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DISCUSSION PAPER

Obtaining Information by Diversifying Projects, Or Why Specialization is Inefficient*

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Abstract

We examine how diversification of projects assigned to an agency can enhance efficiency by informing a principal of the agency's quality. Projects that appear inefficient in isolation may be justified when assigned to the same agency. Assigning different tasks to different special purpose governments, though allowing for technical efficiency in the management of each project, may nevertheless reduce overall efficiency.

JEL Codes: D73, D83, H43

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1 Introduction

A government agency is often assigned multiple tasks. For example, a Department of Transportation may be responsible for building roads, regulating airlines, subsidizing mass transit, and so on. Such multiple assignments may appear obvious, but which tasks are assigned which agency is not trivial. For example, should a new police station be designed by the police department, or by the fire department which had recently built fire stations, or by the city planning department, or by a private architect? Should labor negotiations with teachers be conducted by the school superintendent, the city attorney, or the director of personnel?

The problem we address may be especially relevant for special district governments. In the year 2002, the United States had 35,052 special district governments with total revenue of over $123 billion. Of these districts, 91 percent performed a single function (see US Census 2005 and Stephens and Ross 1998). Such specialization may lead to technical efficiency and to accountability. But, we argue, such specialization can make it difficult to evaluate the quality of an agency's management, and therefore lead to poor decisions of what projects an agency should adopt. Less specialization can reduce technical efficiency, but can increase overall efficiency. Put differently, special districts limit the benefits of economies of scope which can arise not only when an agency produces multiple outputs, but also when an agency produces a single output with different technologies.

This paper asks which tasks or projects should be assigned to which agencies or special purpose governments, and in particular how the diversification (as opposed to the specialization) of tasks assigned to an agency affects decisions of what projects to pursue.

Some disadvantages of multiple responsibilities are well known. Knowledge gained by experience calls for specialization. Assigning multiple missions to one agency can reduce both accountability and effort (Dewatripont, Jewitt, and Tirole 1999). An advantage of assigning different tasks to one agency is that the agency may have expertise in the necessary areas. In particular, Weisbach and Nussim (2004) consider the decision to combine tax and spending programs. They argue, for example, that welfare programs and tax programs both rely on income or wealth measurement, and that both need large-scale information and financial processing, so that it makes sense to put them in the same agency. The advantage of specialization may be countered, however, by problems of coordination across agencies.

We propose a different explanation. Consider a principal (say the voters, city council, or a mayor) who must decide whether to approve a project proposed by a governmental agency. The proposed project may be more attractive the more competent the agency or official in charge, but the principal is unsure about the agency's competence. Suppose the principal can evaluate the quality of one type of project (called M, for Monitored), but not of another type (called N, for Not monitored), and that the agency's competence across the two areas is positively correlated. Then the principal may approve project N only if the agency performed well on project M. This diversification allows the principal to estimate more accurately the quality of project N than when N is proposed alone.[1]

The principal's uncertainty can extend beyond the agency's competence. The uncertainty can also relate to the agency's preferences or ideology. For example, is the agency sufficiently concerned about environmental damage, or about the welfare of the poor, or about creating jobs? A principal who observed the agency's preferences when it designed or implemented project M can then learn about its likely preferences were it to design or implement project N. The principal would then authorize project N only if he had sufficient confidence that the agency will pursue the principal's goals.

The critical idea in our analysis is that an agency's performance on one project can inform a principal about its expected performance on another project. For simplicity, and to highlight the effects, we mostly assume that the agency's performance on one project can be observed; call this the M project. But its performance on another project is observed only long after the project is completed; call this project N.

The assignment of projects to an agency may be more important for local agencies than for national agencies. A national agency can undertake similar projects sequentially, in different locations. For example, it may first build a bridge on an interstate highway in Iowa. If that bridge is successful, it can then expand the bridge-building program to other states. The public can predict an agency's competence on a project by looking at its success on previous projects. In contrast, a city government is unlikely to have an opportunity to build many bridges—one cannot look at its competence in bridge building by looking at previous success in building other bridges. The

[1] Of course, if performance on the two projects is uncorrelated, whereas performance over time on the same type of project is correlated, then specialization is more attractive. We do not deny such consideration, but focus on the more interesting case where diversification is optimal, and may justify some inefficient projects.

alternative is to bundle different projects, as we model.

Local and national governments show an additional difference. Expertise may be jurisdiction specific: conditions in different jurisdictions may differ, or for Tiebout reasons the preferences in different regions may differ. Furthermore, officials in local governments may show high mobility across jurisdictions, while mobility of officials in a national agency may be slower. Then for a local mayor to find out if an agency head is competent, or for voters to find out if the official well matches their needs, they must observe performance on a recent project, rather than rely on a long history of past performance.

Section 2 surveys literature on monitoring. Section 3 presents a model which examines the informational advantages of bundling the two projects. Section 4 generalizes the model to the bundling of four projects, where the observation of two diversified projects helps to choose among two new projects. Section 5 concludes and suggests extensions.

2 Literature

In the study of firms, bundling of projects relates to the span of control given to a manager. Filson (2000) considers removal of managers found to be of low quality, and how much resources to allocate to managers of different estimated quality. Our model differs from his in two main ways. First, we let an increased span of control improve the information about an agency's quality. Second, whereas he focuses on retention or replacement of managers, we consider which projects to adopt.

Several papers study how the internal organization of firms can affect information about the ability of agents. Berkovitch, Israel, and Tolkowsky (1999) study when economic units should be structured as stand-alone firms versus an integrated firm (conglomerate): an integrated firm better controls agency problems through yardstick competition between managers for project acceptance, but reduces the ability to receive division-specific project information from the market. On yardstick competition (how performance by one agent reveals information about the ability of another agent), see Besley and Case (1995). Related arguments about how the success of policy reveals information about an agent's competence are found in Rogoff and Sibert (1988), Rogoff (1990), and Glazer and Hassin (1988). Competitions among local jurisdictions for receipt of federal grants can reveal information

about the ability of local politicians (see Boarnet and Glazer (2002) for evidence relating to the flypaper effect). And, of course, our approach relates to signaling, in which an agent engages in a costly action to reveal his ability. For example, Kotsogiannis and Schwager (2006) show how politicians who compete for office may exert effort on innovation with the aim of signaling ability to the electorate.

A firm may assign tasks to different types of workers with the aim of learning about their abilities. Meyers (1994) considers the problem when production requires the participation of a senior worker and a junior worker. If each of the two juniors divides his time equally between the two projects, then the project outcomes are very informative about which senior is more able, because the total contributions of the juniors to the two projects are perfectly correlated. On the other hand, the project outcomes provide no information about which junior is abler. If, instead, each junior works exclusively on one project, then project outcomes provide more information about the relative abilities of juniors and less information about the relative abilities of seniors.

Diversification of tasks can also affect incentives. Dewatripont et al. (1999) use a career-concern model to study the performance of government agencies. They find that assigning more tasks to one official typically weakens the link between his performance and his talent, and so reduces the agent's effort. The effort will be especially reduced if the agency's mission (the objective the agency gives itself) becomes fuzzy. The major problem is that a government official has difficulty revealing his talent when he must perform several tasks. The poorer revelation may even lead a high-ability agent to refuse some tasks.[2]

3 Project assignment to gather information

We turn next to our explanation, which considers a principal who can estimate the agency's expected performance on a project by evaluating its performance on a different project.

[2]The idea that an agent's incentives are weaker when he incompletely controls asset allocation decisions builds on work by Grossman and Hart (1986), Hart (1995), and Aghion and Tirole (1997).

3.1 Assumptions

Nature determines whether the agency has high quality (is good) or low quality (is bad). The prior probability that the agency is good is γ. The probability a good agency performs well on any project is π_G; the probability a bad agency performs well is $\pi_B < \pi_G$. One interpretation is that output of an agency of type i is $Q_i = f(a_i L)$, where L is the amount of labor used, and $a_G > a_B$. In the next section we extend this to multiple inputs, and have the decision be not only whether to adopt a project, but instead whether to adopt a capital-intensive project or instead a labor-intensive project.

Projects come in two areas, M and N. The principal (for example, the public, or a mayor) can immediately evaluate performance of an M project, but can evaluate performance on an N project only after a long lag.

Let S_G be the principal's observation that project M succeeded (or that the principal observed a good signal). Then, following S_G, the posterior probability that the agency is good is

$$\text{pr}(G|S_G) = \frac{\text{pr}(S_G|G)\text{pr}(G)}{\text{pr}(S_G|G)\text{pr}(G) + \text{pr}(S_G|B)\text{pr}(B)} = \frac{\pi_G\gamma}{\pi_G\gamma + \pi_B(1-\gamma)}. \quad (1)$$

Thus the probability that project N will succeed given that project M was seen to succeed is the probability that the agency was revealed good times π_G, plus the probability that the agency was revealed bad multiplied by π_B:

$$\frac{\pi_G\gamma}{\pi_G\gamma + \pi_B(1-\gamma)}\pi_G + \left(1 - \frac{\pi_G\gamma}{\pi_G\gamma + \pi_B(1-\gamma)}\right)\pi_B. \quad (2)$$

In contrast, if project N is adopted with no prior observation of the agency's quality, the probability that the agency will perform well on N is

$$\gamma\pi_G + (1-\gamma)\pi_B. \quad (3)$$

The timeline with diversification of projects in the same agency is as follows

1. The agency adopts project M.
2. The public observes the outcome of project M and updates its belief about the agency's quality.
3. The public decides whether to adopt project N.

4. The outcome of project N is realized.

The timeline with specialization on project N is

1. The public decides whether to adopt project N.
2. The public decides whether to adopt an additional project N.
3. The outcomes of the projects are realized.

3.2 Assigning tasks to agencies

We assess the benefits of assigning two different types of projects to the same agency by comparing the expected benefits of the specialized and the diversified strategies. The specialized strategy means that the principal adopts N projects without knowing the agency's quality. Let the benefit from project M when it is good be M_G, and let its benefit be M_B when the project is bad. Define N_G and N_B similarly. Note that M_B or M_G may be negative.

We start by computing the expected benefit of the specialized strategy, which is the simple sum of the expected benefits:

$$\max\left[(\gamma\pi_G + (1-\gamma)\pi_B)N_G, 0\right]. \tag{4}$$

To determine the expected benefit of the diversified strategy we must determine the benefit of project N, knowing whether M was good or bad. With probability $\gamma\pi_G + (1-\gamma)\pi_B$ project M is observed to be good. The benefit of diversification consists then of the following terms: (a) the expected benefit of project M; (b) the expected benefit of N knowing that M was good; (c) the expected benefit of N knowing that M was bad. Obviously, if project N has a net negative benefit given that project M was bad, it should not be undertaken. Similarly, if the expected benefit of the combined project is negative it is better to do nothing. Thus, expected benefits under the diversified strategy are

$$\begin{aligned}&\max[\gamma\pi_G + (1-\gamma)\pi_B)M_G + (1 - (\gamma\pi_G + (1-\gamma)\pi_B))M_B + (\gamma\pi_G + (1-\gamma)\pi_B) \\ &\left(\tfrac{\pi_G\gamma}{\pi_G\gamma+\pi_B(1-\gamma)}(\pi_G N_G + (1-\pi_G)N_B) + \max\{(1 - \tfrac{\pi_G\gamma}{\pi_G\gamma+\pi B(1-\gamma)})(\pi_B N_G + (1-\pi_B)N_B), 0\}\right), 0].\end{aligned} \tag{5}$$

3.3 Interpretation

To gain insight into the benefits of diversification, we make simplifying assumptions. Normalize $M_G = N_G = 1$ and let a bad project be the exact opposite of a good project, or let $M_B = N_B = -1$. Let the probability that a bad agency will perform well be zero ($\pi_B = 0$). Suppose for the moment that project M has, in isolation, positive expected benefits. As it is now anyway worthwhile to undertake project M, the net benefit of diversification, Δ, equals the difference between expressions (5) and (4):

$$\Delta = 1 - \gamma\pi_G(1 - 2\pi_G), \tag{6}$$

with $\frac{\partial\Delta}{\partial\gamma} = \pi_G(2\pi_G - 1)$ and $\frac{\partial\Delta}{\partial\pi_G} = \gamma(4\pi_G - 1)$.

Our simplifying assumptions require that $\pi \geq 1/2$. For π near that value, diversification is definitely worthwhile: in the absence of diversification, project N would always be adopted, but would often fail; diversification allows project N to be adopted only when it will likely succeed. When $\pi_G = 1$ (a good agency always adopts a good project), the outcome of project M perfectly predicts the agency's quality, and so again diversification is worthwhile.

Note that diversification can be efficient even when project M and project N considered in isolation each has negative expected benefits. Consider first the case where the informative project M has a negative expected benefit μ. Then to know whether diversification is worthwhile, we need to add this cost to our net benefit of diversification Δ as given by (6). What matters is then both the cost μ and the value of Δ; this value depends on γ and on π_G; the smaller is γ and the higher is π_G the more informative project M will be, and the greater the gains from diversification.

Consider next a project N that in isolation has a negative expected benefit. The expected benefit from diversification now becomes

$$\Delta_N = \gamma\pi_G\,(2\pi_G - 1) - \mu. \tag{7}$$

A necessary condition for this expression to be positive is that $\pi_G > 1/2$: only when the information from project M on the agency's quality has a high probability of generating a good N project is the information valuable. The net benefit of project N in isolation ($(2\gamma\pi_G - 1)$) is negative; if π_G is near $1/2$, then γ must be sufficiently small to make diversification worthwhile. Precisely when γ is small do we expect the information revealed by project M to be worthwhile.

Our argument suggests limits to agency specialization: an agency should be assigned that bundle of responsibilities so that the principal can use performance on projects he can evaluate to predict performance on projects which are harder to evaluate.

4 Information from multiple projects

We so far considered agency quality as one-dimensional—it is either good or bad, and we supposed that one project is informative about quality whereas the other is not. But our approach can apply more generally, with similar qualitative results.

Consider a unified school district, which runs both elementary and high schools. Parents with children in elementary school can well observe the inter-personal qualities of the teachers, for example how well they can control a noisy child, or how well they can comfort a child. But since the material taught is simple, parents may not know how well the elementary school teacher masters the subject taught. In contrast, in high school the material taught is more advanced, and the mastery of the material taught is measured by standardized tests such as Advanced Placement tests or College Board subject tests. Thus, parents may be able to measure the knowledge of teachers in high school. Different activities yield different information about the agency's ability.

For another example, consider a transit agency which may operate buses and trains. Trains are very sensitive to the state of capital (either its maintenance or its original design)—a small defect with an undercarriage can stop all trains. Thus, the public may well estimate the quality with which capital is managed by observing the performance of trains. In contrast, buses are more forgiving in terms of capital (one broken bus does not shut down the whole route), but the public can better observe the quality of the labor, say of the bus drivers, since the public directly observes them. Thus, we can think that trains provide good information about the management of capital, whereas buses provide good information about the management of labor.

In both examples, different activities reveal performance on different tasks, helping the principal select projects. The following modification of the previous model explores that. In contrast to the earlier model, now we suppose that an agency's ability involves two dimensions (ability in managing capital and ability in managing labor) rather than only one (general ability).

4.1 Assumptions

Suppose that management of capital can be good, yielding effective capital input of K_G, or management of capital can be bad, yielding effective capital input of K_B, with $K_G > K_B$. Similar notation applies to management of labor, which can be L_G or L_B. For simplicity, let the prior probability that an agency can manage a given input well be $1/2$. Let the production function be Cobb-Douglas, with output for rail being $K^r L^{1-r}$. Output for bus service is $K^b L^{1-b}$. The costs of the projects are fixed and identical for the two projects. Suppose that $r > 1/2$, that $1 - b > 1/2$, and that the value of r is sufficiently close to the value of $1 - b$ so that, ceteris paribus, if capital is managed well the rail project should be adopted, and if labor is managed well the bus project should be adopted.

We shall compare two regimes or institutions. The first regime, with special district governments, is specialized: one agency (the bus agency) operates buses, and the other agency (the rail agency) operates trains. The second regime we consider, the diversified regime, has a single agency operate both bus and rail service. Alternatively, we can ask whether agencies should be geographically based or functionally determined. A geographic assignment across two cities would have one agency in each city, with each agency operating both bus and rail service. A functional assignment (corresponding to special district governments) would have one agency run buses in both cities, and one agency run trains in both cities.

The timeline of the game is as follows:

- The principal determines whether to have two specialized agencies (one for rail and one for buses) or to have a diversified agency.
- Nature determines the agency's ability in managing capital and in managing labor
- The principal can observe an agency's ability in managing capital by observing its performance on rail, and can observe the agency's ability in managing labor by observing its performance on rail.
- The principal decides whether to adopt a rail project or a bus project. He assigns a project to the same agency which had operated that type of project in the past.

4.2 Specialized agencies

We shall consider outcomes under each regime in sequence. Under the specialized regime, the principal observes the value of K for the rail agency, and the value of L for the bus agency. Under our assumptions, if the observed values are K_G and L_B, then in period 2 the principal should adopt the rail project, assigning it to the rail agency. If the observed values are K_B and L_G, then in period 2 the principal should adopt the bus project, assigning it to the bus agency. If the observed values are K_B and L_B, or if the observed values are K_G and L_G, then the principal is indifferent between the two projects. Note however, that because the agencies have different responsibilities, an observation of, say, K_G is consistent with the rail agency having either low or high productivity in managing labor; the principal does not know which. That is, when the principal observes K_G in the rail agency, he does not know whether that agency has a value of L_G or instead of L_B; and when he observes L_G in the bus agency, he does not know whether that agency has a value of K_G or instead of K_B. Because of his ignorance, the principal may therefore make the mistake of assigning a rail project in period 2 when the rail agency manages capital well and labor poorly, while the bus agency would manage both capital and labor well.[3]

4.3 Diversified agency

Consider next a diversified agency, which manages both a rail project and a bus project in period 1. Because of this diversification, the prinicipal gets perfect information on the agency's ability in managing both capital and labor. If the principal knows that the agency manages capital well and labor poorly, it will adopt the rail project in period 2; if the principal knows that the agency manages labor well and capital poorly, it will adopt the bus project in period 2. And if the principal knows that the agency manages one input well and one poorly, then he is indifferent about the assignment. Notice that the diversification of projects within the agency means that the principal has perfect information about its ability, and so, in contrast to possible outcomes

[3] This simple setup has an additional implication. When the principal behaves optimally in assigning projects in period 2, a rail project will be assigned to the rail agency because the principal knows that it manages capital well, but does not know whether the bus agency manages capital well or not. Put differently, we will observe consistency over time in which projects are assigned to which agencies.

with specialized agencies, that the principal never adopts the wrong project. Indeed, even if it is more costly to run a diversified agency than to run specialized agencies, the informational benefits arising from diversification can justify diversification over specialization.

5 Conclusion

This paper offered an explanation for when and how to diversify projects in government agencies. To keep the diversification option open, government may refrain from privatizing some projects. The public agency may be less efficient on these projects, but they are a good monitor for the overall capability of the agency.

We claim that diversifying projects in one agency can have clear informational advantages for the principal. A few caveats are in order. First adding more projects to the same agency makes it more difficult to monitor the overall performance of the agency, as explained by Dewatripont et al. (1999). Second we assume that the agency does not play strategically: it correctly reports the outcome of the projects it manages and does not manipulate its proposals for new projects. Agencies that know they are good in certain easily monitored projects may propose those new uncertain projects that they favor but that are not necessarily optimal for the policy maker. Third, if learning by doing is important, then specialization can lead to improved performance.

Our approach can apply not only to different tasks, but also to the size of a jurisdiction. Consider public schools. Suppose the middle class can well monitor performance, but that the poor cannot. Then it may be best to have a school district encompass both middle class and poor areas of the city. If the middle class finds that the school board is incompetent or corrupt, then the school board is probably also bad for the schools in the poor area.

This effect may lead to an argument against charter schools. A school which becomes a charter school may improve its performance. But performance in the system as a whole may deteriorate. Also note that the poor may agree to larger spending in the middle-class schools, or even to subsidize the middle-class schools, if they could thereby get the informational benefits from locating in the same school district.

Lastly, the model can be extended to consider a variety of voters rather than a variety of projects: voters may benefit from having voters of a dif-

ferent type in the same jurisdiction, when different types of voters are able to recognize different aspects of performance, say some recognizing efficiency in the use of labor, with others recognizing efficiency in the use of capital. Or different residents may use different services, with some shedding light on the government's efficiency in the use of capital, and the other on the use of labor. Such a benefit from diverse perspectives would go counter to the Tiebout prediction of homogeneous jurisdictions.

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6 Notation

a_K Measure of productivity on capital-intensive project

b_L Measure of productivity on labor-intensive project

M_B Benefit of project M if the agency is bad

M_G Benefit of project M if the agency is good

N_B Benefit of project N if the agency is bad

N_G Benefit of project N if the agency is good

P_K Capital-intensive project in period 2

P_L Labor-intensive project in period 2

Q_K Project which reveals agency's efficiency in managing capital

Q_L Project which reveals agency's efficiency in managing labor

Δ Principal's benefit from diversification compared to specialization

α_K Agency's efficiency in managing capital

α_L Agency's efficiency in managing labor

γ Prior probability that agency is good

π_B Probability a bad agency will perform well

π_G Probability a good agency will perform well