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Abstract

Project appraisal plays an important role in choosing the right project and is crucial for the success of public investment projects. Different factors may affect the choice of appraisal process in different countries. By use of simple game-theoretical models, the article aims to answer two questions: Why do countries adopt different public investment appraisal processes, such as top-down versus bottom-up processes? Why do different countries share similar features, such as external review, in the public investment appraisal process? Two selected countries, China and Norway, are used as case studies. The results illustrate that a country's political system and social norms play important roles in determining the selection of a project appraisal process. However, external review schemes such as external evaluation by consulting companies and experts can be optimal in both top-down and bottom-up project appraisal processes.

Introduction

Why do countries adopt different appraisal processes for public investment, such as top-down processes versus bottom-up processes? Why do appraisal processes share similar features, such as external review, in different countries? The purpose of this article is to answer the above questions by use of simple game-theoretical models, comparing China and Norway as case studies. The results illustrate that a country's political system and social norms play important roles in determining the selection of a project appraisal process. However, external review schemes such as external evaluation by consulting companies and experts can be optimal in both top-down and bottom-up project appraisal processes.

Project appraisal plays an important role in choosing the right project and is crucial to the final success of public investment projects (e.g. Miller and Lessard, 2000; Flyvbjerg et al., 2003). Many countries have introduced project governance schemes applying to important large scale investment projects at either the national level or sectoral level. Feasibility studies and impact assessments such as cost-benefit analysis, environmental analysis, and financial sustainability analysis are either recommended or required by the authorities before a project is undertaken. Stakeholder involvement may be also required during planning processes. Requirements and practices of project appraisal vary significantly from country to country (Dabla-Norris et al., 2011; Klakegg et al., 2009; Laursen and Myers, 2009). The appraisal and decision process may be affected by broad characteristics of governance in the public sector, such as managerial culture, by budgeting processes, and by historical, geographic and demographic factors (Christensen et al., 2008; Dixit, 1998; Laursen and Myers, 2009).

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Only a few studies have compared project appraisal processes between countries. Laursen and Myers (2009) have compared planning and implementation processes of four new EU member states (Latvia, Poland, Slovakia, and Slovenia) with three more developed EU member states (Spain, Ireland, and the UK) in transport infrastructure investments. The processes are found to be affected by broader issues of governance of public sector. In the UK and Ireland, public administration has adopted a more managerial culture, whereas many of the more recent EU member countries still rely extensively on laws and decrees for policy implementation. Klakegg et al. (2009) compare experiences with the system adopted by the Office of Government Commerce (OGC) in the UK with the pre-project evaluation process in Norway, with a particular focus on external reviews for big public investments. The systems are similar in several respects, such as the gateway structure and the use of external reviewing, but the OGC system had a less powerful position during the study conduct phase and was based more on a support strategy than a control strategy. Dabla-Norris et al. (2011) is the first study to develop a composite index to capture *ex ante* and *ex post* dimensions of investment processes. They compare the efficiency of public investment management processes for 71 countries, among which 40 were low-income countries. Middle-income countries were found, on average, to have higher overall efficiency in their investment processes than low-income countries. To our knowledge, no cross-country comparison of public investment appraisal processes has yet answered the questions that are studied in this article.

The project appraisal processes in China and Norway are very different, for example, in terms of project initiation. In Norway, infrastructure investments are often initiated and first assessed locally, even though they often end up being funded by the state. Municipalities and other regional stakeholders have a strong influence on the final decisions, especially in cases concerning land use. By contrast, in China, both the state and political leaders have significant influence over the initiation of public-funded infrastructure investments. Norway and China differ considerably with respect to political system, social norms, economic development stage, and economic size. China is one of the largest and fastest growing emerging economies, with tremendous investments in infrastructure annually. Norway is among the world's richest countries, yet it is relatively small in terms of its economic size. Whereas China has a centralized political system, Norway has a parliamentary democracy governing policymaking. However, both Norway and China share some common characteristics in their choice of project governance schemes, such as the use of consultancy and experts for quality assurance.

As a conceptual framework, our study uses historical and comparative institutional analysis (HCIA). The framework is often used to address questions regarding the origins, nature, and implications of institutions. The essence of HCIA is to examine the factors that determine the relevant "rules of the game," the forces that make the rules self-enforcing and the self-enforcing constraints on behavior that emerge within these rules (Greif, 1998). The HCIA approach is normally used to study equilibrium in a game-theoretical sense (Greif, 1998). In

this article, we use both the HCIA framework and classical game theory to study the impact of political systems and social norms on the choice of project appraisal process for public investments and the effect of external monitoring schemes on the efficiency of project appraisals. The study focuses on projects that are partly or fully state-funded. If a project is funded partly by the state, the rest of the project funding often comes from sources such as user fees or local budgets. China and Norway are selected as cases because of the respective top-down and bottom-up project appraisal processes. Information about the two countries' decision and appraisal processes for major public investments has been collected through reviewing existing literature (e.g. Chen, 2012 on project appraisal processes in China; Christensen, 2011; Klakegg et al, 2009; Samset, et al., 2006; Samset and Volden, 2013 on project appraisal processes in Norway), regulations on project appraisal processes particularly for China (e.g. NDRC, 2005, 2004; National People's Congress, 2003; CIECC, 2002) and other public documents. Information on Norwegian project appraisal process is well documented and publicly available, but not in the case of China. Regulation review is thus carried out to identify the Chinese project appraisal process. We admit that the current study bases solely on literature review, both empirical study and qualitative interviews with relevant regional and central governors as well as local stakeholders are left for future research.

Section 2, presents the general appraisal process for major public investments in both Norway and China, as examples of countries with "bottom-up" and "top-down" appraisal processes, respectively. Section 3 identifies major differences and similarities of project appraisal processes between the two countries. Section 4 applies the HCIA framework and introduces game-theoretical models to explain that the project appraisal process specific to each country is the result of adaptation to, for example, the political system and social norms. The functions of external review in the two different processes are also demonstrated. Section 5 concludes.

Project appraisal process in Norway and China

Both Norway and China have a formal project appraisal process for public investments. The more serious the consequences of the investment and/or the higher the investment cost involved, the more detailed the impact assessments should be, as required by regulations in different countries. To make our study more manageable, it is limited to *major* investment projects financed, at least partly, by the national authorities in the two study countries.

Norway is one of the few countries where the Ministry of Finance has introduced a common scheme for all major public investments, including two external reviews in the planning process for investment projects. The scheme applies to public investments with expected value larger than NOK 750 million (approximately USD 129 million).¹ In China, the threshold for qualifying as a major public investment depends on whether the central state or the local government redeems the bonds, if sovereign bonds are used to finance the project. The

threshold is CNY 5 billion (approximately USD 818 million) if the state redeems sovereign bonds. The threshold is CNY 50 billion (approximately USD 8 billion) if local governments redeem the sovereign bonds (National Development and Reform Committee (NDRC, 2004).

Major public investments in Norway

The appraisal and decision process for major public investments in Norway covers three phases: project initiation, pre-study, and pre-project, before the final approval.

A project idea may be initiated from different sources, such as stakeholder groups, local authorities, politicians, or state agencies. Very often, the idea comes “from below” and is initiated by those who will benefit from the project. Based on a project idea, the responsible agency will perform an internal feasibility analysis of the project (pre-study), and then engage in a more detailed planning process (pre-project). In Norway, the Norwegian Public Roads Administration is an example of an agency responsible for public road projects.

Obligatory external review is required for public investments exceeding NOK 750 million. The system is named the Quality Assurance (QA) scheme, and it has two decision gates at the front-end. QA1 is a review of the internal feasibility analysis, and is performed at the end of the pre-study, before the choice of concept is made by the Cabinet. The consultant reviews the project’s feasibility, impacts, and conformity with societal needs (Samset et al., 2006).² Both the internal feasibility study and QA1 should follow national guidelines for assessing different impacts, such as land use, costs and benefits of the investment, and environmental and social consequences. The appendix 1 provides a list of regulations that are relevant to public investment appraisal.

If the decision is “go” after QA1, the next stage is a pre-project, where a detailed cost estimate and a management base are developed for the project execution. Stakeholder hearings are also important at this stage. After the pre-project, external reviewers go through this documentation and give their recommendation (QA2) before the final approval is made by Parliament (Samset et al., 2006).

The Ministry of Finance has a framework agreement with several independent consulting companies that perform QA. The sectoral ministries, in collaboration with the Ministry of Finance, decide when a QA will start.

The project planning process in Norway was traditionally and is still highly democratic, with extensive involvement by local authorities and stakeholders. The QA system anchors the most fundamental decisions in the Cabinet, but the system is designed to be independent of any particular government. The QA regime introduced by the Ministry of Finance, however, tends to increase the state’s control over fundamental decision-making on major public investments.

Another important purpose of the QA is to increase the professional quality of the evaluation that endorses a project. Because cost overruns for public investments were a serious problem in Norway before 2000, QA2 was introduced to strengthen cost control (Samset et al., 2006; Samset and Volden, 2013). As

local stakeholders are often better informed than the national government, introduction of an external review is expected to reduce local incentives to overestimate benefits and underestimate costs during public project appraisal (Samsset and Volden, 2013).

Major public investments in China

State and political leaders play important roles in project initiation in China. The state is responsible for making a blueprint that states what kind of investment projects should be initiated. Regional governments then propose projects under the state's guidance. In some cases, political leaders play a decisive role in initiating megaprojects.

Project appraisal differs according to the scale of projects and funding sources. Requirements for major public investment fall into corresponding categories. All public projects with government funding in the form of direct government investment and capital injection need approval for project documents, including project appraisal, feasibility study, and project design. The three ministries, the National Development and Reform Committee, the Ministry of Environmental Protection (MEP), and the Ministry of Land and Resources (MLR), are responsible for approval of the documents. If projects have subsidies greater than CNY 2 billion (USD 327 million), or obtain a state investment subsidy between CNY 30 million and CNY 2 billion (USD 4.91–327 million) with the state subsidy share exceeding 50% of the total investment, they will be regarded as funded by direct capital injection from the state budget and will need approval from the three Ministries (NDRC, 2005). Each of the three ministries has a different focus and has the right to veto a project proposal. The MEP focuses on both environmental design and environmental impact assessments. The MLR takes responsibility for monitoring changes to land use. The NDRC is responsible for all the other aspects of project evaluation, such as cost-benefit analysis and socio-economic impacts. Before the three ministries' approval, external review is required. There are 46 consulting companies authorized by the NDRC to conduct external evaluation of project documents submitted to the NDRC. Experts drawn from a database of experts are also involved in such external evaluations. The experts usually are researchers at the universities and research institutes, with a high level of education in the relevant field and a minimum of eight years relevant work experience. If all three ministries approve a project proposal, it will be forwarded to the State Council for final approval³ (Chen, 2012; Ministry of Finance and National Audit Office, 2003; CIECC, 2002).

Recently, increased emphasis has been placed on environmental concerns and public involvement in China. The Chinese Environmental Impact Assessment Law (EIA) issued on 1 September 2003 requires comprehensive environmental reviews in the planning stages of major public and private development projects. The EIA law formally requires public involvement in major investments. However, to our knowledge, public involvement in earlier stages of project appraisal is still limited. Some municipalities, such as Shanghai, have tried

to establish institutions to facilitate public involvement in project appraisal processes (Chen, 2012).

Political systems, social norms, and external review

One of the major differences between Norway and China, in the project appraisal process, is the relationship between the state and regional government and the role of national political leaders in the initiation of the public investments. In China, the state and political leaders seem to have more control of what kind of projects should be proposed, whereas in Norway the state receives and assesses proposals from regional governments. Political leaders have played an important role in initiating several megaprojects in China, such as the south–north water diversion project and the Three Gorges Dam project, although the latter was funded by user fees. By contrast, state leaders in Norway in principle play a less active role in project initiation. In addition, China still has very limited stakeholder involvement in the early project appraisal process compared to the Norwegian case. The study therefore concludes that China has a more top-down decision and appraisal process than Norway with respect to project initiation and appraisal.

Political systems and social norms are likely to be instrumental in shaping diverse institutional arrangements. Given the centralized political system in China and the democratic political arrangements in Norway, a top-down project appraisal process seems to be a natural practice for China, whereas a bottom-up process is more appropriate in Norway. Furthermore, China has a cultural tradition of deference to authority. Regional governments are less prone to challenge the state, and citizens are less prone to challenge the decisions made by bureaucrats. By contrast, Norwegians have far more individualistic attitudes and are more willing to confront opposing ideas and policies. A top-down project appraisal process in China normally has very few opponents from the regional level, unless stakeholders' interests are devastatingly affected by a project. In Norway, adopting such a system could easily give rise to opposition and result in huge negotiation costs, for example in the case of disputes between the regional authorities and the state.

Despite the different approach during project initiation and involvement of regional governments and stakeholders in China and Norway, both countries resort to external review to evaluate projects and to provide solid support for decision making. In Norway, one reason for adopting the QA system was that local governments were strategically overestimating project benefits and underestimating costs in order to convince the state to approve the public investment (Samset and Volden, 2013). Samset and Volden (2013) found that, 13 years after the establishment of the QA system, the percentage of projects with a completed project cost within the agreed cost framework has increased from below 40% to about 80%. The strategic behavior that was observed in Norway is less likely under a top-down project appraisal process,⁴ but external review is still useful. Under a top-down appraisal process, external review may well carry out a peer review function and provide a double check for the first round evaluation.

The following section applies game-theoretical models to explain how the political system and social norms affect project appraisal processes, thus leading to divergent processes in Norway and China. Game-theoretical models are also provided to explain the effectiveness of the external review in the two different types of project appraisal processes.

Game-theoretical models

This section applies two game-theoretical models to explain how the political system and social norms affect the formation of a project appraisal process and lead to divergent processes in Norway (bottom-up) and China (top-down) (section 4.1). Two further models are constructed to explain why external consultants and experts are important for the selection of good projects under both bottom-up and top-down project appraisal processes (sections 4.2 and 4.3).

The choice of project appraisal process

Model specifications

Here, we introduce a two-stage game-theoretical model. Two players are assumed in the model: the state, which makes its decision on behalf of the whole country; and the regional government, which represents the interests of local people. In the first stage, the state implements a project appraisal process, choosing between a top-down project appraisal process and a bottom-up project appraisal process. In the second stage, the regional government chooses to obey the new process or to oppose it. The process will be fully implemented only if the regional government obeys it. If the regional government opposes the process, the state will not be able to carry out the process fully and hence not be able to obtain the benefit from the process.

Both bottom-up and top-down project appraisal processes bear administrative costs. $E^i > 0$ denotes the gain the state obtains after establishing a new project appraisal process under political system i by improving the efficiency of project appraisal, where $i = D, C$. D stands for a democratic political system and C stands for a centralized political system. A_j^i denotes the administrative cost under political system i , where $j = t, b$. t stands for a top-down project appraisal process and b stands for a bottom-up project appraisal process. The administrative cost is assumed to be higher if the project appraisal process has a different structure (top-down versus bottom-up) from the political system than if the two share the same structure. When the two systems share the same structure, bureaucratic institutions could be shared and the cost be reduced. This implies $A_t^D > A_b^D$ and $A_b^C > A_t^C$. The benefit for the regional government under a political system i is B_j^i if the regional government obeys the project appraisal pro-

cess, j . Here, we assume that the regional government always prefers a bottom-up project appraisal process as it will take into account the interests of different stakeholders regardless of the political system. A top-down project appraisal process may also contradict social norms if individualism is a fundamental value for the majority of people and thus reduce the welfare of local people. Therefore, $B_b^i > 0$ and $B_t^i < 0$. If the regional government opposes the proposal from the state, the benefit for the state is simplified as zero and it only bears the administrative cost⁵. The regional government's benefit also will be zero if it opposes the proposal under a democratic political system, while the regional government bears a cost, $C^C > 0$, if it opposes the proposal under a centralized political system. The cost could come from different sources. In the case of China, promotion of leaders in the regional government is decided by the central government and there is competition for promotion between the leaders in the regional governments (Zhou, 2010). Openly confronting a decision from the central government means risking the loss of promotion opportunities or political rents. Here we assume that the political rent is much higher than the absolute loss incurred by the region, that is $C^C > B_t^C$ or $-C^C < -B_t^C$.

Figures 1 and 2 show the decision trees for the state (S) and regional government (R) with Figure 1 for a democratic political system, and Figure 2 for a centralized political system.

Figure 1: The decision trees for state (S) and regional government (R) when forming a project appraisal process under a democratic political system (the payoffs are shown in parentheses: the first player's payoff on the left and the second player's payoff on the right).

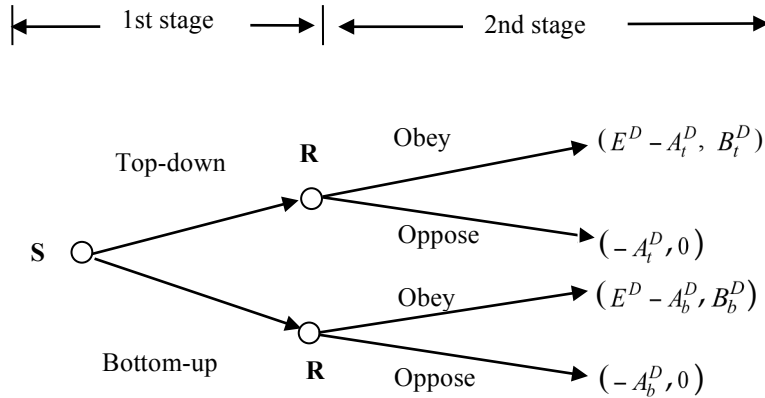
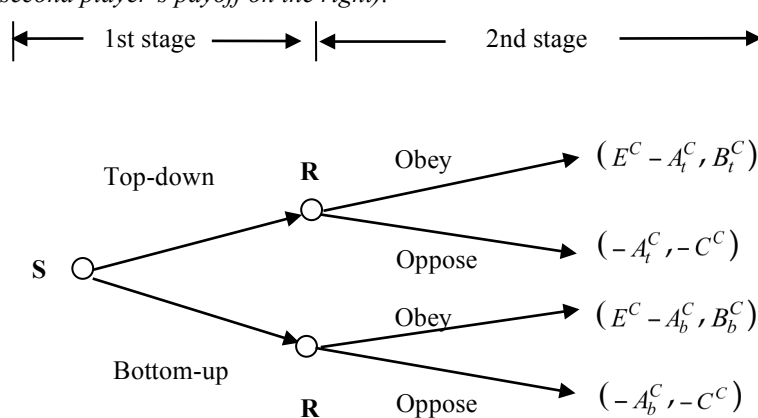


Figure 2: The decision trees for state (S) and regional government (R) when forming a project appraisal process under a centralized political system (the payoffs are shown in parentheses: the first player's payoff on the left and the second player's payoff on the right).



Backward induction

Backward induction is used to determine the optimal strategy for both the state and the regional government.

Democratic system

The decision process under a democratic system is analyzed in Figure 1:

Stage 2: If the state proposes a top-down project appraisal process, the regional government obtains net benefit B_t^D if it obeys the process and 0 if it opposes the process. Because $B_t^D < 0$, the regional government is better off opposing the proposal than obeying it. By contrast, if the state proposes a bottom-up project appraisal process, the regional government obtains net benefit B_b^D if it obeys the process, whereas B_b^D is higher than 0 if it opposes the process. The regional government will then be better off accepting the process.

Stage 1: Given that the regional government will oppose a top-down process if the state proposes it, the state will bear the administrative cost, $-A_t^D < 0$. Given that the regional government will obey a bottom-up process if the state proposes it, the state obtains net benefit $E^D - A_b^D > 0$. Because

$E^D - A_b^D > -A_t^D$, the optimal strategy for the state is to propose a bottom-up project appraisal process. The strategy (Bottom-up, Obey) is the subgame perfect Nash equilibrium⁶ of the game.

Centralized system

Figure 2 shows a decision tree for the state (S) and the regional government (R) when forming a project appraisal process under a centralized political system. At stage 2, the regional government always gains more by accepting the proposal from the State, no matter the type of proposal. If the state proposes a top-down process, the regional government loses by obeying, and the loss from sacrificing the interests of some stakeholders is less than the loss of political rents i.e., $-C^C < -B_t^C$. If the state proposes a top-down project appraisal process, obeying will be a better choice for the regional government as $B_b^C > 0 > -C^C$. At stage 1, given that the regional government always will obey, the state will propose a top-down process because the administrative cost is lower with a top-down process, hence the state incurs a net benefit, that is, $E^C - A_t^C > E^C - A_b^C$. Henceforth, the strategy (Top-down, Obey) is the subgame perfect Nash equilibrium of the game.

Proposition 1: Under a democratic political system, the optimal strategy is (Bottom-up, Obey), i.e., the state proposes a bottom-up project appraisal process and the regional government chooses to obey the process. Under a centralized political system, the optimal strategy is (Top-down, Obey), i.e., the state proposes a top-down project appraisal process and the regional government chooses to obey the process. Both optimal strategies are subgame perfect Nash Equilibrium.

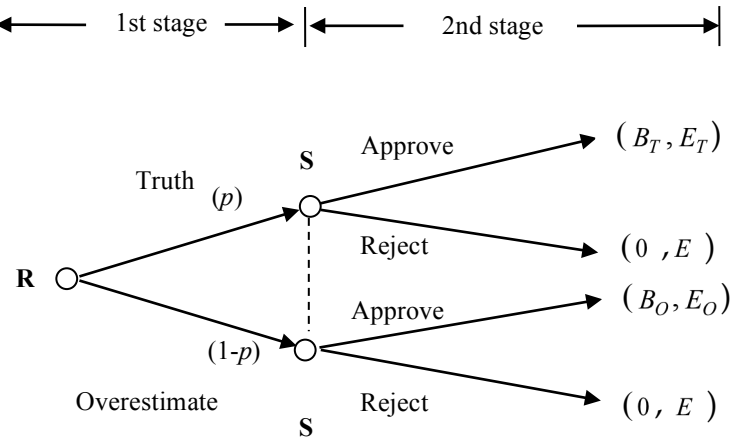
External review under a bottom-up project appraisal process

Benchmark: without external review

We first look at the importance of external review in a bottom-up project appraisal process. Once the appraisal process is passed at the national level, the regional government proposes a project. In the first stage, the regional government needs to submit a project proposal to the state, including a social cost and benefit analysis. The regional government is assumed to have more information about the net benefit of the proposed project, that is, the project net benefit is unobservable to the state and only known by the region. Hence, the regional government could choose to reveal the true net benefit of the project or to overstate it. The regional government will reveal the project's true net benefit only if the project is a "good" project. In this case, the project has large positive effects nationwide, even if it brings relatively low regional benefits. However, the re-

gional government will overestimate the net benefit of the proposal only if the project is a “bad” project. The “bad” project is defined as a project with low positive impact nationwide but relatively high regional effects. The true cost could be revealed by external review. In the second stage, the state either approves the project or disapproves it after reviewing the proposal. Figure 3 shows the decision trees for both the state (S) and the regional government (R) without external monitoring and under a democratic political system.

Figure 3: The decision trees for state (S) and regional government (R) without external review under a democratic political system (the payoffs are shown in parentheses: the first player’s payoff on the left and the second player’s payoff on the right; and the dashed represents one information set for the two strategies of regional government)



The payoffs depend on how the regional government reports the net benefit of the project and whether the state will approve the project or not. The state only knows that, with probability p , the regional government will reveal the true net benefit of a “good” project, and with probability $1-p$, the regional government will overestimate the net benefit of a “bad” project. The state will obtain a net present value at national level, E_T , if the regional government truly reveals a project’s net benefit when the project is “good.” The state will gain E_O if the regional government overestimates a “bad” project’s net profit. If the state rejects the project proposed and invest the budget in the other area instead, it will gain E . We assume that $E_T > E > E_O > 0$. The regional net benefit for carrying out a “good” project is B_T and for a “bad” project is B_O . $0 < B_T < B_O$. Stand-

ard backward induction is adopted to solve the two-stage game under a top-down political system without external review.

Stage 2: Given a project appraisal process, when the regional government proposes a project to the state, it could choose to reveal the true net profit if the project is a “good” project or overestimate the net benefit if the project is “bad.” The state chooses whether to approve the proposal. As the state only knows the probability of the regional government’s choices, the expected benefit for the state reads $EB_{\text{state}}(\text{Prove}) = pE_T + (1 - p)E_O$ if it approves the project. The expected benefit for the state will equal $EB_{\text{state}}(\text{Reject}) = E$ if it rejects the project proposal and invests the same amount of the budget somewhere else. As long as $(E - E_O)/(E_T - E_O) \leq p \leq 1$, $EB_{\text{state}}(\text{Prove}) > EB_{\text{state}}(\text{Reject})$. The optimal strategy for the state will always be to approve the project if the state believes the probability that the regional government will tell the truth is high. If $0 \leq p < (E - E_O)/(E_T - E_O)$, the state will reject the proposal.

Stage 1: Given that the state will approve the project where $(E - E_O)/(E_T - E_O) \leq p \leq 1$, the regional government gains B_T if it reveals the true net benefit of the project and B_o if it overestimates the net benefit. Because $B_T < B_o$, the optimal strategy for the regional government is to overestimate the project net benefit, that is, $p = 0$. However, the regional government’s choice is not consistent with the state’s belief and choice in Stage 1 with $(E - E_O)/(E_T - E_O) \leq p \leq 1$. Hence, the optimal strategy (Overestimate, Approve) is *not* a subgame perfect Nash equilibrium.

With $0 \leq p < (E - E_O)/(E_T - E_O)$, the regional government will be no different in choosing (Truth) and (Overestimate). Both strategies (Truth, Reject) and (Overestimate, Reject) are the optimal strategy. However, only the strategy (Overestimate) by the regional government is consistent with the belief of the State in stage 1 with $0 \leq p < (E - E_O)/(E_T - E_O)$. Hence, only one strategy (Overestimate, Reject) is the subgame perfect Nash equilibrium.

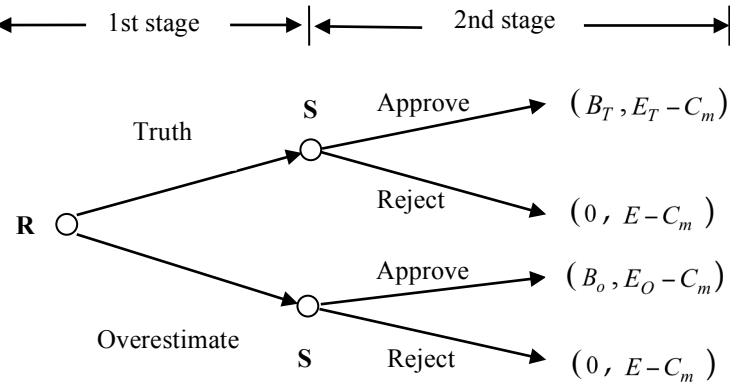
Proposition 2: Without an external review, the regional government will tend to propose projects with low national value and to overestimate the net benefit of a given project. The state will reject the project when it is proposed. The strategy (Overestimate, Reject) is the only subgame perfect Nash equilibrium for the game. Therefore, with asymmetric information and diverting interests

between state and region, few projects will be approved and funded by the state, which is not a good solution for society.

With an external review

Figure 4 shows the decision tree when there is an external review scheme under a democratic political system. With an external review scheme, there is no information asymmetry concerning the project net benefit between the regional government and the state. The decision tree is similar to that in Figure 3. The two strategies of the regional government, (Truth) and (Overestimate), provide two separate information sets for the state, i.e., the behavior of overestimating the project net benefit will be revealed. The state will bear the external monitoring cost, C_m , regardless of whether it approves or rejects the project proposal in the second stage. In a democratic political system, the state is assumed to obtain a net positive benefit if the project is approved and the true cost is low, i.e., $E_T - C_m > 0$. Payoffs for regional government are the same as those described in Section 4.2.1.

Figure 4: The decision trees for state (S) and regional government (R) with external review under a democratic political system (the payoffs are shown in parentheses: the first player's payoff on the left and the second player's payoff on the right.)



Stage 2: If the regional government reveals the true cost of a “good” project, the state obtains $E_T - C_m$ by approving the project but gains $E - C_m$ by rejecting the proposal. Because $E_T - C_m > E - C_m$, the state will always approve the project. If the regional government proposes a “bad” project with large regional effect but negative national impact and overestimates the benefit of the project,

the state will lose if it approves the project, because $E_O - C_m < E - C_m$. The state will therefore reject the project proposal.

Stage 1: Given the state's choice in Stage 2, the regional government will compare the payoffs, B_T , by proposing a "good" project and revealing the true net benefit of the project, with payoffs, 0, by proposing a "bad" project and overestimating the project net benefit. As $B_T > 0$, the regional government will propose a "good" project with large positive impact nationwide and reveal the true net benefit of the project. Therefore, the strategy (True, Approve) is optimal and is a subgame perfect Nash equilibrium.

Proposition 3: *With an external review scheme*, the regional government will tend to propose a project with a positive effect at the national level and to reveal the true net benefit of the project. The state will approve the project when it is proposed. The strategy (True, Approve) is a subgame perfect Nash equilibrium.

Under a bottom-up project appraisal process, our theoretical model proves that it is efficient to adopt an external review, for example, hiring external consulting companies to carry out evaluations, like the QA system in Norway.

Next, we look at the effect of an external review under a top-down project appraisal process.

External consults and experts under a top-down project appraisal process

Benchmark: without external review

China has a top-down project appraisal process where the state forms a general plan for the types of projects needed nationwide. This means that only projects with a large national impact will be proposed. External review might still be important to ensure that pre-project evaluations are technically adequate, competently performed, properly documented, and satisfy established quality requirements (Dearfield and Flaak, 2000). In the model presented in this section, "Nature" determines the true net benefit of a project, whether high or low. Nature means external factors that affect the project costs and benefits, such as geological and economic factors, that neither the State nor the regional governments can manipulate. The regional government is not regarded as a decision maker in the model. The regional government and the state are assumed to have the same information set about the cost and benefit of the projects. Hence, without external review, the government knows that, with probability q , the project net benefit will be high, and with probability $1 - q$ the project net benefit will be low. The state obtains payoff $E_k - A$ if it approves the project and $E - A$ if it rejects the

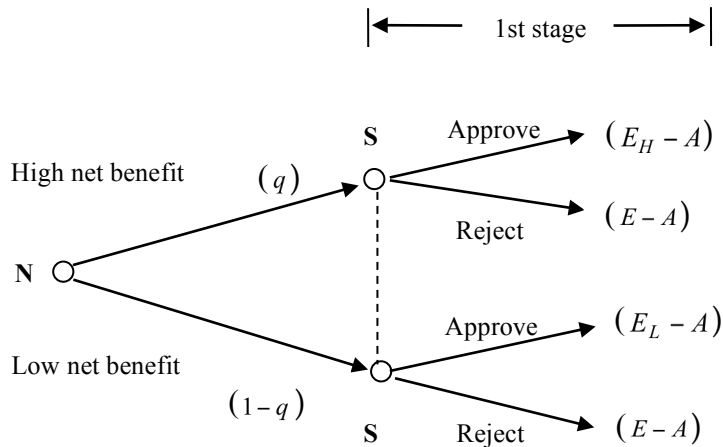
project. E_k is the net benefit of the project nationwide, where $k = L, H$. L stands for low net benefit and H stands for high net benefit. E is the net benefit if the state invests in another project with the same budget. A is the cost of evaluating the project. We assume $E_H > E > E_L > A$.

Figure 5 shows the decision trees for the state *without external review* under a centralized political system.

The expected payoff for the state following approval of the project is $EB(\text{Prove}) = q(E_H - A) + (1 - q)(E_L - A)$. The expected payoff for the state following rejection equals $EB(\text{Reject}) = E - A$. As long as $(E - E_L)/(E_H - E_L) \leq q \leq 1$, $EB(\text{Prove}) \geq EB(\text{Reject})$. If $0 \leq q < (E - E_L)/(E_H - E_L)$, $EB(\text{Prove}) < EB(\text{Reject})$.

Proposition 4: Without external review, the state will approve the project only if it believes there is a high probability of the project having high net benefit, i.e., $(E - E_L)/(E_H - E_L) \leq q \leq 1$. Otherwise, it will reject the project.

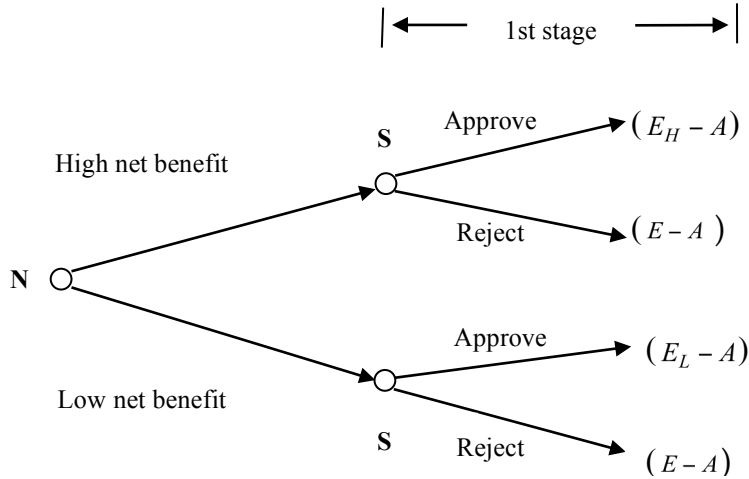
Figure 5: The decision trees for the state (S) without external review under a centralized political system (the payoffs of the state are shown in parenthesis); and the dashed represents one information set for the two strategies of regional government).



With external review

After introducing external expertise, the state will obtain more information about whether the project net benefit will be H or L . Figure 6 shows the decision tree for the state when external expertise is used.

Figure 6: The decision trees for the state (S) with external review under a centralized political system (the payoffs of the state are shown in parentheses).



Because $E_H - A > E - A$ and $E_L - A < E - A$ when the state can use external expertise to correctly identify the net benefit of the project, the state will approve the project if it has high net benefit and reject the project if the net benefit is low.

Proposition 5: With external review, the state will have more information with which to evaluate the project's net benefit. The state will approve the project if the project's net benefit is high and reject the project if the net benefit is low.

In reality, of course, pre-project cost and benefit estimation may not be 100% correct even with external review. Factors like forecasting errors, uncertainty, cognitive bias of people and cautious attitudes towards risk may persist after review (Cantarelli et al., 2010). Therefore, our model is a simplification of reality.

Discussion and conclusion

Project appraisal plays an important role in choosing the right project and the success of public investment projects. Different factors may affect the choice of appraisal process in different countries. Only a few studies in the project appraisal literature have compared the project appraisal process between countries. The present article aims to answer the following two questions: Why do countries adopt different public investment appraisal processes, for example a top-down versus a bottom-up process? Why do different countries share similar features of the public investment appraisal process, such as external review? For our study, China was chosen as an example of a country with a top-down project appraisal process, whereas Norway was chosen as an example with a bottom-up project appraisal process.

By using simple game-theoretical models, we show that the political system and the social norms in a country play important roles in determining what project appraisal process is selected. In a democratic political system with regional governments and other stakeholders accustomed to being heard, and in a society advocating individualism, a bottom-up project appraisal process will be preferred. In a centralized political system and a society with a tradition of not challenging superiors, a top-down project appraisal process will be chosen.

An external review mechanism can be optimal in both a top-down project appraisal process and a bottom-up project appraisal process. With the bottom-up process, such a scheme reduces the incidences of strategic cost underestimation from regional actors during project appraisal by reducing information asymmetry between the regional government and the state. With a top-down process, it brings increased competence into the process and leads to a high-quality project appraisal, so that the state can be sure to approve good projects and reject bad ones.

Our findings are consistent with those of Laursen and Myers (2009) and Dabla-Norris et al., (2011), who found that appraisal processes, project selection, and the extent to which politicians involve the public investment management processes vary between individual countries. Similar to the OGC system in the UK mentioned by Klakegg et al., (2009), the external review scheme in China plays a supportive role in project evaluation. By contrast, external review in Norway has a more powerful position in quality control and plays an important role in final project selection. Thus, empirical study of our theoretical model would be desirable in future research.

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Notes

- ¹ Exceptions apply to some sectors, such as oil and gas investments, hospitals and airports.
- ² If the problem is low capacity in a road system, the choice of concept could be, for example to build a bigger road, to increase the number of buses, or to introduce a tax for using the road. In many cases, the conclusion is that there is no need for an expensive infrastructure investment project.
- ³ Smaller public investments with government funding in the form of direct government investment and capital injection need to be approved only by the regional development commissions, i.e., they do not need approval from the State Council.
- ⁴ Regional government leaders do compete with each other by investing more in their own region as their promotions are directly correlated with the GDP growth of their region (Li and Zhou, 2005; Zhou, 2010). Such competition is different from the strategic overestimation of project benefits at pre-project evaluation for state invested projects. And the strategic overestimation of project benefits may be a signal for bad performance of regional government leaders and have negative impact on their promotions.
- ⁵ The model only focuses on when a new project appraisal process is introduced. No payoffs from the current situation are considered. Therefore, payoffs for the regional government when it rejects the proposal from the state will be zero. The assumption is made for the sake of simplicity.
- ⁶ A strategy profile is Nash equilibrium if and only if each player's prescribed strategy is a best response to the strategies of the others. (p83, Watson, 2002)

Appendix 1: Norwegian national guidance for different impact assessment

Norwegian national guidance for different impact assessment for both internal and external review should follow:

- *Instructions for Official Studies and Reports*
- *Assessment of the Consequences of Gender Equality*
(www.regjeringen.no/nb/dep/bld/dok/veiledninger_brosjyrer/2001/utredning-av-konsekvenser-for-likestilli.html?id=87759)
- *Norwegian guidelines for Cost-benefit Analysis*
(www.regjeringen.no/nb/dep/bld/dok/veiledninger_brosjyrer/2001/utredning-av-konsekvenser-for-likestilli.html?id=87759).
- *The Planning and Building Act* for environmental and social consequences impact assessments
- *The Planning and Building Act of 2008*
(www.regjeringen.no/en/doc/laws/Acts/planning-building-act.html?id=570450)