https://doi.org/10.51408/issi2025_103

Exploring the Policy Impact and Funding Mechanisms of Scientific Collaboration Between Taiwan and New Southbound Policy (NSP) Priority Countries

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Abstract

International scientific collaboration defines the fourth age of research, with policy incentives frequently cited as key motivators for researchers to engage in cross-border collaboration and exchange. However, empirical evidence from non-Western contexts remains limited, and the heterogeneity within international collaboration is often overlooked. To address these empirical and conceptual gaps, this study examines the impact of Taiwan's New Southbound Policy (NSP) on its scientific collaboration with eight designated priority countries over the period 2011–2021. Drawing on bibliographic data from the Web of Science (WoS) Extended API, we analyzed 28,465 co-authored articles. Funding status was identified through funding acknowledgments, and co-authorship types were categorized based on the country affiliations of first and last authors. Our preliminary findings show no strong evidence that the NSP itself contributed to the post-NSP growth of scientific collaboration between Taiwan and NSP priority countries. However, we observe a decline in minimal collaborations and an increase in co-affiliated ones, with the former particularly evident in the number of co-publications funded by Taiwan. Despite the null results, this work contributes to the literature by empirically evaluating the effectiveness of science diplomacy initiatives and pointing to their potential limitations.

Introduction

International scientific collaboration (ISC) defines the fourth age of research (Adams, 2013), with policy incentives often cited as key motivators for researchers to engage in cross-border collaboration and exchange (Katz & Martin, 1997). For instance, in response to grand challenges that transcend national borders and the shifting international order, ISC has also gained traction amid renewed interest in science diplomacy (Royal Society, 2010). However, empirical evidence remains scarce and predominantly in the EU context (e.g., Glänzel et al., 1999; Makkonen & Mitze, 2016). Moreover, the heterogeneity within international collaboration has only recently gained attention, particularly with the rise of multiple institutional affiliations (Hottenrott et al., 2021) and the prevalence of shared heritage collaboration (Gök & Karaulova, 2023) as inferred from author surnames (Karaulova et al., 2019). To address these empirical and conceptual gaps, this study examines scientific collaboration between Taiwan and designated priority countries—

including Indonesia, Malaysia, the Philippines, Thailand, Vietnam, Singapore, India, and Australia—under the New Southbound Policy (NSP), considering variations across co-authorship types.

Launched in 2016 as Taiwan's new "Regional Strategy for Asia", the NSP aims to strengthen ties with Indo-Pacific countries amid shifting global and regional geopolitics (Office of the President Republic of China (Taiwan), 2017). The same year, the National Science Council established the Southbound Science & Technology Cooperation (NSTC) project office to (1) promote regional academic cooperation, (2) promote talent exchange and cultivation, (3) build international collaboration platforms, and (4) connect international science parks. This framework provides a unique opportunity to explore the policy's impact on scientific collaboration in a non-Western context.

Specifically, we pose two research questions: (1) How has the New Southbound Policy (NSP) influenced the volume of co-publications between Taiwan and the NSP priority countries? and (2) What funding mechanisms support international scientific collaboration under the NSP, given that research grants are one of the most common R&D policy instruments (Martin, 2016)? Recognizing the complex dynamics involved in collaboration—which reflect not only S&T capacity but also hierarchies within global science (Miao et al., 2024)—we further examine whether the policy's impact and funding mechanisms vary across types of co-authorship.

Data and Methods

For this study, we draw bibliographic data from the Web of Science (WoS) Extended API to retrieve publications published between 2011 and 2021 and having at least one author affiliated with Taiwan and one with at least one of the NSP priority countries. This timeframe provides a five-year window before and after the launch of the NSP in 2016, allowing us to examine changes in collaboration trends and patterns. After cleaning and processing, the analytic sample consists of 28,465 articles written in English, without missing country affiliations for the first and last author, and authorship order not in alphabetical sequence for four or more authors.

The co-authorship types were determined by the country affiliations of first and last authors into *TWN-led* (either first or last authors are affiliated with Taiwan but not NSP priority countries), *NSP-led* (opposite of TWN-led), *Equal* (either first author is affiliated with TWN and last author with NSP or vice versa), *Minimal* (neither first nor last authors are affiliated with TWN or NSP), and *Co-affiliated* (either first or last authors are affiliated with both TWN and NSP).

Funding status was identified through funding acknowledgements. To determine whether an article was funded by Taiwan, we first used Stanza, a natural language processing (NLP) toolkit developed by the Stanford NLP group (Qi et al., 2020), to identify named entities and their types from the funding text. For this work in progress, we focused on geopolitical entities (GPE), such as countries, cities, or states. We then developed a rule-based system that leveraged our knowledge of various ways Taiwan might be referenced in the funding text (e.g., "R.O.C") and included names of Taiwan's cities sourced from the Simplemaps' World Cities database (Simplemaps, n.d.). Articles having at least one named entity pointing to

Taiwan were classified as Taiwan-funded. Finally, we applied regular expressions to cross-check and maximize the number of identified articles.

We fitted piecewise linear regression models to examine the policy effect and funding mechanisms in terms of both absolute and relative changes. Changes before and after the launch of the NSP was described by two separate slopes. We also included interaction terms between co-authorship type and each slope to assess whether the changes varied by co-authorship type. To test whether the pre- and post-NSP slopes differed significantly, the pre-NSP slope was re-specified as a linear time slope covering the entire period from 2011 to 2021. To facilitate interpretation, the time variable was centered at 2016, and TWN-led was used as the reference category, so the intercept represents the expected number/share of TWN-led co-publications in 2016. Absolute changes in co-publication counts were modeled using a negative binomial distribution to account for skewness. Given the nested structure of the data, which introduces dependence among observations, we employed robust standard errors to account for clustering.

Preliminary Results

Policy Impact

As shown in Table 1, TWN-led co-publication counts (the reference group) increased by 12% annually prior to 2016 ($p < .001$) and by 19% annually after the implementation of NSP in 2016 ($p < .001$) (M1). The 6% difference between the pre- and post-NSP periods, however, is not statistically significant (model not shown). As of 2016, minimal collaboration occurred 1.16 times as frequently as TWN-led ones ($p = .034$), while co-affiliated co-publications were only half as frequent ($p < .001$). Although the pre-NSP growth rates did not differ by co-authorship type, post-NSP, minimal collaboration exhibited a slower growth trajectory, with an additional annual decrease of 5% ($p = .097$) while co-affiliated co-publications grew more rapidly, with an additional 10% annual increase ($p = .047$).

Table 1. Results from piecewise linear models for co-publications and co-publications funded by Taiwan.

	Co-publications		Taiwan-funded co-publications	
	M1 (N)	M2 (%)	M3 (N)	M4 (%)
(Intercept)	453.98***	21.62***	268.44***	59.09***
	(21.57)	(0.93)	(17.87)	(3.29)
Pre-NSP	1.12***	0.02	1.16***	1.77
	(0.02)	(0.30)	(0.03)	(1.07)
Post-NSP	1.19***	-0.23	1.20***	0.88
	(0.03)	(0.32)	(0.04)	(0.92)
Co-authorship				
TWN-led	–	–	–	–
NSP-led	0.95	-1.17	0.31***	-40.13***

	(0.08)	(1.27)	(0.05)	(4.07)
Equal	1.06	1.23	0.69**	-21.23***
	(0.07)	(1.38)	(0.09)	(4.41)
Minimal	1.16*	2.99+	1.03	-7.85+
	(0.08)	(1.49)	(0.10)	(4.17)
Co-affiliated	0.49***	-11.16***	0.36***	-16.16**
	(0.06)	(1.24)	(0.04)	(5.34)
Pre-NSP × Co-authorship				
Pre-NSP × NSP-led	1.01	0.15	1.00	-1.56
	(0.03)	(0.55)	(0.05)	(1.23)
Pre-NSP × Equal	0.98	-0.46	0.97	-1.05
	(0.02)	(0.50)	(0.05)	(1.77)
Pre-NSP × Minimal	1.00	-0.17	0.94	-3.45*
	(0.04)	(0.98)	(0.05)	(1.37)
Pre-NSP × Co-affiliated	1.05	0.37	0.99	-2.91+
	(0.04)	(0.38)	(0.04)	(1.70)
Post-NSP × Co-authorship				
Post-NSP × NSP-led	1.06	1.29**	0.98	-1.85
	(0.04)	(0.44)	(0.05)	(1.11)
Post-NSP × Equal	0.98	-0.48	0.96	-0.68
	(0.03)	(0.42)	(0.04)	(1.20)
Post-NSP × Minimal	0.95+	-1.01+	0.83***	-5.57***
	(0.03)	(0.56)	(0.03)	(1.16)
Post-NSP × Co-affiliated	1.10*	1.33**	1.09*	-0.25
	(0.05)	(0.41)	(0.04)	(2.20)
Num.Obs.	55	55	55	55
R2 / R2 Adj.		0.924 / 0.897		0.944 / 0.924
RMSE	42.82	1.37	22.79	3.54

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Results from modeling percentage changes (M2) largely aligns with the observations above, though the pre-/post-NSP slope changes are not significant, suggesting that the shares of TWN-led co-publications remain relatively stable. In addition to the varying post-NSP growth patterns observed in minimal (-1.01%, $p = .078$) and co-affiliated (1.33%, $p = .002$) co-publications, there also appears to be an additional increase in the share of NSP-led ones, which grew by 1.29% annually more than that of TWN-led ones ($p = .006$).

It should be noted, however, that the changes pertain only to the models with two direct slopes, each compared independently against the intercept. No significant

differences were found between the pre-NSP and post-NSP periods. The predicted trends of co-publications between Taiwan and NSP priority countries, in terms of both absolute counts and relative shares, are shown in Figure 1.

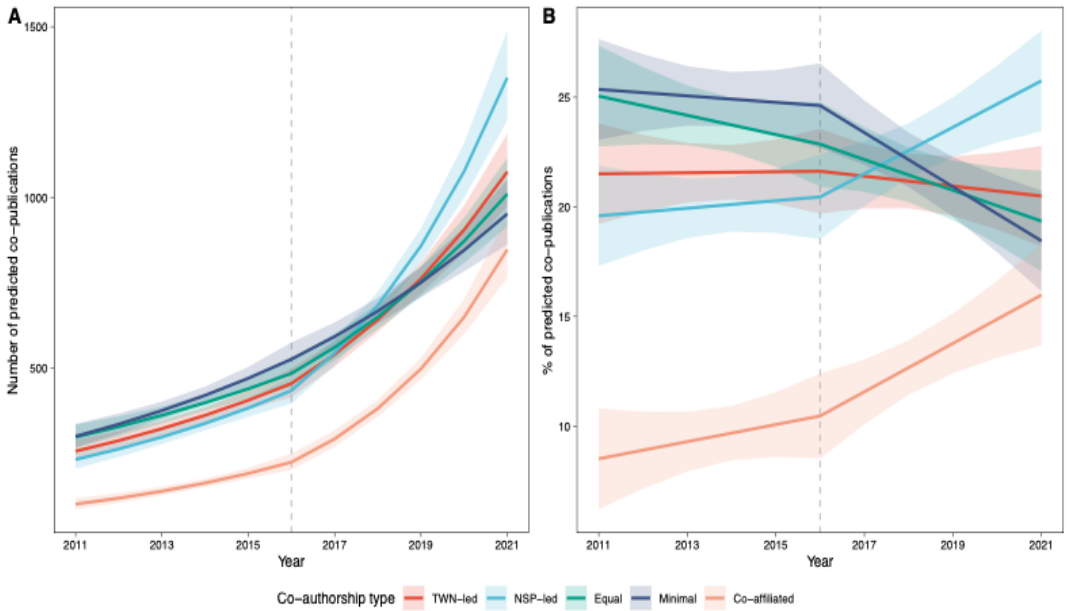

Figure 1. Predicted trends in co-publications between Taiwan and NSP priority countries (2011–2021), by co-authorship type: (A) Absolute changes in counts; (B) Relative changes in shares. The grey dashed line marks the year 2016, when the NSP was launched.

Funding Mechanisms

For TWN-led co-publications funded by Taiwan, the annual growth rates were 16% before and 20% after the NSP launched in 2016 (M3), although the 4% difference is not statistically significant (model not shown). All other co-authorship types, except for minimal collaboration, had significantly fewer papers compared to TWN-led co-publications as of 2016. Similar to M1, differences in growth rates among co-authorship types became more pronounced post-NSP, with minimal collaboration being 17% more slowly ($p < .001$), while co-affiliated publications grew 9% more quickly ($p = .037$). It is worth noting that the pre-/post-NSP difference in minimal collaboration is statistically significant at 0.01 level (IRR = .87, $p = .082$).

When looking at the proportion of TWN-fund co-publications among all funded papers (M4), the share of TWN-led papers funded by Taiwan increased only slightly, by 1.77% annually pre-NSP and 0.88% post-NSP, and neither is statistically significant. In 2016, all other co-authorship types had substantially lower shares: NSP-led, equal, co-affiliated, and minimal collaborations were 40.13% ($p < .001$), 21.23% ($p < .001$), 16.16% ($p = .004$), and 7.85% ($p = .067$) lower, respectively, compared to TWN-led co-publications. Even during the pre-NSP period, the shares of minimal and co-affiliated co-publications saw additional annual declines of 3.45% and 2.91%, respectively. Post-NSP, the share of minimal collaboration dropped by

an additional 5.57% relative to TWN-led co-publications ($p < .001$), while the additional loss for co-affiliated ones was much smaller, at just 0.25%.

The predicted trends of TWN-funded co-publications between Taiwan and NSP priority countries, in terms of both absolute counts and relative shares, are presented in Figure 2. Particularly notable is the flattening of minimal collaboration funded by Taiwan after 2016 accompanied by a sharp decline in its shares. Also noteworthy is the share of TWN-funded co-affiliated publications, which, like minimal collaborations, showed similar downward trend prior to 2016, but experienced growth comparable to that of TWN-led co-publications following the launch of the NSP.

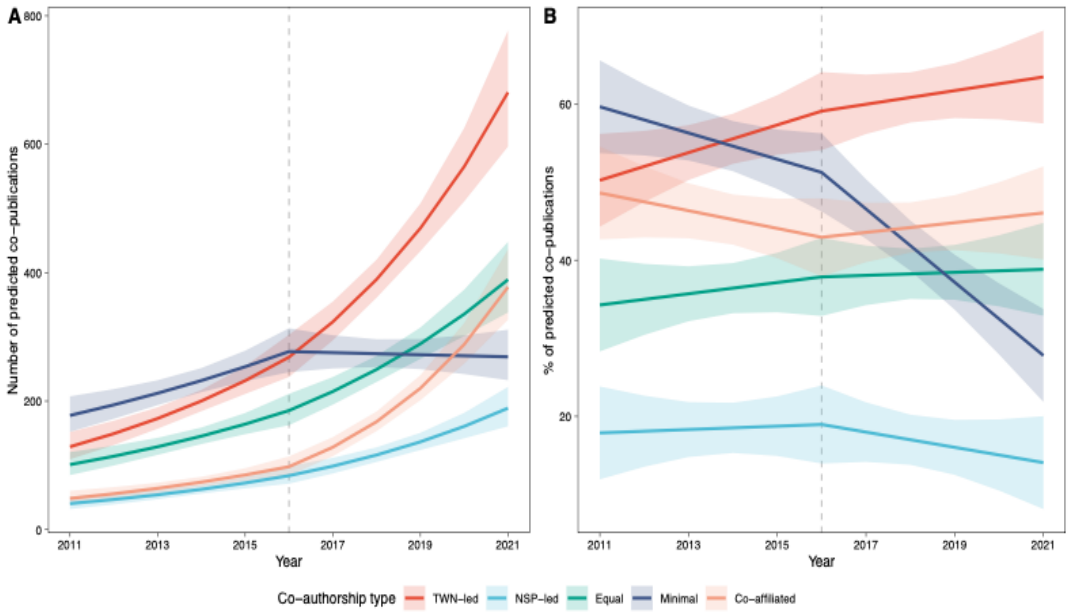

Figure 2. Predicted trends in Taiwan-funded co-publications between Taiwan and NSP priority countries (2011–2021), by co-authorship type: (A) Absolute changes in counts; (B) Relative changes in shares. The grey dashed line marks the year 2016, when the NSP was launched.

Discussion and Tentative Conclusion

Statistically, we found no strong evidence that the NSP itself contributed to the overall growth of scientific collaboration, as measured by co-publications between Taiwan and NSP priority countries. However, we did observe variations across co-authorship types: minimal collaboration and co-affiliated publications displayed distinct post-NSP patterns, with the former declining and the latter increasing. This is especially evident in the number of minimal collaborations funded by Taiwan.

We acknowledge the potential misclassification of Taiwan-based funding using the rule-based approach, which may have introduced bias into the modeling results presented here. In future work, we plan to incorporate metadata for research organizations from Research Organization Registry (ROR), including location (country) and name variants. By leveraging the similarly between embedding

representations of organization names in the WOS and ROR data, we aim to improve the accuracy of identifying the countries affiliated with funding agencies, under the assumption that name variants of an institution will be located near each other in the embedding space.

We also recognize the substantial variation in science and technology (S&T) capacity among NSP priority countries, which span all four levels defined by Wagner et al. (2001) — from scientifically advanced (e.g., Australia and Singapore) to lagging (e.g., Vietnam and Indonesia). In light of this, we aim to investigate country-level variations to gain a more granular understanding of the policy effects and the funding mechanisms driving the NSP initiative in science and technology cooperation.

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