taiwan (e.g. Chang 1994, and Rodrik 1995a). However, it is homogeneity in the entrepreneurs' distances from public agencies rather than low inequalities within the entire society that matters according to our model.

India, South Korea and (former) Zaire during the emergence of the computer industry. He finds that industrial policies have been successful in South Korea, sometimes helping and sometimes hindering in Brazil and India, and disastrous in Zaire. In a similar vein, Rodrik (1995b) presents case studies of export subsidization. He finds that export subsidization was a success in Brazil and South Korea, a failure in Bolivia and Kenya, and somewhat in between in India and Turkey. Interestingly, Bolivia, Kenya and (former) Zaire are by far the most ethnically fractionalized of all these countries while South Korea is by far the most ethnically homogeneous.[22] As in Kenya and Zaire, industrial policies have also failed on a large scale in many other highly ethnically fractionalized sub-Saharan African countries. Our model suggests that industrial policies tend to fail in such countries because high fractionalization and the associated high variability in the entrepreneurs' closenesses to the relevant public agencies raises the importance of political considerations for these agencies.

Case 2: Non-binding budget

Let us now briefly look at the case in which the IPA can support all the entrepreneurs it wants to support because its budget Ω is not binding.

It follows from the utility function (9) that the IPA supports an entrepreneur with closeness θ and signal s_g^j if and only if $\tilde{\lambda} w_1(s_g^j) + \theta > 0$. Hence, the IPA supports $\alpha\Phi(s_g^\pi)$ projects with s_g^π and $(1-\alpha)\Phi(s_g^0)$ projects with s_g^0, where

$$\Phi(s_g^j) \equiv \begin{cases} 1 & \text{if } \mu_\theta \geq -\tilde{\lambda} w_1(s_g^j) + \frac{\sigma_\theta}{2} \\ \frac{\overline{\theta} + \tilde{\lambda} w_1(s_g^j)}{\sigma_\theta} & \text{if } \mu_\theta \in \left(-\tilde{\lambda} w_1(s_g^j) - \frac{\sigma_\theta}{2}, -\tilde{\lambda} w_1(s_g^j) + \frac{\sigma_\theta}{2} \right) \\ 0 & \text{if } \mu_\theta \leq -\tilde{\lambda} w_1(s_g^j) - \frac{\sigma_\theta}{2}. \end{cases} \tag{22}$$

For the IPA's budget not to be binding, it must therefore hold that

$$\Omega \geq \alpha\Phi(s_g^\pi) + (1-\alpha)\Phi(s_g^0). \tag{23}$$

The aggregate welfare effect of industrial policy is

$$W = \alpha\Phi(s_g^\pi) w_1(s_g^\pi) + (1-\alpha)\Phi(s_g^0) w_1(s_g^0). \tag{24}$$

[22]The index of ethnic fractionalization is 0.00 for South Korea, 0.32 for Turkey, 0.42 for India, 0.54 for Brazil, 0.74 for Bolivia, 0.86 for Kenya and 0.87 for Zaire (Alesina et al. 2003).

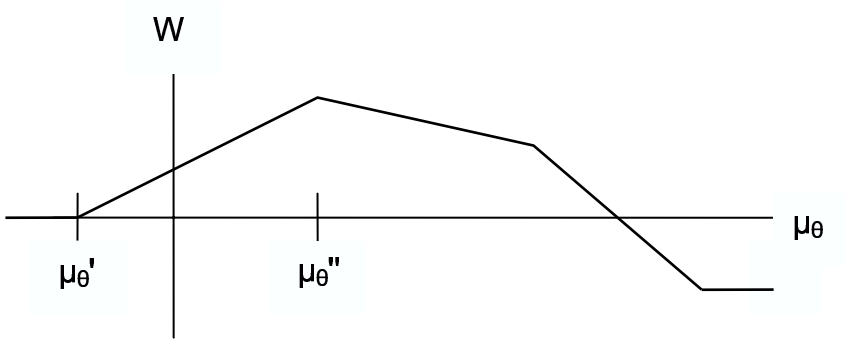

Figure 2: Welfare W and the IPA's attitude towards entrepreneurs μ_θ

If $\mu_\theta \leq \mu'_\theta \equiv -\tilde{\lambda} w_1(s_g^\pi) - \sigma_\theta/2$, the IPA's attitude towards entrepreneurs is so hostile that the IPA does not support any project. Hence, $W(\mu_\theta \leq \mu'_\theta) = 0$. If the IPA's attitude towards entrepreneurs is somewhat less hostile such that $\mu'_\theta < \mu_\theta < \mu''_\theta \equiv -\tilde{\lambda} w_1(s_g^0) - \sigma_\theta/2$, the IPA supports only projects with s_g^π. $W(\mu'_\theta < \mu_\theta < \mu''_\theta)$ is thus positive and increasing in μ_θ. But if the IPA is relatively friendly towards entrepreneurs such that $\mu_\theta \geq \mu''_\theta$, it supports projects with s_g^0 as well. Hence, $W(\mu_\theta \geq \mu''_\theta)$ may be positive or negative, and

$$\frac{\partial W(\mu_\theta \geq \mu''_\theta)}{\partial \mu_\theta} \leq \alpha w_1(s_g^\pi) + (1-\alpha) w_1(s_g^0) = E(w_1) < 0. \tag{25}$$

It follows

Proposition 5 *If the IPA is partly politically motivated and if the IPA's budget Ω is not binding, the welfare effect W of industrial policy is a hump-shaped function of the IPA's attitude towards entrepreneurs μ_θ: W is weakly positive and increasing if $\mu_\theta < \mu''_\theta$, but starts decreasing and eventually becomes negative if $\mu_\theta \geq \mu''_\theta$.*

The hump-shaped relationship between W and μ_θ is illustrated in Figure 2. Moreover, W again increases in λ, q_g and Π while it decreases in c_g.

Hence, a change in the IPA's attitude towards entrepreneurs μ_θ when Ω is not binding has a very similar welfare effect W to that of a change in the IPA's budget Ω when this is binding. To avoid repetitions, we subsequently assume that Ω is binding, which requires Ω to be sufficiently small relative to μ_θ. It can however be deduced how a change in μ_θ would affect the results from how a change in Ω does.

3 Communication

In the previous section, we excluded - quite unrealistically - interactions between the IPA and entrepreneurs. We therefore present some extensions to our baseline industrial policy model in which the IPA and entrepreneurs can interact. We focus on communication in this section and on rent seeking in the next.

Many studies of South Korea and Taiwan highlight the intensive communication between public agencies and entrepreneurs and most of them claim that this communication has been crucial for the success of industrial policies in these countries (e.g. Pack and Westphal 1986, Wade 1990, Evans 1995, and Rodrik 1995b).[23] As pointed out by Rodrik (2004), this however is in stark contrast with the popular belief that public agencies should be kept at arm's length from entrepreneurs. In section 3.1, we allow the IPA to talk to entrepreneurs about their projects and we investigate how this possibility affects industrial policy and its effectiveness given that entrepreneurs with unprofitable projects can often convince the IPA that they expect their projects to be profitable. This extension can explain why we may indeed observe intensive communication in countries with relatively successful industrial policies and why intensive communication can contribute to the success of industrial policies.

In section 3.2, we briefly show that the government or the IPA can, in certain circumstances, induce entrepreneurs to invest simply by communicating its signals, i.e. by informing the entrepreneurs what it knows about their projects.

3.1 When the IPA tries to learn from entrepreneurs

We now extend our baseline industrial policy model and allow the IPA to talk to entrepreneurs about their projects before deciding which projects to support. We investigate under what conditions the IPA can learn from such talks, and we show with whom the IPA chooses to talk and whom it then chooses to support.

For the IPA, the potential benefit from talking to an entrepreneur about

[23] Some of these studies, most notably Evans (1995), argue that it is the simultaneity of intensive communication and state autonomy that matters.

her project is that it may learn what she knows about the profitability of her project, i.e. it may learn her signal. However, entrepreneurs try to mislead the IPA and to convince it that they have received a good signal s_e^π since this increases the probability of receiving public support. The signals that the IPA receives from talking to entrepreneurs may therefore be heavily biased. We assume that each entrepreneur to whom the IPA talks can mislead the IPA with probability $\kappa \in [0,1]$. In this case, the entrepreneur can convince the IPA that she has received a good signal s_e^π and the IPA receives a good interaction signal s_{eg}^π, independently of the signal the entrepreneur really received. With probability $1-\kappa$, the IPA learns the entrepreneur's true signal such that $s_{eg}^i = s_e^i$. The IPA however may not know whether or not she learns the true signal.[24,25]

First, we should emphasize that the IPA can learn from talking to entrepreneurs about their projects even if entrepreneurs can often mislead the IPA:

Proposition 6 *If the IPA talks to an entrepreneur about her project, the IPA's belief about the profitability of this project becomes more accurate unless the entrepreneur can mislead the IPA with certainty. That is,* $p\left(\pi|s_g^j, s_{eg}^\pi\right) > p\left(\pi|s_g^j\right) > p\left(\pi|s_g^j, s_{eg}^0\right)$ *for* $j = \pi, 0$ *unless* $\kappa = 1$.

The proof is given in appendix B.

The reason why the IPA can in general learn from talking to an entrepreneur is that the interaction signal s_{eg} contains some information whenever the entrepreneur cannot mislead the IPA with certainty (since $q_e > 0$). This information then allows the IPA to update its beliefs about the corresponding project's profitability using Bayes' law.[26]

We subsequently assume $\kappa < 1$ such that the IPA can learn from talking to entrepreneurs, and we investigate whether the IPA actually wants to talk to certain entrepreneurs about their projects and whether it finally supports mainly entrepreneurs it has talked to or mainly entrepreneurs it has *not* talked to. We assume that the IPA is willing to talk to an entrepreneur if it

[24] Alternatively, one could assume that entrepreneurs with whom the IPA interacts succeed with probability κ in gaining the IPA's sympathy and that the IPA then treats these entrepreneurs as if they received good signals s_e^π.

[25] The subsequent results are robust to the addition of some noise.

[26] This would hold even if κ were unknown to the IPA because the IPA can derive κ from the interaction signals whenever it interacts with a positive mass of entrepreneurs.

accepts a small disutility $\varepsilon \to 0$ for talking to her. We focus on the cases in which the IPA is entirely politically motivated ($\lambda = 0$) or benevolent ($\lambda = 1$), which is sufficient to grasp the main pattern.

An entirely politically motivated IPA is only interested in supporting the closest Ω entrepreneurs. Its decisions are therefore independent of its beliefs about the different projects' profitabilities. Hence, it is not willing to accept any disutility for more accurate beliefs and chooses *not* to talk to any entrepreneur about her project.[27]

Now suppose the IPA is benevolent and $\Omega \leq \alpha p(s_{eg}^{\pi}|s_g^{\pi})$. If the IPA knew the interaction signals s_{eg} of all projects, it would support only projects with two good signals, s_g^{π} and s_{eg}^{π}, since $p\left(\pi|s_g^{\pi}, s_{eg}^{\pi}\right) > p\left(\pi|s_g^{\pi}\right) > p\left(\pi|s_g^{\pi}, s_{eg}^{0}\right)$. But since talking to entrepreneurs is costly, the IPA does not talk to any entrepreneur with s_g^0 and only to $\Omega/p\left(s_{eg}^{\pi}|s_g^{\pi}\right)$ entrepreneurs with s_g^{π}. The IPA then receives a good interaction signal s_{eg}^{π} (in addition to s_g^{π}) for exactly Ω entrepreneurs. Even though the share $\kappa/\left[\kappa + (1-\kappa)p\left(s_e^{\pi}|s_g^{\pi}\right)\right]$ of these entrepreneurs is able to mislead the IPA, their projects are, on average, more likely to be profitable than the project of an average entrepreneur with s_g^{π}, exactly because the interaction signals contain some information nevertheless. The IPA therefore supports all those projects for which it receives s_{eg}^{π}.

If $\Omega > \alpha p\left(s_{eg}^{\pi}|s_g^{\pi}\right)$, a benevolent IPA's behavior depends on Ω and on the ordering of c_g, $p\left(\pi|s_g^{\pi}, s_{eg}^{0}\right)\Pi$ and $p\left(\pi|s_g^{0}, s_{eg}^{\pi}\right)\Pi$. In particular, we can distinguish the following five cases:

1. $c_g/\Pi \geq \max\left\{p\left(\pi|s_g^{\pi}, s_{eg}^{0}\right), p\left(\pi|s_g^{0}, s_{eg}^{\pi}\right)\right\}$: The IPA talks to all entrepreneurs with s_g^{π} and supports all those with s_{eg}^{π}.

2. $p\left(\pi|s_g^{\pi}, s_{eg}^{0}\right) > c_g/\Pi \geq p\left(\pi|s_g^{0}, s_{eg}^{\pi}\right)$: Given $\Omega < \alpha$, the IPA talks to all entrepreneurs with s_g^{π} and supports all those with s_{eg}^{π} and $\Omega - \alpha p\left(s_{eg}^{\pi}|s_g^{\pi}\right)$ of those with s_{eg}^{0}. Given $\Omega \geq \alpha$, the IPA directly supports all entrepreneurs with s_g^{π}.

3. $p\left(\pi|s_g^{\pi}, s_{eg}^{0}\right) \geq p\left(\pi|s_g^{0}, s_{eg}^{\pi}\right) > c_g/\Pi$: For $\Omega < \alpha$, see case 2. Given $\Omega \geq \alpha$, the IPA talks to $(\Omega - \alpha)/p\left(s_{eg}^{\pi}|s_g^{0}\right)$ entrepreneurs with s_g^0 and supports all those with either s_g^{π} or s_{eg}^{π}.

4. $p\left(\pi|s_g^{0}, s_{eg}^{\pi}\right) > c_g/\Pi \geq p\left(\pi|s_g^{\pi}, s_{eg}^{0}\right)$: The IPA talks to all entrepreneurs with s_g^{π} and to $\left[\Omega - \alpha p\left(s_{eg}^{\pi}|s_g^{\pi}\right)\right]/p\left(s_{eg}^{\pi}|s_g^{0}\right)$ entrepreneurs with s_g^0 and supports

[27] In a different setting with uncertainty about the entrepreneurs' political closenesses θ an entirely politically motivated IPA may talk to entrepreneurs to get more accurate beliefs about θ. We do however think that bureaucrats are in general well aware how close different entrepreneurs are.

all those with s_{eg}^{π}.

5. $p\left(\pi|s_g^0, s_{eg}^{\pi}\right) > p\left(\pi|s_g^{\pi}, s_{eg}^0\right) > c_g/\Pi$: For $\Omega < p\left(s_{eg}^{\pi}\right)$, see case 4. If $\Omega \geq p\left(s_{eg}^{\pi}\right)$, the IPA directly supports $[\Omega - \alpha p\left(s_{eg}^{\pi}|s_g^{\pi}\right) - (1-\alpha)p\left(s_{eg}^{\pi}|s_g^0\right)]/p(s_{eg}^0|s_g^{\pi})$ entrepreneurs with s_g^{π}. It further talks to all other entrepreneurs and supports all those with s_{eg}^{π}.

This leads to the following proposition:

Proposition 7 *An entirely politically motivated IPA never talks to an entrepreneur.*
A benevolent IPA talks to entrepreneurs with good signals s_g^{π} and supports only entrepreneurs to whom it has talked (even when they often mislead it) if $\Omega \leq \alpha p(s_{eg}^{\pi}|s_g^{\pi})$ or if $c_g \geq \max\left\{p\left(\pi|s_g^{\pi}, s_{eg}^0\right), p\left(\pi|s_g^0, s_{eg}^{\pi}\right)\right\}\Pi$. Even otherwise, it talks to some entrepreneurs and then supports some of these entrepreneurs unless $\Omega \geq \alpha$ and $p\left(\pi|s_g^{\pi}, s_{eg}^0\right)\Pi > c_g \geq p\left(\pi|s_g^0, s_{eg}^{\pi}\right)\Pi$.

This proposition has several implications worth emphasizing: First, a benevolent IPA with a small budget Ω or relatively high investment costs c_g talks to entrepreneurs to learn more about their projects' profitability, which is possible - as shown earlier - even if entrepreneurs can often mislead the IPA. Second (and closely related to the first point), a benevolent IPA with small Ω or high c_g supports only entrepreneurs to which it has talked even if it might be misled by most of these entrepreneurs. This choice is neither malevolent, nor naive; it is (socially) optimal. Providing a benevolent IPA with the possibility to talk to entrepreneurs therefore increases the welfare effect W of industrial policy. Third, a highly politically motivated IPA is not interested in costly talks about the profitability of different projects since it cares only about supporting close friends and allies, which it can support anyway. Allowing a highly politically motivated IPA to talk to entrepreneurs about their projects does not therefore affect welfare W as such an IPA does not use this possibility.

Hence, the intensive communication between public agencies and various entrepreneurs observed in South Korea and Taiwan and the fact that these entrepreneurs were more likely to receive public support than others does not necessarily imply that public agencies were highly politically motivated in these countries. According to our model, the opposite could be true; i.e. that public agencies were relatively benevolent and therefore talked

to entrepreneurs to learn about their projects, and that they supported entrepreneurs to whom they talked to as these entrepreneurs were on average more likely to have profitable projects than other entrepreneurs. Because of the latter, it is moreover possible that the intensive communication with entrepreneurs improved the public agencies' budget allocation and contributed thereby substantially to the success of industrial policies in South Korea and Taiwan.

3.2 When the IPA shares its information

In this section, we briefly analyze under what circumstances the government or the IPA can induce entrepreneurs to invest simply by communicating the signals s_g it has received for the different projects. Note that such a policy does not require the IPA to pay any investment costs.

We know that entrepreneurs receiving good signals s_e^π invest under laissez-faire to discover their projects' profitability if and only if condition (12) holds, i.e. if and only if $q_e > q_e'$. Similarly, entrepreneurs receiving s_e^π and knowing that the IPA has also received a good signal s_g^π invest if and only if $p\left(\pi|s_e^\pi, s_g^\pi\right)\pi > c_e$. Equations (2) and (4) and

$$p\left(\pi|s_e^\pi, s_g^\pi\right) = \frac{p\left(\pi\right)p\left(s_e^\pi|\pi\right)p\left(s_g^\pi|\pi\right)}{p\left(\pi\right)p\left(s_e^\pi|\pi\right)p\left(s_g^\pi|\pi\right) + p\left(0\right)p\left(s_e^\pi|0\right)p\left(s_g^\pi|0\right)} \tag{26}$$

imply that $p\left(\pi|s_e^\pi, s_g^\pi\right)\pi > c_e$ if and only if

$$q_e > q_e'' \equiv \frac{\alpha}{(1-\alpha)}\frac{c_e - [q_g + (1-q_g)\alpha]\,\pi}{[q_g + (1-q_g)\alpha]\,\pi - q_g c_e}. \tag{27}$$

Condition (27) is less restrictive than condition (12) because $q_e'' < q_e'$ if $\pi > c_e$ (which follows from $q_e'' = q_e'$ if $q_g = 0$, and $\partial q_e''/\partial q_g < 0$ if $\pi > c_e$) and because no entrepreneur would ever invest if $\pi \leq c_e$. It follows

Proposition 8 *Whenever $q_e \in (q_e'', q_e']$, entrepreneurs with good signals s_e^π invest if and only if they know that the IPA has also received a good signal s_g^π for their projects.*

This proposition implies that the IPA can increase welfare and foster development simply by communicating its signals s_g if $q_e \in (q_e'', q_e']$. The reason is that the additional signal makes the entrepreneurs' belief about their

projects' profitability more accurate, i.e. that $p\left(\pi|s_e^\pi, s_g^\pi\right) > p\left(\pi|s_e^\pi\right)$.[28] The probability that this additional signal can induce investment increases in the signal's quality q_g and depends crucially on the relationship between s_g and s_e. Put bluntly, the higher the correlation, the less likely it is that communication can induce some entrepreneurs to invest. Moreover, communication could not trigger any investment if s_g were just a noisy version of s_e, because no entrepreneur would then update her belief that her project is profitable. In addition, the IPA's announcements could hardly encourage some entrepreneurs to invest if entrepreneurs did not expect the IPA to tell the truth.

But even in the given setting, where signals are independent and where the IPA has no incentive to lie, active industrial policy (as discussed in section 3) is required to discover the profitability of some projects if $q_e \leq q_e''$. It is more likely that active industrial policy can increase welfare ($q_g > q_g'$) while sharing information is not enough ($q_e \leq q_e''$), the higher Π relative to π and the lower c_g relative to c_e.

4 Rent Seeking

In line with Krueger (1990, p. 11), we have already assumed in our baseline model that public agencies are not "selfless social guardians," but that they may act politically. It is often argued, again most prominently by Krueger (1974) herself, that politically motivated agencies are particularly harmful because they provoke corruption, lobbying and rent seeking. In this section, we analyze how such activities, which are henceforth just called rent seeking, affect industrial policy and its effectiveness. We therefore assume that the IPA is partly politically motivated, i.e. $\lambda < 1$, and that entrepreneurs can engage in rent seeking to get closer to the IPA and, consequently, to increase the likelihood of public support.

In particular, we assume that each entrepreneur's closeness is $\underline{\theta}$ unless she pays the rent seeking costs r, which brings her closer to the IPA, to $\overline{\theta} > \underline{\theta}$. These rent seeking costs may either be financial costs, such as bribes, or some other disutilities associated with rent seeking. We further assume

[28] The proof that $p\left(\pi|s_e^\pi, s_g^\pi\right) > p\left(\pi|s_e^\pi\right)$ is straightforward and similar to the proof of Proposition 6 with $\kappa = 0$.

that public support leads to utility $v(\pi)$ for entrepreneurs with profitable projects and to utility $v(0)$ for entrepreneurs with unprofitable projects, where $v(\pi) \geq v(0) \geq 0$. Utilities $v(\pi)$ and $v(0)$ may exceed π and 0, respectively, since public support can lead to certain benefits in addition to the private returns that would be gained if the entrepreneurs paid the investment costs themselves. Further, $v(\pi)$ could deviate from π if entrepreneurs with profitable projects were required to repay parts of the investment costs or of their private returns π.

An entrepreneur with signal s_e^i, where $i = \pi, 0$, receives public support with probability $\sum_{j=\pi,0} \left[p\left(s_g^j|s_e^i\right) p\left(1|s_g^j, \overline{\theta}\right)\right]$ if she pays the rent seeking costs r, and with probability $\sum_{j=\pi,0} \left[p\left(s_g^j|s_e^i\right) p\left(1|s_g^j, \underline{\theta}\right)\right]$ otherwise, where the probability $p\left(1|s_g^i, \theta\right)$ that an entrepreneur with signal s_g^i and closeness θ receives public support is endogenous and dependent on, among other things, the IPA's budget Ω. Further, the expected benefit from public support is $\sum_{k=\pi,0} \left[p\left(k|s_e^i, s_g^j\right) v(k)\right]$ for an entrepreneur with signal s_e^i given that the IPA has received signal s_g^j. An entrepreneur with s_e^i thus pays r if and only if $r < r(s_e^i)$,[29] where

$$r(s_e^i) \equiv \sum_{j=\pi,0} \left\{ p\left(s_g^j|s_e^i\right) \left[p\left(1|s_g^j, \overline{\theta}\right) - p\left(1|s_g^j, \underline{\theta}\right)\right] \sum_{k=\pi,0} \left[p\left(k|s_e^i, s_g^j\right) v(k)\right] \right\}. \tag{28}$$

The threshold $r(s_e^i)$ measures how much an entrepreneur with signal s_e^i is willing to pay for getting closer to the IPA. We subsequently focus on this willingness to pay. If $r(s_e^\pi) > r(s_e^0)$, entrepreneurs with good signals s_e^π are more likely to engage in rent seeking than entrepreneurs with bad signals s_e^0 in the sense that the former always pay the rent seeking costs r if the latter do, and that the latter pay r only if the former do. If $r(s_e^\pi) < r(s_e^0)$, the reverse is true. It can be shown that $r(s_e^\pi) > (<) r(s_e^0)$ if and only if

$$\sum_{j=\pi,0} \left\{ \left[p\left(1|s_g^j, \overline{\theta}\right) - p\left(1|s_g^j, \underline{\theta}\right)\right] \Psi(s_g^j) \right\} > (<) 0, \tag{29}$$

where $\Psi(s_g^j) \equiv p\left(s_g^j|\pi\right) v(\pi) - p\left(s_g^j|0\right) v(0)$.[30] It is straightforward that $p\left(1|s_g^j, \overline{\theta}\right) \geq p\left(1|s_g^j, \underline{\theta}\right)$ for $j = \pi, 0$. Further, it follows from $p\left(s_g^\pi|\pi\right) >$

[29] We assume that entrepreneurs never engage in rent seeking if they are indifferent.

[30] This is shown in appendix C.

$p\left(s_g^\pi|0\right)$ and $v(\pi) \geq v(0)$ that $\Psi(s_g^\pi) > 0$ unless $v(\pi) = v(0) = 0$.[31] Moreover, it holds that $\Psi(s_g^0) > 0$ if and only if

$$\frac{v(0)}{v(\pi)} > \frac{p\left(s_g^0|\pi\right)}{p\left(s_g^0|0\right)} = \frac{(1-\alpha)(1-q_g)}{(1-\alpha)(1-q_g)+q_g}, \tag{30}$$

where the equality follows from equations (3) and (5).

We next analyze whether the entrepreneurs with good signals s_g^π or those with bad signals s_g^0 are more likely to engage in rent seeking. For that purpose, we look at two cases that differ in the effectiveness of rent seeking. We first assume $p\left(1|s_g^\pi, \underline{\theta}\right) \geq p\left(1|s_g^0, \overline{\theta}\right)$. In this case, rent seeking is not overly effective and the IPA supports a distant entrepreneur with s_g^π rather than a close entrepreneur with s_g^0. It follows from condition (16) that this is more likely the higher the IPA's benevolence λ, the social returns Π and the quality q_g of the IPA's signals and the lower the distance $\overline{\theta} - \underline{\theta}$ between rent seeking entrepreneurs and others.

Given $\Omega \in (0, \alpha)$, the IPA does not therefore support any entrepreneur with a bad signal s_g^0 and it supports close rather than distant entrepreneurs with good signals s_g^π. That is, $p\left(1|s_g^0, \overline{\theta}\right) = p\left(1|s_g^0, \underline{\theta}\right) = 0$ and $p\left(1|s_g^\pi, \overline{\theta}\right) > p\left(1|s_g^\pi, \underline{\theta}\right)$. Combined with $\Psi(s_g^\pi) > 0$, this implies that condition (29) holds and, consequently, that $r(s_e^\pi) > r(s_e^0)$. Entrepreneurs who have received a good signal s_e^π are thus more likely to pay the rent seeking costs r than entrepreneurs who have received a bad signal s_e^0. Rent seeking therefore makes the IPA weakly more likely to support projects with two good signals, s_e^π and s_g^π, and less likely to support projects with s_e^0 and s_g^π. Since $p\left(\pi|s_e^\pi, s_g^\pi\right) > p\left(\pi|s_e^0, s_g^\pi\right)$, rent seeking thus leads to a socially weakly superior allocation of the IPA's budget Ω.[32]

Given $\Omega \in (\alpha, 1)$, the IPA supports all entrepreneurs with s_g^π such that $p\left(1|s_g^\pi, \overline{\theta}\right) = p\left(1|s_g^\pi, \underline{\theta}\right) = 1$. But among entrepreneurs with s_g^0, it supports those that are close rather than those that are distant such that $p\left(1|s_g^0, \overline{\theta}\right) > p\left(1|s_g^0, \underline{\theta}\right)$. It follows from conditions (29) and (30) that $r(s_e^\pi) > r(s_e^0)$ and, consequently, that entrepreneurs with s_g^π are more likely to pay r than those with s_g^0 if and only if $v(0)/v(\pi)$ is sufficiently low, i.e. if and only if the

[31] If $v(\pi) = v(0) = 0$, then $\Psi(s_g^\pi) = 0$. We subsequently ignore this case, in which no entrepreneur would pay a positive price for an increased likelihood of public support.

[32] The proof that $p\left(\pi|s_e^\pi, s_g^j\right) > p\left(\pi|s_e^0, s_g^j\right)$ is straightforward and similar to the proof of Proposition 6 with $\kappa = 0$.

profitability of a supported entrepreneur's project has a sufficiently strong effect on the entrepreneur's benefit from public support. But if $v(0)/v(\pi)$ is so high that condition (30) fails to hold, then $r(s_e^\pi) \leq r(s_e^0)$. Hence, given $\Omega \in (\alpha, 1)$, rent seeking leads to a socially weakly superior allocation of the IPA's budget Ω if $v(0)/v(\pi)$ is relatively low, but to a socially weakly inferior budget allocation if $v(0)/v(\pi)$ is relatively high.[33]

Suppose now that rent seeking is relatively effective such that $p\left(1|s_g^0, \overline{\theta}\right) > p\left(1|s_g^\pi, \underline{\theta}\right)$. If $\Omega \leq \alpha\beta(s_g^\pi)$, where $\beta(s_g^j)$ denotes the share of entrepreneurs with s_g^j that engage in rent seeking, again it holds that $p\left(1|s_g^\pi, \overline{\theta}\right) > p\left(1|s_g^\pi, \underline{\theta}\right)$ and $p\left(1|s_g^0, \overline{\theta}\right) = p\left(1|s_g^0, \underline{\theta}\right) = 0$. Hence, if Ω is sufficiently small, entrepreneurs with s_e^π are again more likely to pay r than those with s_e^0, and rent seeking leads again to a socially weakly superior allocation of the IPA's budget Ω. Moreover, it still holds that rent seeking leads to a socially weakly superior budget allocation if $v(0)/v(\pi)$ is sufficiently low for condition (30) to hold. But given that $v(0)/v(\pi)$ is relatively high, entrepreneurs with s_e^0 are more likely to pay r than those with s_e^π if $\Omega \geq \alpha + (1-\alpha)\beta(s_g^0)$, while it is ambiguous which entrepreneurs are more likely to pay r if $\Omega \in \left(\alpha\beta(s_g^\pi), \alpha + (1-\alpha)\beta(s_g^0)\right)$.

The effect of rent seeking on welfare or on the welfare effect of industrial policy W, respectively, depends on how rent seeking affects the IPA's budget allocation and on whether rent seeking costs r represent transfers or social waste. If rent seeking leads to a socially superior allocation of Ω and if r represents bribes or other transfers, rent seeking increases W. If rent seeking leads to a socially superior allocation of Ω, but r represents social waste, the welfare effect of rent seeking is ambiguous. And whenever rent seeking leads to a socially inferior allocation of Ω, rent seeking must lower W.

It follows from our discussion:

Proposition 9 *Rent seeking leads to a socially weakly superior allocation of the IPA's budget Ω if Ω is sufficiently small or $v(0)/v(\pi)$ is sufficiently low. In these cases, rent seeking may increase the welfare effect of industrial policy W.*

In section 2, we have shown that an IPA with a small budget Ω supports mainly profitable projects in absence of rent seeking. Proposition 9 implies

[33] If $\Omega = 0, \alpha, 1$, nobody pays r because the allocation of Ω is independent of θ.

that rent seeking activities further increase the share of supported projects that are profitable if Ω is small.

Moreover, rent seeking tends to improve the IPA's budget allocation if the profitability of a supported entrepreneur's project has a relatively strong effect on an entrepreneur's benefit from public support, i.e. if $v(0)/v(\pi)$ is relatively low. The observation that the states in South Korea and Taiwan were likely to cut public support for unprofitable projects (e.g. Amsden 1989, and Kim 1993) implies that $v(0)$ was relatively low in these countries. In South Korea and Taiwan, industrial policies may thus have been relatively successful and rent seeking not detrimental because rent seeking was more attractive for entrepreneurs expecting their projects to be profitable than for entrepreneurs expecting their projects to be unprofitable.

An entrepreneur's political closeness θ to a public agency may in reality well depend on exogenous factors, such as ethnicity, (as in section 2) as well as on rent seeking (as in this section). The observation often made that South Korea and Taiwan had hard, autonomous states (e.g. Amsden 1989, Wade 1990, Chang 1994, Evans 1995, and Rodrik 1995b) suggests that rent seeking may have had a smaller effect on an entrepreneur's political closeness to public agencies in these countries than elsewhere. This may also help to explain why rent seeking was not detrimental in South Korea and Taiwan.

5 Policy and Institutional Implications

In this section, we discuss on the basis of our theoretical findings what institutional setting should be chosen to make industrial policies effective.

A first set of implications follows from the result that the welfare effect of industrial policy increases in the quality q_g of the IPA's signals and that industrial policy can only raise welfare if q_g is sufficiently high. The IPA should thus be equipped with competent staff.[34] Further, the institutional setting should enable and encourage the IPA to collect accurate information about the different projects and to communicate with entrepreneurs as this will allow the IPA to update its beliefs about the different projects' profitability even if entrepreneurs often mislead it. However, if all these measures are

[34]Rodrik (2004) suggests delegating industrial policy to an existing agency that is known to be (relatively) competent.

inadequate to make the IPA sufficiently well-informed to enable industrial policy to work, then there should be no industrial policy.

Since the welfare effect of industrial policy further increases in the IPA's benevolence λ, the institutional setting should be designed such that the IPA behaves as benevolently as possible.[35] Because politically motivated policies persist in many (less developed) countries, this insight is not particularly helpful. But our model further suggests that industrial policies have a positive effect on welfare even if the IPA is highly politically motivated *given* that the institutional setting allows only for modest industrial policies. Modest industrial policies are effective because any IPA that cares at least marginally about social welfare supports first projects it expects to be profitable. Modest industrial policies can most easily be achieved by restricting the IPA's budget Ω. Proposition 4 implies that the welfare effect of industrial policy is maximized if $\Omega = \Omega'$. The budget should therefore not only be smaller, the more politically motivated the IPA, but also the worse its information, the higher the variability in the entrepreneurs' distances from the IPA, the rarer profitable projects and the lower the social returns to these projects.

Alternatively, one can attain modest industrial policies, i.e. industrial policies that increase welfare even if the IPA is highly politically motivated, by appointing bureaucrats with a relatively hostile attitude towards entrepreneurs, i.e. by making μ_θ relatively low. Notice the similarity to the well-known argument that society may be best served by a conservative central banker.

The possible presence of rent seeking is yet another reason for ensuring that industrial policies are modest because entrepreneurs with profitable projects are then more likely to engage in rent seeking than those with unprofitable projects, which, in turn, leads to a socially superior allocation of the IPA's budget. The same could alternatively be achieved by ensuring that benefits from public support are small (if not zero) for entrepreneurs with unprofitable projects. This however is probably more difficult to enforce than

[35] One could e.g. make the IPA relatively independent (like many central banks) to reduce its exposure to strong political groups; this would however also reduce its accountability. Alternatively, one could link the IPA's future budget to its current performance, i.e. to the share of supported projects that are profitable. If this could be done credibly, the IPA would have a stronger incentive to support projects it expects to be profitable rather than projects of close entrepreneurs. In addition, one could introduce performance-linked wages for bureaucrats.

a limited budget.

Finally, it should be borne in mind that the government or the IPA could, under certain conditions, foster development without active interventions simply by sharing its knowledge. Since this passive policy requires no public investment into private projects, it is more difficult to misuse. It might therefore be a serious alternative to active industrial policies - given that it could indeed foster development - if public investment costs and the IPA's political motivation are relatively high.

6 Conclusions

We have presented an industrial policy model with both market and government failures. On the one hand, this model helps us to understand why the same industrial policies that have failed elsewhere have been relatively successful in South Korea and Taiwan. It shows how competent bureaucrats, ethnic homogeneity among entrepreneurs, intensive communication between bureaucrats and entrepreneurs, and the readiness to cut public support for unprofitable projects may all have contributed to the success of industrial policies in these countries. On the other hand, this model provides some guidance as to the institutional setting under which industrial policies may work. In particular, it has highlighted an asymmetry in how different government failures should be handled: Incompetent public agencies should lead to the abandonment of industrial policies since they render any industrial policy ineffective, whereas highly politically motivated public agencies are merely a reason for modest industrial policies. Given that the public agencies' budget is sufficiently small (or that public agencies are sufficiently hostile), industrial policies are effective even if public agencies are highly politically motivated, because any public agency first supports close entrepreneurs with projects it expects to be profitable.

This latter result asks for a nuanced view on industrial policies: Those who claim that industrial policies cannot work because of rampant government failures should be aware that modest industrial policies may even work if public agencies are highly politically motivated; and those who claim that industrial policies are necessary to circumvent rampant market failures should be aware that in reality modest industrial policies will be more likely

to work than generous industrial policies. Notice that this implication is in stark contrast to the belief that successful development requires the government (or international donors) to finance a big push.[36]

Even though our model has proved helpful to get reasonable answers to the questions posed in the introduction, we are convinced that further research on the interactions between market and government failures is needed to improve our understanding of the possibilities and dangers associated with industrial policies. We think that our model could provide a good basis for this research.

Finally, we would like to highlight two policy implications for international donors that follow from our model. First, international donors should convince governments in developing countries to choose an adequate institutional setting for their industrial policies. This entails abandoning industrial policies if public agencies lack competence, and choosing modest industrial policies if public agencies are highly politically motivated. Second, for the same reasons international donors should not provide financial aid for extensive industrial policies conducted by incompetent or highly politically motivated public agencies.[37] But insofar as convincing governments and public agencies requires financial "incentives", these policy implications are partly conflicting. International donors must therefore act circumspectly to foster development in places where people are already suffering from both market failures and incompetent, highly politically motivated public authorities.

[36]The idea that industrialization requires a big push goes back to Rosenstein-Rodan (1943). Murphy, Shleifer and Vishney (1989) and Rodrik (1996) provide relatively recent models on industrialization and the big push. However, contrary to what is often argued, these models do not imply that a big push requires public expenditures (Rodrik 2004).

[37]Our model suggests that massive aid payments to support industrial policies should be harmful in most developing countries while modest aid payments might be effective. This is consistent with the (inconclusive) evidence of a hump-shaped relationship between foreign aid and growth (e.g. Hansen and Tarp 2001, and Roodman 2004).

Appendix A

This appendix attempts a brief summary of the debate about the role played by industrial policies in South Korea, Taiwan and some other fast growing East Asian countries. The focus on industrial policies is however not meant to deny that export orientation, sound macroeconomic policies and the rapid accumulation of physical and human capital may have been important.

In the 1970s and 1980s, when evidence accumulated that various East Asian countries had been experiencing extraordinarily fast growth, many economists argued that these countries were free-market, free-trade economies with very limited government interventions (see e.g. Balassa 1988).

This view was challenged by a series of "revisionist" contributions in the late 1980s arguing that industrial policies were used in most fast growing East Asian countries to foster development. The best-known contributions are probably those of Amsden (1989) and Wade (1990). They provide an extensive account of various selective government interventions in South Korea and Taiwan, respectively. Further, they both argue that these interventions contributed substantially to these countries' extraordinary performance.

In 1993, the World Bank published the East Asian Miracle report, in which it argues that governments in South Korea, Taiwan and other East Asian countries had indeed intervened systematically and often selectively, but that these interventions were not the driving force behind the East Asian miracle. Since then most economists have acknowledged that industrial policies have been present in various successful East Asian countries, but - due to the lack of the counterfactual - there is still disagreement about the effect industrial policies have had on these countries' performance: The effect could have been positive or negative, and substantial or of second order.

Given that no country (except Botswana) grew more rapidly than these East Asian countries between, say, 1960 and 1985 (Summers and Heston 1988), it is implausible (but not impossible) that industrial policies had a negative effect and that growth would have been even faster in the absence of industrial policies. The question of whether the (weakly) positive effect of industrial policies was small or substantial is, however, unresolved. But note that even if industrial policies have had only a small positive effect in East Asia, this would still contrast with the significant negative effect industrial

policies have had in most other countries.

Appendix B

This appendix proves proposition 6. Since $p\left(\pi|s_g^j, s_{eg}^\pi\right) > p\left(\pi|s_g^j\right) > p\left(\pi|s_g^j, s_{eg}^0\right)$ directly follows from $p\left(\pi|s_g^j, s_{eg}^\pi\right) > p\left(\pi|s_g^j, s_{eg}^0\right)$, it is sufficient to prove that the latter holds if and only if $\kappa < 1$. We prove it by contradiction. Suppose therefore $p\left(\pi|s_g^j, s_{eg}^\pi\right) \leq p\left(\pi|s_g^j, s_{eg}^0\right)$ and $\kappa < 1$.

It follows from

$$p\left(\pi|s_g^j, s_{eg}^i\right) = \frac{p\left(\pi\right) p\left(s_g^j|\pi\right) p\left(s_{eg}^i|\pi, s_g^j\right)}{p\left(\pi\right) p\left(s_g^j|\pi\right) p\left(s_{eg}^i|\pi, s_g^j\right) + p\left(0\right) p\left(s_g^j|0\right) p\left(s_{eg}^i|0, s_g^j\right)} \tag{31}$$

that $p\left(\pi|s_g^j, s_{eg}^\pi\right) \leq p\left(\pi|s_g^j, s_{eg}^0\right)$ holds if and only if

$$p\left(s_{eg}^\pi|\pi, s_g^j\right) p\left(s_{eg}^0|0, s_g^j\right) \leq p\left(s_{eg}^\pi|0, s_g^j\right) p\left(s_{eg}^0|\pi, s_g^j\right). \tag{32}$$

Given $\kappa < 1$ (as well as $q_e > 0$ and $q_g < 1$), it must hold that $p\left(s_{eg}^\pi|\pi, s_g^j\right) > p\left(s_{eg}^\pi|0, s_g^j\right)$ and that $p\left(s_{eg}^0|0, s_g^j\right) > p\left(s_{eg}^0|\pi, s_g^j\right)$. Hence, there is a contradiction. Consequently, $p\left(\pi|s_g^j, s_{eg}^\pi\right) > p\left(\pi|s_g^j, s_{eg}^0\right)$ if and only if $\kappa < 1$.

Appendix C

This appendix proves that $r(s_e^\pi) > r(s_e^0)$ if and only if condition (29) holds.

It directly follows from definition (28) that $r(s_e^\pi) > r(s_e^0)$ if and only if

$$\sum_{j=\pi,0} \Psi'(s_g^j) \left[p\left(1|s_g^j, \delta^l\right) - p\left(1|s_g^j, \delta^h\right)\right] > 0 \tag{33}$$

with $\Psi'(s_g^j) \equiv \sum_{k=\pi,0} \left\{\left[p\left(s_g^j|s_e^\pi\right) p\left(k|s_e^\pi, s_g^j\right) - p\left(s_g^j|s_e^0\right) p\left(k|s_e^0, s_g^j\right)\right] v(k)\right\}$. By definition,

$$p\left(k|s_e^i, s_g^j\right) \equiv \frac{p(k) p\left(s_e^i|k\right) p\left(s_g^j|k, s_e^i\right)}{p\left(s_e^i\right) p\left(s_g^j|s_e^i\right)}. \tag{34}$$

Since s_e contains no information about s_g in addition to its information about the project's type, it holds for all $i, j, k = \pi, 0$ that $p\left(s_g^j|k, s_e^i\right) = p\left(s_g^j|k\right)$ and thus that

$$p\left(s_g^j|s_e^i\right) p\left(k|s_e^i, s_g^j\right) = \frac{p(k) p\left(s_e^i|k\right) p\left(s_g^j|k\right)}{p\left(s_e^i\right)}. \tag{35}$$

Equations (2) to (5) and (35) imply $\Psi(s_g^\pi) = \Psi'(s_g^\pi)/q_e$ and $\Psi(s_g^0) = \Psi'(s_g^0)/q_e$. Hence, $r(s_e^\pi) > r(s_e^0)$ if and only if condition (29) holds.

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