

Analyzing the Role of National PPP Units in Promoting PPPs: Using New Institutional Economics and a Case Study

H. Ping Tserng¹; Jeffrey S. Russell²; Ching-Wen Hsu³; and Chieh Lin⁴

Abstract: The global expansion of public-private partnerships (PPPs) has generated interest in establishing national PPP units for implementing or analyzing PPPs. Despite the good intentions for establishing such units, results have been mixed. Unless its role is clarified, a national PPP unit cannot be successful because it lacks adequate authority to respond appropriately to the changing environment. However, relevant research in construction journals is too limited to provide policymakers with constructive suggestions. This study aims to improve this situation by aligning a theoretical model with empirical data. The PPP activities can be analyzed as a game between the host government and private promoters trying to maximize their respective payoffs; thus, in accordance with new institutional economics (NIE) theory, a national PPP unit can be considered an endogenous equilibrium outcome of a game. On the basis of this perspective, three game (four consensus) theoretical models are constructed to find equilibriums: a single game for a single authority, repeated games for a single authority, and repeated games for government with multiple subordinate authorities. This study also uses a case study to present the history of PPPs in Taiwan and the evolutionary role of the National PPP Taskforce, Taiwan. National and international data confirm the theoretical model, which indicates that the common role of a national PPP unit is as a trust-creator between the public and private sectors. This pilot study contributes to the theoretical foundation that policymakers need to accelerate the learning process for implementing a PPP. It also provides researchers in the construction field with an NIE methodology for analyzing other governance structures in the construction field. **DOI: 10.1061/(ASCE)CO.1943-7862.0000398.** © 2012 American Society of Civil Engineers.

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Introduction

Use of public-private partnerships PPPs has become a global trend for providing public services in recent years. According to the Private Participation in Infrastructure Database (World Bank 2009), 137 developing countries are eagerly inviting private participation in infrastructure projects. The trend is also evident in developed countries such as the United States, the United Kingdom, the European Union, Japan, and Korea. Whether drivers for adopting PPPs are economy-related or efficiency-related (Chan et al. 2009), the common challenge is establishing the institutional framework needed for a successful PPP.

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Problem Statement

A recent trend in many countries is establishing PPP units, (i.e., units tasked with implementing or advising on PPPs). At least 25 state and national governments have established PPP units during the past decade (Farrugia et al. 2008). Public-Private Infrastructure Advisory Facility (PPIAF 2007) stated that, in just the past year, Albania, Egypt, Malawi, Mozambique (Maputo), Nigeria, Tanzania, and Turkey have established PPP units. Because such units are a common feature of countries that have successfully promoted PPPs, they seem an important measure of the institutional environment associated with PPPs.

A review (Dutz et al. 2006) of international practices shows that most PPP units inform and guide government departments. Many also provide advisory support and funding. Finally, some have roles in approving PPP projects developed by line agencies. Dutz et al. (2006) proposed a method for optimizing the location of such units and for managing conflicts of interest.

However, a qualitative study of eight PPP units around the world by PPIAF (2007) concluded that PPP units are not a cure-all. The PPIAF suggested that governments should design the function of the unit according to the specific mission, which is preventing government failures in promoting PPPs. Farrugia et al. (2008) similarly concluded that global best practices for PPP agencies have not been established and provided 13 questions for public officials contemplating the development of a new PPP agency. A successful agency must be tailored to the structure, practices, and objectives of the host government.

The authors argue that the essential question that must be answered first is the common role of national PPP units in

successfully promoting PPPs. In line with the global increase in PPPs, the number of PPP-related publications in construction journals has increased from 2.94% in 1998 to 5.18% in 2008 (Ke et al. 2009). However, few have addressed the role of PPP units. Mahalingam (2010) argued that to maximize the effectiveness of PPPs in delivering urban infrastructure services, the roles of coordination agencies and regulators must be clarified.

Another issue is the methodology used in previous studies of PPP units. Such studies tend to rely on empirical methods, especially expert interviews and reviews of public documents. Although previous studies show policymakers “how” to develop PPP units, they cannot explain “why” they should do so because of their lack of theoretical support. Properly bridging the theoretical gap would provide policymakers with comprehensive knowledge and the capability to apply the findings and suggestions in the literature to specific contexts in their own countries.

Research Objective and Research Approach

The objective of this paper is to apply a rigorous analytical technique for identifying the role of a national PPP unit in promoting PPPs. The theoretical approach of new institutional economics (NIE) is used by constructing game theory models and by testing them with data reported in other countries and data obtained from a case study of the evolutionary role of the National PPP Taskforce in Taiwan.

Definitions

1. National PPP Unit: This is a national level unit, as opposed to a unit within a single department or a local government. National PPP units are usually responsible for national policy making and sometimes advise on provisions for individual projects, whereas departments/local governments are generally responsible for PPP project delivery. The best example is Treasury PPP Taskforce/ Partnerships UK in the United Kingdom (Farrugia et al. 2008). Other examples are PFI Promotion Office in Japan, the National PPP Taskforce in Taiwan, and the Public and Private Infrastructure Investment Management Center in Korea.
2. Government/Authority: The government and authority responsible for delivering individual PPP projects are not interchangeable terms in this discussion. Government refers to a set of authorities, including departments and local governments. For example, the Taiwan government consists of 39 departments and 25 local governments. Because government represents a collection of authorities, each of which is a self-interested administrative organ, these two words must be distinguished when discussing the role of a national PPP unit founded by government.

Theoretical Tools

New Institutional Economics

The emerging consensus of the NIE pathfinders, including Ronald H. Coase, Douglass C. North and Oliver E. Williamson, is that “institutions matter” when analyzing economic performance over time and space. Their research focus was the underlying causes of the emergence of new institutions, the evolution of existing institutions, and the correlation between institutions, and economic performance. Frequently cited NIE concepts in other scientific fields include transaction costs, asymmetric information, monitoring costs, enforcement mechanism, asset specificity, opportunism, moral hazard, organizational arrangements, and

governance structure (Williamson 1985; Eggertsson 1996; Allston 1996; Williamson 1996; Dixit 1996; Aoki 2001).

The NIE view of the “effect” of institutional change is that institutions provide incentives to change relative prices and preferences, which may mitigate transaction costs and improve economic performance (North 1990). In an efficient market, the contribution of proper institutions enables the exchange of production factors and information at a relatively low price. However, transaction costs increase when poor institutions, such as those in an imperfect market, encourage hidden barriers to free trade.

Regarding the “causes” of institutional change, a view of institutional disequilibrium is proposed. North (1990) defined institutional equilibrium as a situation in which, given the bargaining strength of the players and the set of contractual bargains that make up the total economic exchange, no players find it advantageous to expend resources on restructuring the agreements. In a disequilibrium situation, however, the benefits of altering existing institutions relative to the costs make it worthwhile to do so. Therefore, the demanders, which may be constituent or contractual counterparties, have incentives to lobby suppliers, such as the government or other stakeholders. Therefore, as Alston (1996) suggested, institutional change can be considered a result of supply and demand forces in a society. Aoki (2008) similarly argued that, in a game that is played repeatedly, parameters such as mental states, skill levels, and technologies gradually change. Therefore, a substantial equilibrium shift can cause a qualitative change in equilibrium.

New Institutional Economics with Game Theory

Applications of game theory in the construction field, although limited scope, confirm its value as a systematic conceptual and analytical framework. Ho (2006) modeled financial renegotiation and discussed its policy implications from a game theory perspective.

For NIE scholars, game theory is an important theoretical tool because it outperforms NIE in defining institutions and enhancing the quality of evidence used to test the proposed model.

Regarding the first advantage, Aoki (2001, 2008) defined institutions as an endogenous equilibrium outcome of game theory. In this sense, certain rules of the game may be considered self-enforcing and may thus become institutionalized only if all the players, including the enforcer of the rules, consider deviation from the rules is unbeneficial. Because these rules are endogenously created through the strategic interactions of agents, they are held in the minds of agents and thus become institutions. In other words, an institution is a Nash equilibrium. According to Gibbons (1992), “Nash equilibrium is a unique prediction about the strategy each player will choose to a game-theoretical problem. In order for this prediction to be correct, it is necessary that each player be willing to choose the strategy predicted by the theory. Thus, each player’s predicted strategy must be that player’s best response to the predicted strategies of the other players. Such a prediction could be called strategically stable or self-enforcing, because no single player wants to deviate from his or her predicted strategies. We will call such a prediction a Nash equilibrium.”

The second advantage of game theory to NIE is enhancing the quality of the validation process. To provide evidence consistent with their hypotheses, most studies have relied on the qualitative historical record in case studies because institutions are historically specific and sensitive to the historical context. Thus, because the unique circumstances of institutional change often limit the number of data points, quantitative measures such as conventional statistical analysis are rarely possible (Alston 1996). In this sense, because conventional NIE methodologies tend to be empirical and descriptive, a common criticism is their lack of scientific rigor. The advantage of introducing a game-theoretical approach to

institutions, as noted by Aoki (2008), is the intuitively appealing and plausible notion that institutional interdependencies, coherence, and robustness are considered analytically tractable rather than ad hoc presumptions.

For example, on the basis of historical evidence revealed by a repeated-game model, Greif et al. (1994) concluded that merchant guilds that emerged during the late medieval period allowed rulers of trade centers to commit to providing security for alien merchants. A similar methodology was adopted by Weingast (1995). Combining case study and the game-theoretical perspective has enhanced NIE research methods by making them complementary.

Analysis of National PPP Units Using National Institutional Economics

The first reason for using NIE to address the role of a national PPP unit in this study was to introduce NIE in the construction field. Use of NIE to test correlations between institutions and economic performance has been successful in different scientific fields; applications in the construction field (Chang and Iwe 2002; Lee et al. 2009), however, have been limited.

Secondly, NIE with game theory provides a useful research framework in this study. The PPP activities are treated as a game between the host government and private promoters attempting to maximize their payoffs; as proposed by Aoki (2001, 2008), a national PPP unit can be considered an equilibrium outcome of the game in accordance with NIE theory. Thus, the role of a national PPP unit should be responding appropriately to the conditions of the equilibrium point.

The government has the most power to change PPP institutions. As Eggertsson (1996) stated, economies of scale make the state relatively efficient in both lowering the cost of contracts and disrupting contracts. Regarding PPP, government also has a positive incentive to regulate its behavior because of the role of its subordinate authority, which is the counterparty in PPP contracts. By acting as both regulator and repeat player, these investments in creating a favorable institutional environment are directly compensated by the accumulated savings in the transaction costs of each PPP project. The government's dual roles as institutional supplier and demander increases the pace of institutional change as observed in the rapid evolution of responsibilities of the National PPP Taskforce in Taiwan over the past 15 years in response to its changing needs (see the subsequent discussion). Interested readers can refer to Dutz et al. (2006) for a discussion of government conflicts of interest when acting as both regulator and repeat player.

Theoretical Model

Given the arguments made in previously, this paper presents a national PPP unit game model with three subgames (four consensus) to explore the role of a national PPP unit in finding the equilibriums of the proposed three subgames (four consensus). The proposed model is inspired by the works of Greif et al. (1994) and Weingast (1995) mentioned in previously. Their models and equations are reconstructed in line with the PPP features to introduce NIE, which was originally applied in the social sciences, in the construction field. The theoretical model in this pilot study is intentionally simplified. All players are assumedly rational and self-interested in seeking to maximize their payoffs. Other assumptions are

- The players act sequentially instead of simultaneously.
- In addition to the payoff matrix, the track record of trust for each authority is "common knowledge" to all players. Because the costs ascribed to media liberalization and development of an information technology infrastructure are relatively low, this

assumption is realistic. The track record of trust includes pre- and postcontract stages. The precontract trust ensures that the authority considers affordability and conducts feasibility studies before making promises. The postcontract trust refers to the confidence in the authority honoring its partnership commitments not only in the contract, but also in the event of unexpected and unpleasant conditions (e.g., political impact, revenue shortage, and fierce opposition from end-user), regardless of costs.

- Each private company is homogenous and is therefore treated equally and without discrimination by the authority/government. Although this assumption is not entirely realistic, it is justified by providing the simplification needed for the current modeling effort.
- In each analytical interval, (e.g., 1 year), the number of private companies who enter into PPP arrangements is n .
- Each authority has the following business technology:
 - $V(n)$ is the expected gross value of signed PPP projects during that analytical period. Because the authority shall never release a negative value PPP project into the market, V is nonnegative and differentiable, i.e. $[V(0) = 0]$.
 - n^* is the efficient number of private companies at which V achieves a maximum at some unique value $n \equiv n^*$; hence, $V'(n^*) = 0$.
 - The cost to authority (AC) is the cost per unit of expected gross value incurred by the authority to honor its partnership commitments ($AC > 0$).
 - The income of authority (AI) is the income per unit of expected gross value earned by the authority ($AI > 0$), such as royalties, rental income, tax, and quasi-rent from value for money assessment.
 - The company cost (CC) is the cost per unit of expected gross value incurred by the private company to win and deliver contracts ($CC > 0$), including tendering costs, construction costs, and operation costs. However, the model excludes payment to the authority to avoid double counting.

In practice, AC, AI, and CC should be evaluated on a case-by-case basis. However, the averaging method is justifiable because of its simplicity. To determine the governance structure between government/authority and private companies, three games (four consensus) are designed.

Game 1: Single Game for Single Authority

This game has two players, one authority and one private company. In the analytical interval, the expected gross value of this signed PPP project is $V(1)$. The expected net value is $V(1)(1 - AC - CC)$. Because the project is assumed profitable to both the public and private sectors, $AI - AC > 0$ and $1 - AI - CC > 0$

Proposition. The game terminates. No private company is willing to participate in this PPP project.

Proof. Fig. 1 shows the extensive form of payoffs. At the first decision point, the private company must decide whether to trust (enter) or not trust (not enter) the authority, and the authority must decide whether to betray or honor its commitment. The authority prefers betray when the private company chooses enter because of opportunism [i.e., the payoff of betray $AI \times V(1)$ outweighs the payoff of honor $(AI - AC)V(1)$].

However, assuming information is complete, the payoff matrix is also known by the private company. Because, as noted previously, the commitment by the authority is not credible, the payoff to a private company choosing to enter is $-(AI + CC)V(1)$, not $(1 - AI - CC)V(1)$. In conclusion, the private company rejects the enter strategy. The game then terminates, leaving both players with zero payoff (QED)

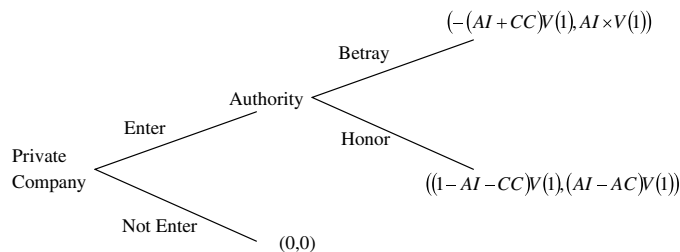


Fig. 1. The extensive form of Game 1

The win-win strategy (enter, honor) used in Game 1 results in an institutional demand for both parties to solve the authority commitment problem. The three questions that arise and their appropriate responses are

1. Is $V(1)$ a constant value as assumed? In an actual long-term (i.e., 20 to 30 years) contract, the gross expected value of a PPP project should be a function of time if the authority betrays its commitment, $V(1, t)$. Nevertheless, the authority is expected to eventually refuse to perform its obligation. The authority betrays when the total cost of honoring the current and future commitments exceeds the future benefit [i.e., when $\partial V(1, t)/\partial t = 0$].
2. Will the private company betray in the postcontract stage, instead of the authority as assumed? The tendency of the private company to betray because of information asymmetry is a recognized problem that can hold up the authority (Chang and Iye 2002; Ho 2006). However, this study argues that the authority is not only the counterparty in a PPP project but is a political organ with administrative powers, such as tax inspection, fire safety inspection, and permission of land development and construction, which can be exercised in future transactions with the private company. Ultimately, the authority can also threaten to expropriate the PPP project (Wells and Gleason 1995). Given these administrative powers and potential for abuse of rights, the private company is likely to be concerned about the future actions of the authority.
3. Can other enforcement mechanisms force the authority to honor its commitment? The private company can theoretically protect its rights in the event of default by the authority via third-party enforcement mechanisms, such as court or arbitration institutions. However, the transaction costs of using dispute resolution mechanisms, such as costs of collecting evidence, and costs of delay, are often too high to protect the rights of the private company reliably. Moreover, the long and complex nature of PPP projects increases the likelihood of an unforeseen event not governed by the original contract. The government can attempt to maximize its own profits by opportunistically exploiting unforeseen events in which the private company has difficulty claiming that the authority is at fault. Another issue is the independence of the judiciary system. The private company may prefer not to rely solely on the enforcement mechanisms of the court/arbitration institution.

Essentially, the private company is unlikely to enter into a PPP arrangement if the counterparty authority implements only one or a few PPP projects. The private company is likely to prefer investing in other business opportunities rather than in PPP projects to avoid the inevitable situation in which the authority is reluctant to fulfill its partnership commitment.

Game 2: Repeated Games for Single Authority

This game assumes that the authority has implemented many PPP projects. Discount factor δ accounts for the time value of money

when calculating periodic payoffs. Assuming information is complete, private companies are aware of how the authority has treated other private companies. Owing to rationality, the strategy observed by each private company is to avoid contracting with an authority that has a poor record. Therefore, a joint exit punishment consensus is formed automatically and without coordination if the authority betrays any private company.

Proposition. Assuming the profit for the private company is reasonable, $[1 - AI - CC > 0]$ and $AC \leq \gamma(AI - AC)$, in which $\gamma = \delta/(1 - \delta)$ a Markov perfect equilibrium forms the following strategy profiles: The authority fulfills its commitments in all PPP projects unless private companies exit PPP markets; after a joint exit occurs, it cheats all private companies. Private companies join PPP projects in a given period if and only if none has been cheated by that authority.

Proof. A Markov perfect equilibrium is a Nash equilibrium of the game with the properties that, given the equilibrium strategies of the other players, (1) the players' strategies at any date depend only on whether a boycott has been announced, and (2) each player's strategy at each date maximizes his or her payoff from that date onward. (Greif et al. 1994).

The formal proof for the proposition is directly verifiable. The authority in question honors its commitments only if the cost of betraying the PPP projects in the current period is lower than the present value of the total rent it receives from each future PPP project over time. That is,

$$AI \times V(n_0) \leq \sum_{t=0}^{\infty} \delta^t (AI - AC)V(n_t) \quad (1)$$

Owing to self-interest, the objective of authority is optimizing the number of private companies to maximize V (i.e., $n_t \equiv n^*$).

Substituting n^* into Eq. (1) gives

$$AI \times V(n^*) \leq (AI - AC)V(n^*) + \gamma(AI - AC)V(n^*) \quad (2)$$

The outcome of Games 1 and 2 should be clear to readers familiar with trust theory. Whether the authority honors its commitments in each PPP contract is determined by average rent rather than by marginal rent.

The issue of leak of joint exit punishment may also arise. Truly, the threat of leaks may be insufficient to ensure honest behavior and to deter the authority from violating its commitments. In some cases, such as a mutually profitable bilateral agreement in an imperfect competition market, the authority may cooperate with private companies and therefore break the equilibrium as proposed. However, this results in failure of the proposed objective of maintaining an efficient level of private companies, and in the requirement of another enforcement mechanism, such as corrupt contracting (Lambsdorff et al. 2005), to prevent the authority from abusing the rights of the breakers. Thus, it is not considered in this study.

Limitation. Although the strategies described in the proposition for Game 2 may achieve equilibrium, the required conditions seem implausible. Equilibrium requires repeated games in which the "number" of PPP transactions is sufficient for a single authority to support honest behavior. Each year, the authority may make numerous conventional government procurement tender offers. Conversely, for PPP tenders, this requirement is unrealistic given the complexity and large scale of PPP projects. Of the 39 departments of the Taiwan government, only the Ministry of Transportation and Communications implements an average of 10 or more PPP projects annually. Most departments and local governments

implement only one or two PPP projects annually. Unlike conventional government procurement methods, which are consistent with the repeated-games assumption, Game 3 shows that a single authority can rarely create the institutional demand to meet the repeated-games requirement in PPPs.

Game 3: Repeated Games for Government

A scenario with multiple authorities and many private companies is more realistic compared with the preceding scenario. Administration systems are hierarchical. The administrative units are departments at the central government level, municipal governments at the municipal level, and county governments at the county level. In the view of each authority level, because a Authorities retain responsibility for PPP project delivery, some may rarely implement PPP as seen in Game 2, but most resemble those observed in Game 1. However, owing to economies of scale, the assumptions of “repeated games” when optimizing the number of private companies ($n_t \equiv n^*$) are much more easily achieved by the overall government than by a single authority.

Two submodels are constructed to explore the equilibrium on the basis of the consensus of private companies.

Game 3-1. The common consensus of private companies, as in Games 1 and 2, is to avoid participating in PPP projects initiated by authorities with poor records and to work with those that have good reputations.

Proposition. No Nash equilibrium can support honest government behavior at an efficiency level comparable with that of private companies (i.e., $n \equiv n^*$)

Proof. Assuming such an equilibrium exists, consider the payoff to the government if it deviates from the equilibrium strategy and betrays a fraction ε of the first-period project authorities in Games 1 or 2. In this initial period, the government payoff is $V(n)[AI - AC(1 - \varepsilon)]$. In subsequent periods ($t = 1, 2, 3, \dots$), the informational assumptions of the model imply that “most” ε authorities are affected (in the event that all selected cheating projects are implemented by Game 1 authorities). Thus, at least $1 - \varepsilon$ authorities retain their credibility in each future period, the number of PPP projects implemented by these well-reputed authorities is at least $n(1 - \varepsilon)$, and the present value of the government payoff from treating them honestly is at least $\gamma(AI - AC)V[n(1 - \varepsilon)]$. Therefore, the total government payoff from betraying a fraction ε of projects in the initial period and adhering to the purported equilibrium thereafter is

$$V(n)[AI - AC(1 - \varepsilon)] + \gamma(AI - AC)[V(n(1 - \varepsilon))] \quad (3)$$

If this equilibrium occurs, this expression coincides exactly with the actual payoff when $\varepsilon = 0$ (i.e., when the government adheres to the purported equilibrium). The derivative of Eq. (3) with respect to ε at $\varepsilon = 0$ and $n \equiv n^*$ is

$$AC \times V(n^*) - \gamma(AI - AC)n^* \times V'(n^*) = AC \times V(n^*) > 0 \quad (\because V'(n^*) = 0). \quad (4)$$

This establishes that the government has a profitable deviation; restated, the specified behavior is inconsistent with the Nash equilibrium (QED).

On the basis of the proposition in Game 3-1, the belief shared by private companies is that, at the efficient volume of the PPP market, no mechanism on the basis of only boycotting authorities who cheated can encourage the government to honor its commitments in each PPP project. The reason is that when the number of PPP projects is at the efficient level, the marginal authorities have zero net value to the government. Marginal authorities in Game 1 are

unaffected, because, according to the proposition in Game 1, games terminate when no private company is willing to work with a single-game authorities. However, for marginal authorities in Game 2, the proposition in Game 3-1 motivates the government to instruct them to betray their commitments as the government observed in its own games. By cheating in a few projects implemented by marginal authorities, the government as a whole loses nothing in terms of future income but and avoids an expense in the present period. For private companies, the situation is worse because even the repeated-games authorities are not trustworthy at the efficient volume of the PPP market in Game 3-1. Therefore, as shown subsequently, the common consensus among private companies must evolve over time to overcome the government credibility problem.

Game 3-2. The common consensus of private companies is to boycott all PPP projects of that government if any subordinate authority of the government in question betrays its commitments in any PPP project.

Proposition. Assume the private company has a reasonable profit ($1 - AI - CC > 0$) and $AC \leq \gamma(AI - AC)$, in which $\gamma = \delta/(1 - \delta)$. A Markov perfect equilibrium of this game then reveals the following strategy profiles: The government fulfills its commitments in all PPP projects implemented by any subordinate authority unless private companies exit PPP markets; if a joint exit occurs, it cheats all private companies. Private companies join PPP projects in a given period if and only if none has been cheated by any subordinate authority of that government.

Proof. This proposition is identical to the proposition in Game 2 except that “authority” is replaced by “government.” The proof, which is also similar, is left to interested readers because of limited space.

The authority/government reputation always starts from zero. Because of the uncertainty about future PPP projects when the “first” invitation to tender is announced by a department, a private company may have difficulty categorizing a department to determine the appropriate action in a single game or in repeated-games. Additionally, the progress in achieving an efficient volume in the PPP market is not considered in Game 2 or in Game 3-1. In Game 3-2, the assumption of repeated games and the establishment of a track record in a “positive cycle” can be modeled more realistically because of economies of scale (i.e., the government is a set of many authorities).

Summary

Table 1 summarizes each game equilibrium point and its implication. The data confirm that Games 1, 2, and 3-1 are impractical. Only the equilibrium of Game 3-2 is a possible institution. The ex post opportunism of a single authority triggers the negative cycle in Game 3-2. To pursue its maximum interest in successive periods of a positive cycle in Game 3-2, the government must ensure that all subordinate authorities, even single-game authorities, honor their commitments in all PPP projects. Therefore, the government requires a mechanism for enforcing compliance by individual authorities; restated, a national PPP unit is needed in countries that lack adequate enforcement mechanisms. The role of a national PPP unit created by the government guarantees the trust of its subordinate authorities. The analysis explains why before committing to mutually beneficial arrangements, a powerful government may find it advantageous to help private companies by creating an entity that can exert countervailing power on its subordinate authorities.

Table 1. Summary of Proposed Games

Game	Equilibrium	Implication
Game 1	Terminate	No private company is willing to join the PPP market. An institutional demand for both parties to overcome the authority's commitment problem is created to reach the win-win strategy profile (enter, honor).
Game 2	Markov perfect equilibrium	The authority will choose to honor its commitments only if its rent of betraying current period PPP projects will be less than the present value of its total rent from each future PPP project. Limitation: The requirement of "repeated" games is implausible for a single authority.
Game 3-1	No Nash equilibrium	Private companies realize that, at the efficient volume of PPP market, no mechanism on the basis of only boycotting cheating authorities can support the government's honest behavior in all PPP projects. Thus, the common consensus among private companies must be evolved over time to overcome the government's credibility problem.
Game 3-2	Markov perfect equilibrium	To prevent the opportunism of authorities from destroying the government's long-term benefit from PPP business, a dedicated national PPP unit that has the ability to enforce compliance from the individual authorities is created for those countries without other adequate mechanisms in place. Its role is the guarantor of its subordinate authorities' trust and therefore facilitates the development of the PPP market.

Case Study

Evidence from Studies in Countries Elsewhere

According to "Guidelines for successful public-private-partnerships," published by Directorate-General Regional Policy, European Commission (2003), "Such (National PPP) units and the public sector in general, have a key role to play in creating trust which in turn allows a reduction in risk and therefore cost, but importantly also the development of effective and sustainable partnerships." Brown et al. (2006) and PPIAF (2007) share the same view. The empirical research outcomes in this study are consistent with the theoretical outcome given previously; a national PPP unit creates trust between authorities and private companies. The game-theoretical perspective of NIE reasoning proposed by this study can supplement the theoretical gap in previous studies on the basis of expert rules of thumb.

National PPP Taskforce Taiwan

Taiwan was chosen because of its abundant and valuable experience in promoting PPPs. The results of the case study, which included a detailed literature review of press notices and guidance published by the Taiwan government, in conjunction with face-to-face interviews with high-ranking officials responsible for promoting PPPs, are subsequently provided.

PPP Implementation in Taiwan

Taiwan is a written law country in which formal institutions must be clearly specified by law before implementation. The official kick-off for this study was 1994, which was the year in which the Statute for Transportation PPP was promulgated. Several investment incentives and deregulations were provided to make a clear policy statement to attract private capital. On the basis of the valuable experience obtained in the first major PPP case [Taiwan High Speed Rail Bank of Taiwan Project (THSRP)], the Act for Promotion of Private Participation in Infrastructure Projects (hereafter referred to as Act for PPP) was promulgated in 2000. The Act for PPP expands the number of transportation sectors authorized to use PPP for infrastructure development to 13. Its major role in Taiwan PPP development is guiding implementation by various relevant project parties (Zheng and Tiong 2010).

Regarding the implementation results, one of the largest PPP projects in the world, the THSRP, is currently running on schedule, and the overall contracted figures are comparable with those reported in well-recognized PPP pioneer countries. From 2000

to 2009, more than 700 contracts with a total investment of approximately US\$13.4 billion were signed (THSRP excluded; US\$ NT \$=NT\$ 31.450–31.992 as of June 21, 2010, from Bank of Taiwan). On average, PPP represents 12.7% of the annual infrastructure investment in Taiwan, which is comparable with that reported by countries recognized by PPIAF (2007) as having successfully completed PPP programs (Table 2).

Evolving Role of National PPP Taskforce Taiwan as Indicated by Proposed Game Models

Fig. 2 shows the key measures taken by the Taiwan government and implementation results in terms of number of signed projects. To simplify, Taiwan PPP development can be divided into four stages on the basis of the number of contracts signed annually (a similar trend is apparent when development stages are on the basis of the annual capital amount of signed contracts).

1. 1994 ~ 1999 (Game 1): In the initial stage, neither the application sectors of PPP nor the National PPP Taskforce in Taiwan had been established. In this limited projects and no trust-creator game, the results of the implementation were disappointing, which was generally consistent with the Game 1 model. However, the THSRP contract was signed in Game 1 because the winning consortium hoped to increase the credibility of the authority. First, the winning consortium requested to sign the contract with the Ministry of Transportation and Communications instead of with its subordinate Bureau of High Speed Rail. Second, it publicly announced that the consortium signed the contract only because of their trust in then Premier Hsiao.
2. 2000 ~ 2006 (Positive Cycle of Game 3-2): Taiwan established its National PPP Taskforce in 2000. A series of policy declarations were made, and impetus measures were taken to establish a cooperative environment. The repeated-games condition was also met by expanding the authorized number of PPP infrastructure sectors for transportation to 13 and by developing

Table 2. Summary of Average Annual PPP Contribution to Infrastructure Investment from Literature and This Research

Country	PPP Contribution
United Kingdom	10 ~ 15%
Australia	5 ~ 20% (average 10%)
Korea	5 ~ 14%
Taiwan	12.7%

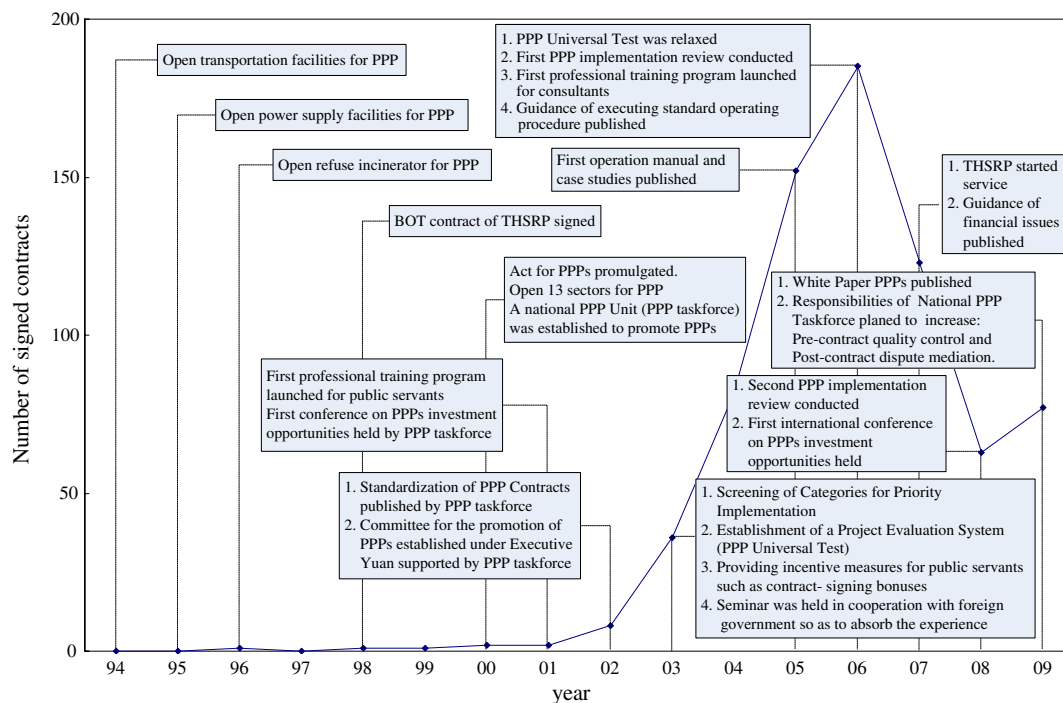


Fig. 2. A brief diagram of the Taiwan PPP regimen

a well-understood pipeline, thereby increasing bidder interest. Both the number of signed projects and the amount of investment increased, which confirmed that private companies were committed to investing as the positive cycle of Game 3-2.

3. 2006 ~ 2008 (Negative Cycle of Game 3-2): Most early pilot PPP projects started services during this period; some severe postcontract disputes had emerged since 2005. Unfortunately, the National PPP Taskforce did not take action because the government led private companies to believe partnerships would happen when they signed contracts. In most disputes, that authorities were reluctant to admit they did not honor their commitments; however, private companies felt betrayed. Therefore, several influential entrepreneurs criticized the government and declared that they would not participate in future PPP projects. The number of signed projects declined sharply. Partly because of the 2008 financial crisis, PPP activities reached their lowest point in 2008 (NT\$ 16.7 billion), which showed the ineffectiveness of the National PPP Taskforce and damaged its reputation. This boycott strategy of the private companies was consistent with the negative cycle of Game 3-2.
4. 2008 ~ (Positive Cycle of Game 3-2): Fortunately, the situation did not deteriorate. A PPP was clearly needed by the Taiwan government rather than simply an option owing to budgetary constraints. For its long-run benefit, the short-sighted opportunistic behavior was addressed to overcome the government credibility problem and to restore the positive cycle of Game 3-2. First, the Taiwan government expanded the responsibilities of the National PPP Taskforce to include pre-contract quality control power to ensure that precontract commitments made by the authority were feasible. The National PPP Taskforce was also given postcontract dispute mediation power to ensure that the precontract commitments made by the authority were honored properly and that relevant disputes were settled efficiently and effectively. These two shifts in responsibility were made by amending the Act for PPP to

demonstrate the government commitment. Second, President Ma provided high-level political support. He announced that one-third of the upcoming 8-year mega infrastructure scheme, the so called i-Taiwan 12 Projects, would be implemented by PPPs. In 2009, the amount of PPP investment returned to NT\$ 53 billion, which approximated the average in 2001–2006. Investment also soared to a record high of NT\$ 224 billion in 2010.

Although it is still too early to conclude that the Taiwan government has restored investor confidence as seen in the positive cycle of Game 3-2, the game results clearly show that the responsibilities of the National PPP Taskforce Taiwan have evolved over time in response to changing needs and that it has become the guarantor of trust by the authorities during the past 15 years. Initially, the government did not recognize this role; instead, its learning-by-doing approach incurred high transaction costs. The experience of Taiwan provides a valuable example for other countries that intend to develop national PPP units and promote PPP business.

Conclusions

Government credibility is the foundation for successful PPP programs. Despite the high cost of putting the slogan of partnerships into action, the reward of maintaining a positive reputation provides a long-term and stable return from these projects over long time periods.

This study treated the national PPP unit as an institution by defining it as an endogenous equilibrium outcome of the game in the view of NIE. From this perspective, the historical evidence from the case study of Taiwan and international evidence from the literature are interpreted in light of the proposed three game (four consensus) models, which indicate that a common role of such a unit is as a trust-creator between authorities and private companies. In countries that do not have other adequate enforcing mechanisms in place, a national PPP unit is in the best interest of the government and is a win-win solution that discourages ex post opportunistic

behaviors by authorities and persuades private companies to participate in PPP projects with the government. Bearing in mind its role, a national PPP unit should be given adequate authority and should act properly in response to the changing environment in each PPP project.

Given the potential use of PPPs for delivering infrastructure projects in other countries, more research efforts, including cross-country information exchange, are needed to accelerate the learning process. Clearly, an efficient institution can minimize the expenditure of resources in terms of time, money, and effort in countries planning to introduce PPP or to improve their current PPP institution.

Lastly, unlike superficial reasoning on the basis of intuition, the game equilibrium view of institutions proposed by NIE and historical evidence convincingly supports the conclusions of this study. Finally, this methodology sheds light on issues of governance structure other than PPPs, including the mediating role of the national PPP unit in reducing the transaction costs of finding potential partners and in aspects of construction financing.

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