PPP Model for Airport Development in China: An Assessment of Risks and Potential Solutions

Jiajun Chu

Nanjing University of Aeronautics and Astronautics, Nanjing, 211100, China

Abstract. Public-Private Partnership (PPP) models are widely popular all over the world. China witnesses an extraordinarily economic growth and has used a great-amount PPP models in transport infrastructure such as express railway, express highway, municipal road and so on. However, PPP models are still immature in airport in China due to its political, economic, and legal environment. Although many researchers have investigated some reasons of this phenomenon, it is still necessary to investigate more because the PPP models have not been applied in airport nowadays. This paper found the huge amount of investment and long period hinder the application of PPP in airport most, according to questionnaires and interviews from public. And we also proposed several potential solutions, such as making multi-stage development strategy, selling real estate development right near the airport and adding more recreation facilities at the airport, which are helpful to promote the utilization of PPP in airport.

Keywords: Public-Private Partnership, China, Airport, Risk, Factor, Potential Solution.

1. Introduction

1.1 PPP in China

With the ever-accelerating development in China, increasing number of public infrastructures has been established here in recent decades. As science and technology updating at an extraordinarily speed, some investment models are explored to adapt ever-changing environment. Public-Private Partnership (PPP) is a mode of cooperation between a public-sector organization and a private-sector enterprise in design, construction, and operations of a pubic infrastructure project, according to Investopedia (2022). In this model, both parties play their own advantages to provide public services, share financial risks and responsibilities, and share benefits. China has invested a great number of projects in transport infrastructure and logistic sectors, especially for express railway, express highway, and municipal road (Li, 2016). According to China Public Private Partnerships Center (2022), there are a total of 10,312 PPP projects have been registered in the Project Management Database of the National PPP Integrated Information Platform by the first half of 2021, and the investment of these projects reach to 16.4 trillion RMB (nearly 2.37 trillion US dollars), which means there do exist such great number of PPP projects in China with huge amount of fund.

1.2 PPP in airports

According to the data from Civil Aviation Administration of China (CAAC), in 2019 a total of 1.35 billion passengers took to the air, which is an increasing by approximately 63 percent from 2014 and shows that the demand of air travel in China is rising at an extraordinarily speed. However, PPP model is rarely utilized in airport even it is so popular in economical market nowadays and there do exist quite risk factors hindering the use of PPP model in airport, for example immature legislation, financial risks, transparency of procurement, etc. These risks impact the appliance of PPP in airport infrastructure projects in China, and it is necessary to search relevant solutions to resolve the problems.

1.3 Contribution and Innovation

This paper will bring lots of contributions and innovation to analyze risk factors and find potential solutions. Firstly, many papers do not focus on PPP in airport, but we concentrate on this topic and consider lots of potential risks around airports. Secondly, researcher used questionnaires and interviews from public as cases to analyze risk index and summarize potential solutions. Thirdly,

there is an enlightenment that we could not only focus on the development of using new models but also emphasize the significance of the risk factors behind the new models.

2. Literature Review

As what have mentioned before, many risk factors are considered as barriers or hurdles for PPP deployment either in China market or some other countries and regions around the world. Nine factors will be introduced and identified how they influence the development of application of PPP projects as follows:

(1) Financial risk: The infrastructure of an airport is not an easy project like building a mall. It is a huge project with several-years plan and construction, and of because it also depends on a great foundation of financial support. Taking Beijing Daxing international airport as an example, its construction spent £8.8 billion which might be a great financial stress even just invest 10 percent of total investment (Kumar, 2022). Likewise, it can be a problem for some governments who have not ability to afford the construction, maintain, operation and management cost. Thus, PPP project in airport may be stopped by the expensive investment.

(2) Payback period: As we all known, private-sector entities are mainly working for profits but not for volunteer, so before investing a project, it is critical for private companies to estimate how long is possible to get the capital back, which is called payback period. As a kind of basic infrastructure, building an airport is destined to be a long payback period project which could be a risk factor for private enterprises.

(3) Incomplete and immature legislation: Complete and mature legislation for PPP project indicates that legal cooperation will be protected by the existing laws and the cooperators do not need to worry about their legal rights are violated. On one hand, complete and mature legislation come out by government can encourage the collaboration between public and private sectors, but on the other hand, there was a case that legal and economic obstacles in US airport industry acted as significant barriers to hinder the privatization of this field (Gupta, 2015). So only enough legislation in airport area can PPP project in airport be applied healthily.

(4) Private sectors' responsibility of safety: Physically and operationally, the air traffic system is consisted of several complex components. Although the instruments in civil aviation field are more and more sophisticated, several accidents happen all over the world due to ATC errors (Arinicheva et al., 2018). So, ensuring the safety of system at a satisfactory level is not as easy as reducing the possibility of accidents in each component and element function. For example, according to a news from BBC, net loss of Malaysia Airlines rose by 59 percent to 443 million ringgit (138 million dollars) in the January-to-March period, making its fifth straight quarter of losses due to the vanishment of MH370. In this case, a private-sector organization could hardly bear losses, let alone private-sector enterprises.

(5) Responsibility of environment protection: Except safety risk, some other externalities factor are necessary to be considered such as noise, air pollution, land-used, water pollution and so on which we call them environment-protecting risk. There is doubt that whether private-sector enterprises are willing to give up more profit for the environment. Fortunately, a study investigated that independent private firms are less likely to pollute and incur EPA penalties than are public firms and increasing oversight may reduce the pollution made by enterprises (Shive & Forster, 2020). There is no doubt that every company pays more attention on environment protecting tasks, so does civil aviation industry. Thus, no matter how concerned about environment-protecting risk in airport is not exaggerated.

(6) Development prospect of airport: As for individual entities, the development prospect of airport is a crucial factor influencing whether they would invest the project, that is because only an airport that has good development prospects is worth to be invested. However, after the outbreak of pandemic, most airports and airlines reached their bottom in a short period. According to Štimac et al. (2021)

airports recorded a decrease of 70-95% in passenger traffic, and many airlines were facing the risk of going bankrupt. So, the development of airport can never be not considered by private companies.

(7) Distribution of leadership and management: Distribution of leadership and management of an airport between public and private sectors indicates who grasp main power and control of the airport. On the other side, optimal distribution of leadership and management also means sharing responsibilities of risk in a good way because risk is allocated to the sector who takes the most management and leadership of the airport (Abd Karim, 2011). As we all known, compared with public-sector organizations, private-sector enterprises have less ability to resist risks, so PPP model should emphasize on how to distribute the leadership and management between partners.

(8) Lack of experience in China: From the investigation of Li (2016), the investment of airport construction in China mainly depends on government, for example, the equity capital of Beijing Daxing International Airport, the total of which is 40 billion RMB, involved a 18 billion RMB investment from the Civil Aviation Development Fund (CADF), 6 billion RMB investment from the Capital Airports Holding Company (CAHC) and some government funds from the National Development and Reform Commission (NDRC) and Ministry of Finance (MOF). Thus, Private sector takes a little part in construction of an airport which means the experience of utilizing the PPP model in airport in China even in the world is not enough.

(9) Transparency of procurement process: In traditional PPP models few private firms are willing to investment such projects while government is more able to carry the risks of pay a number of monies for procurement (Välilä, 2020). What is more, low efficiency, lack of advanced operating and managerial techniques and limited channels to encourage private sector to participate in this process may be a risk factor for collaboration between public and private sectors during a PPP project.

The major objectives of this research are to (1) identify and relatively rank major PPP risk factors for the Chinese aviation industry, and (2) determine effective solutions to enhance the adoption of the PPP model for Chinese airport projects.

3. Methodology

Literature review has prepared us to develop a questionnaire. Researcher set several questions to collect the background of respondents. The first-part questions are concerning occupation and their working or study direction. Then their working experiences would be asked if they have. According to these questions, we will have basic ideas about volunteers' background about this investigation. After that, some questions about PPP projects would appear which are the most significant part during the questionnaire.

Data in this paper was basically collected via a questionnaire about the Public-Private Partnership in airport operation. People who have working experiences in or study for airports and PPP projects are proper to share ideas about this topic. So, the respondents were mainly students and professors from Nanjing University of Aeronautics and Astronautics which enjoys high temperature in civil aviation field. However, the information from public citizens is also meaningful because we can collect various suggestions from different areas. Thus, some people from other fields were invited to participate in this investigation as well.

The volunteers were asked to choose the degree of influence of the following risk factors on the development of PPP model in airports: "Development prospect of airport in future decades", "Incomplete and immature legislation", "Financial risk", "Responsibility of environment protection", "Payback period", "Private sectors' responsibility for safety", "Lack of experience in China", "Transparency of procurement process", "Distribution of leadership and management between government and private sector" and to estimate the reasonableness of the following relevant measures: "learn experiences from other countries or other transport sectors", "establish related laws for different kinds of PPP models", "search innovative ideas by private sectors", "predict airport development trend with more accurate methods". In the end of the questionnaire, two open questions

were set to collect more opinions about risks and solutions concerning promoting utilization of PPP in airport.

After that, this study focused on in-depth interviews with eight representative respondents: two professors of NUAA, two staff members with working experiences in transport field, and four college students in China. They talked about their opinions concerning the application of PPP in airport, ranked the most critical risk factors and proposed some open mind ideas to promote the application of PPP in airport in the future. Finally, separating the sentences into words and graphs to count the frequency of every valid one then ranked their frequency from most to least. Researcher also summarized opinions for the most critical risk factors of using PPP models in Chinese airport from interviewees and used the word cloud technique to indicate the frequency of results. In this technique, the larger the font size is, the more frequently a word is used.

During analyzing the results of interviews, we would give more weight to professors' words and less to students' sentences, because no one can deny that professors must gain more knowledge and information, but students have less working experiences or ideas in this special field.

These results of the questionnaire and the interview might can be used for reference by other developing or developed countries who expect to introduce more PPP models into airport field.

4. Discussion

4.1 Questionnaire

4.1.1 Background

There were 40 questionnaires are successfully returned and reckoned valid. The distribution of respondents can be seen in Figure 1. Four respondents are professors in transport or relevant fields (10%) who have the most say in the topic about PPP in airport. And ten of them are students whose majors are transport or relevant sectors (25%), especially from NUAA, because their compulsory courses may contain some knowledge concerning airlines or airports which is helpful to finish the questionnaire from a special perspective. The largest part is college students from various fields (52.5%), and the answers from these respondents could reflect the role of PPP in public eyes.

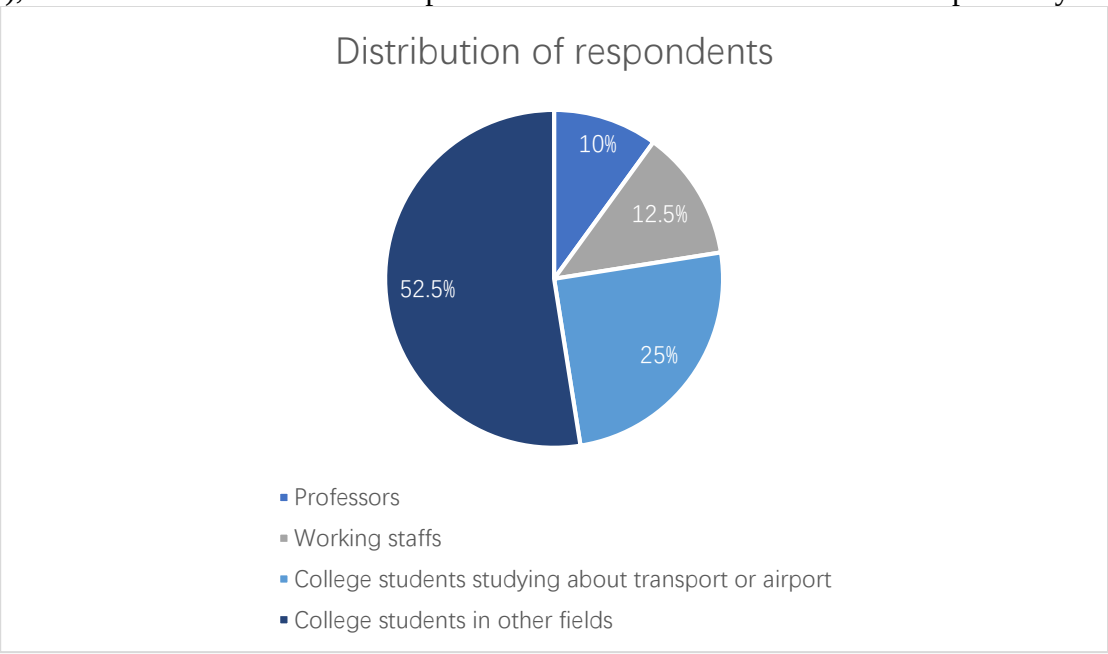

Figure 1. Distribution of respondents

4.1.2 Results

In the questionnaire, every risk factor on the development of PPP model in airports follows five index options (1-5). In these five options, the lager the number is, the higher the impact of the risk

factor on the application of the PPP in airports. Then, researcher will calculate the average influence index of every risk factor to analyze which one is the most critical risk to hinder the utilization of PPP in airport. As we can see in Figure 2, "Pay period", "Financial risk", and "Incomplete and immature legislation" ranked first three of the most critical risk factors in this investigation with index of 3.85, followed by "Private sectors' responsibility for safety" and "Development prospect of airport" whose index is 3.8. On the contrary, "Transparency of procurement process" and "Responsibility of environment protection" are regarded as the least influential factors with index of 3.33 and 3.3 respectively.

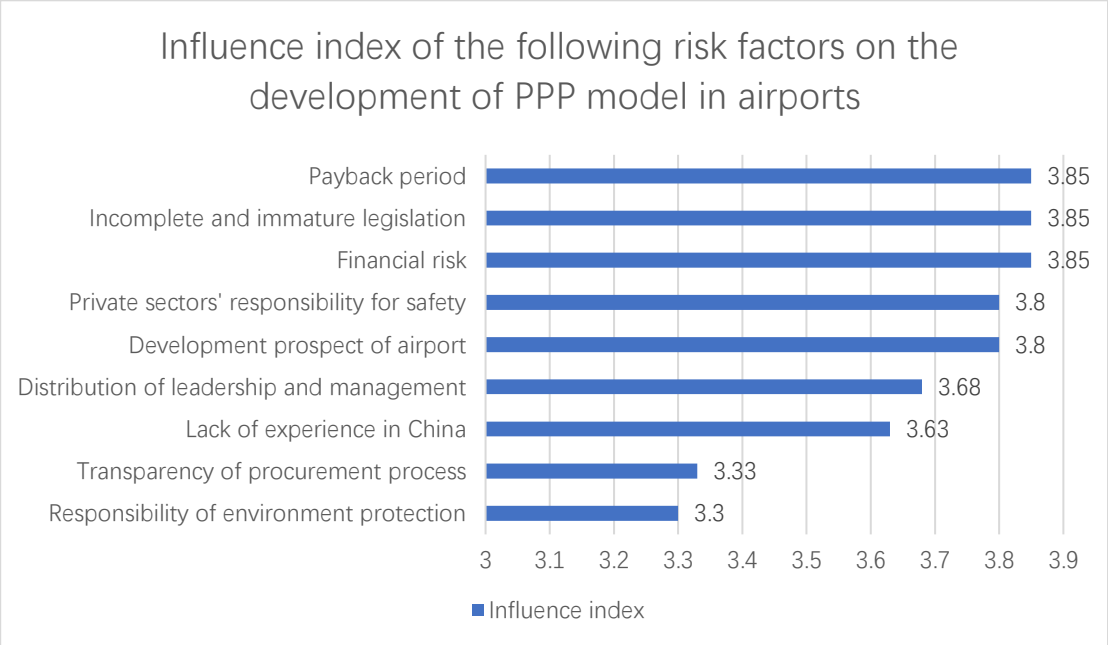

Figure 2. Influence index of the following risk factors on the development of PPP model in airports

After reading some materials an information, it is not difficult to find that the rank of influence of these risk factors can be made sense in some degrees. Initially, Kumar (2022) mentioned that the utilization of Public-Private Partnership generally needs a large financial support especially for airport field. For example, Beijing Daxing International Airport is one of the largest new airports in China with an area of 700,000 square meters and cost involved for its construction was approximately £8.8 billion which means investing a new airport will be a huge financial stress for private-sector entities. A private company who has already joint a PPP project must highly focus on profit and payback period because every private company all expects higher profit and shorter payback pay period so that they can recover costs as soon as possible and strengthen the enterprise. From the economic point of view, lack of investment and long Payback period in airport project may hinder the development of PPP in airport. The results of this paper are mostly as same as the idea mentioned in literature review that financial risks may be one of the most critical factors during these nine factors.

In other perspective, development prospect of airport in recent decades also can be a critical risk factor to be considered. As we all known, at the beginning of 2020, COVID-19 spread all over the world, and this pandemic has hit many fields including civil aviation. Jamieson et al. (2022) stated that there was a negative impact on the market about investment of private-sector entities in the first half of 2020 with a decreasing of 56 percent compared to the same period in 2019. Therefore, it is understandable that people feel unconfident about prospect of civil aviation and related fields which reflects that private companies might be unwilling to invest projects.

Finally, the reason why transparency of procurement process and responsibility of environment protection were ranked the last two risk factors might be that there are enough rules and regulation to constrain both private and public sides to work under a healthy and legal way so that public-sector organizations and private-sector enterprises do not need to worry about these two factors.

4.2 Interview

Many basic information items can be collected by analyzing the public questionnaire. What is more, researcher interviewed some of the respondents for more details about PPP projects in airport. We separated them into three groups. First group includes some college students, second group consists of two staff members with working experiences, and the last one group includes two professors from NUAA.

Before we analyzed the interviews, there is a brief overview (Table 1) of the 11 most frequency words and graphs mentioned during interviews. According to the Table 1, a word cloud about the topic that PPP projects in airport was created as Figure 3. As we can see, except PPP, financial risk, payback period and high investment cost are ranked three most mentioned phrases in the interviews. The details of interviews about the PPP model in airport field are as follows.

Table 1. Frequency index of words and graphs mentioned in interviews

Words or graphs	Frequency index
Payback period	28
PPP	26
High investment cost	26
Financial risk	25
Economic benefit	23
Pandemic	20
Public odder	20
Public-Private partnership	20
Competition in transport	18
Development prospect	15
National policy	10

Figure 3. Word cloud visualization of critical risk factors for public-private partnership projects in airport

4.2.1 Group1: College students

Among four college students without any working experience, two of them are student in NUAA whose major is airport-related, and others are studying in other fields. During nine risk factors that have been mentioned before, they reckoned that development prospect, national policy and competition of other transport influence the application of PPP in airport mainly. According to them, development prospect is a significant factor because non-private-sector entity does not consider the profit of a project, and if development prospect of airport is not such bright it will not have enough reason to attract fund from private sector. Then, national policy can never be ignored. For example, blocking some airport occasionally definitely decreased the revenue during the pandemic period, which means a policy will hinder the development of utilization of PPP model. However, on the

contrary, a policy absolutely can also promote the application of PPP potentially. Additionally, other modes of transportation pose a threat to the civil aviation. Some of them suggested that more and more passengers are more willing to take high-speed rail in their travel. So, these three risk factors are thought influence the PPP's entry into airport. At the end of the interviews, they proposed to increasing recreation facilities or creative project to attracts passengers so that it can increase the revenue of airport and surrounded industries potentially.

4.2.2 Group 2: Staff members

The next group includes two staff members, one is from a technical company whose major is about transport and another is working in an airport in China right now. Their ideas are more suitable for public market. In their opinions, the advantage of public-sector organization is abundant funds while the advantage of private-sector enterprise is more energetic ideas. All of these two parts have their own merits. However, there are also some problems that we need to focus on. Firstly, the aim of private company is always higher profit but not better service. But airport as a communal facility, there is no doubt to say that it needs to take the responsibility of service function. If the airline scheduling is mainly decided by capital but not public demand, the airport will lose this function and flights are in short supply which will disrupt the airline order and even the improper use of airspace. In the other perspective, among nine risk factors, they also thought it is difficult to ensure the transparency of procurement, and if PPP model will be used in the recent future, this problem is necessary to be resolved.

4.2.3 Group 3: Professors

Compared with other respondents, professors of transportation are more qualified to discuss the application of PPP project in airport. A professor without any other working experience out of college stated that it is common to find a concession project in airport especially about duty-free stores and restaurants, but PPP model is still rarely utilized in infrastructure and management project in airport. He said there are two main reasons. One is the construction of the airport is huge and it requires a lot of financial support which might be a great stress for private entities to join a such huge project and most of them cannot take the risk of failure. Another one is low return of capital and long payback period, which means in this period private entities need to reduce their investment in other fields, so it is not a good idea for private-sector investors to choose a project like airport. As for the risk that private-sector entities possess less responsibility of safety, this professor reckoned that it is not a serious question, because any operation of airport must follow the safety standards from relevant documents published by ICAO and government, which are able to protect basic safety of staffs and passengers. The ideas from another professor with working experiences in design institutes and government departments are almost the same as the former professor but he gave more suggestions about how to apply PPP model in airport more effectively.

4.3 Potential solutions

Then, after collecting and analyzing these information from the in-depth interviews, this paper proposed three potential solutions to promote the utilization of PPP model in airport as follows:

(1) Multi-stage development strategy: Ideas from a professor is that at the beginning of the collaboration private enterprises can invest less and hold less shares, after accumulating some experiences and technical support they can gradually increase their proportion in PPP project.

(2) Selling real estate developing right near the airport: It is a good idea for public-sector organizations to provide some favorable preferential policies, such as selling lands near airport to private sector at lower price to cover profit which can help private companies to cover some investment in the beginning of the PPP projects so that they could be more willing to participate in such projects.

(3) Adding more recreation facilities at the airport: College students group proposed to increase more recreation facilities or creative project to attracts passengers so that it can increase the revenue of airport and derive surrounding industries potentially.

5. Conclusions and implications

The public-private partnership models must be a new kind of cooperation model in many fields. It has already used in some projects in highway and express railway, but there do exit some risks to hinder its step into airport field. After analyzing the questionnaires and interviews, we can separated risk factors into 3 groups. The first group is the most critical factors: Payback period, Incomplete and immature legislation, Financial risk. The second group includes factors influencing less on PPP projects in airport: Private sectors' responsibility for safety, Development prospect of airport, Distribution of leadership and management, Lack of experience in China. Other factors are recognized as least influential factors: Transparency of procurement process and Responsibility of environment protection. Professors stated in interviews that due to the particularity of civil aviation, airports naturally possess some special characters which we cannot change in recent years, so some of these risks will still be problems in the recent future.

Even though there are a heap of difficulties, we can still take some measures to promote the application of public-private partnership projects in airport and it need efforts on both private and public sides. Some potential solutions to resolve the phenomena that PPP model develops at a low speed in airport area are proposed: (1) Multi-stage development strategy, (2) Selling real estate developing right near the airport, and (3) Adding more recreation facilities at the airport. These potential solutions are worth to be tried in PPP projects in airport not only in China but also all over the world.

Finally, I totally agree with the solutions that supported by respondents, and I still have some suggestions about promoting the PPP models in airport. For public sectors, it will be better to give private sectors more and more rights and supports in policies which is beneficial to strengthen the collaboration between these two sides. For private sectors, bringing the vitality of private-sector enterprises to the airport is hoped and developing different industries near airport could not only shorten payback cycle but also broaden the market boundaries to near-airport districts.

References

[1] Li Kaimeng (2016). A brief intro to China's PPP Application in Transport and Logistics Sectors. United Nations Economic Commission for Europe.

[2] Kumar, B. R. (2022). Case 9: Beijing Daxing International Airport. In Project Finance (pp. 139-144). Springer, Cham.

[3] Gupta, R. A. J. I. V. (2015). Issues in airport infrastructure development under public private partnership. International Journal of Business Management Intervention (IJBMI), 4(6), 66-77.

[4] Arinicheva, O., Dalinger, Y., Malishevskii, A., Sukhikh, N., & Khoroshavtsev, Y. (2018). Objectification of subjective estimation of abnormal cases danger in air traffic control. Transport Problems, 13.

[5] Shive, S. A., & Forster, M. M. (2020). Corporate governance and pollution externalities of public and private firms. The Review of Financial Studies, 33(3), 1296-1330.

[6] Štimac, I., Pivac, J., Bračić, M., & Drljača, M. (2021). The impact of covid-19 pandemic on the future airport passenger terminals design. International Journal for Traffic and Transport Engineering, 11(1).

[7] Abd Karim, N. A. (2011). Risk allocation in public private partnership (PPP) project: a review on risk factors. International Journal of Sustainable Construction Engineering and Technology, 2(2).

[8] Välilä, T. (2020). An overview of economic theory and evidence of public-private partnerships in the procurement of (transport) infrastructure. Utilities Policy, 62, 100995.

[9] Jamieson, J., Chao, J. J., & Sy, J. T. (2022). Assessing Operational PPP Portfolios.