Caught in the Crossfire: Time-Varying Transmission of U.S.-China Uncertainty to Taiwan

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November 27, 2025

Abstract

This research proposal outlines a study to investigate the sources and impacts of economic uncertainty in Taiwan using order-invariant stochastic volatility in mean vector autoregressions (OI-SVMVAR). Building on the methodological framework developed by Davidson, Hou, and Koop (2025), this study addresses critical gaps in understanding how macroeconomic versus financial uncertainty affects Taiwan's small open economy. The research will construct a large-scale dataset of over 40 monthly variables spanning macroeconomic, financial, and global indicators, and employ advanced Bayesian estimation techniques to identify time-varying uncertainty sources. Key innovations include: (1) using a methodologically robust, order-invariant framework that overcomes limitations of small-scale models; (2) distinguishing between domestic macroeconomic and financial uncertainty channels; (3) incorporating US variables and US-China relationship indicators to account for Taiwan's unique geopolitical and economic position; and (4) allowing for time-varying classification of ambiguous variables. The findings will provide crucial policy insights for the Central Bank of China (Taiwan) and contribute to the

broader literature on uncertainty in small open economies.

1 Introduction

Economic uncertainty has emerged as a fundamental driver of business cycles, influencing investment decisions, consumption patterns, and policy effectiveness. While extensive research has examined uncertainty in large, relatively closed economies like the United States, understanding of uncertainty dynamics in small open economies remains limited and potentially biased by methodological constraints.

Taiwan presents a particularly compelling case for investigating economic uncertainty. As a small open economy deeply integrated into global supply chains, heavily dependent on exports (especially to China and the United States), and positioned at the geopolitical crossroads of US-China relations, Taiwan faces multiple sources of uncertainty that may operate through distinct transmission channels. Recent events—including the US-China trade war, global supply chain restructuring, and heightened geopolitical tensions—have amplified the importance of understanding which types of uncertainty matter most for Taiwan's economic stability.

This research proposes to apply the cutting-edge methodological framework developed by Davidson, Hou, and Koop (2025, hereafter DHK) to investigate economic uncertainty in Taiwan. DHK demonstrate that three critical methodological issues plague existing uncertainty research: (1) model size matters—small models with approximately 30 variables produce biased estimates and incorrect conclusions; (2) variable ordering in large VARs creates order-dependence problems that compromise inference; and (3) researcher-imposed classification of variables as "macroeconomic" or "financial" may be inappropriate given that many variables exhibit time-varying characteristics.

The DHK framework addresses all three issues simultaneously through an order-invariant SVMVAR that accommodates large datasets and allows for time-varying, data-driven classification of ambiguous variables. Applying this robust methodology to Taiwan will enable us to answer fundamental policy questions that previous studies, constrained by small models or order-dependent methods, could not credibly address.

1.1 Research Motivation

First, this research exploits a novel application of Davidson, Hou, and Koop (2025)'s methodological framework to address a question they did not examine: through which transmission channels—macroeconomic (real economy) or financial (capital markets)—do external uncertainty shocks impact small open economies? While DHK (2025) investigate which type of uncertainty (macro vs. financial) dominates within the US economy, we leverage their "unclassified variables" feature in an innovative way: by treating all external shock sources (US variables, China variables, global indicators, and US-China relations indices) as unclassified, the model can objectively identify whether these shocks transmit through macroeconomic or financial channels, and how this mechanism evolves over time. Traditional VAR models cannot answer this question without imposing arbitrary block exogeneity restrictions that DHK's order-invariant framework was designed to avoid (Chan, 2020; Davidson et al., 2025). This distinction is fundamental: whereas DHK ask "which uncertainty type affects the US?", we ask "which transmission channel do external shocks use to impact Taiwan?"—a qualitatively different question with direct implications for monetary policy design in small open economies. The methodological innovation lies not in extending DHK's framework, but in repurposing their time-varying classification mechanism to identify external shock transmission pathways rather than domestic uncertainty decomposition.

Second, methodological rigor requires large-scale modeling to avoid omitted variable bias. DHK (2025) demonstrate that models with approximately 30 variables yield substantially different—and incorrect—conclusions compared to models with 43 variables, a finding that echoes earlier work on Bayesian shrinkage in large VARs (Banbura et al., 2010). For Taiwan, a small open economy where domestic fluctuations are predominantly driven by external factors, omitting US, Chinese, and global variables would severely bias estimates. The most rigorous existing Taiwan study, Sin (2015), employs only six variables (four Taiwan variables plus two China variables) in a structural VAR. While pioneering in documenting that Chinese economic policy uncertainty significantly affects Taiwan's output and exchange rate, this small-scale approach likely suffers from

the omitted variable bias that DHK's large-model framework was designed to overcome. Furthermore, empirical evidence from comparable small open economies suggests that "global uncertainty delivers deeper and more long-lasting effects compared to within-country uncertainty," underscoring the necessity of explicitly modeling external shock sources rather than treating them as residual disturbances. The risk of misattribution is particularly acute for Taiwan: without including US Federal Reserve policy, Chinese credit conditions, and bilateral trade policy uncertainty, the model may incorrectly attribute externally-driven volatility to Taiwan's domestic uncertainty factors.

Third, understanding transmission channels is more policy-relevant for small open economies than merely knowing impact magnitudes. Brianti (2025) demonstrates that macroeconomic uncertainty shocks trigger deflationary patterns, allowing central banks to simultaneously stabilize output and inflation through accommodative policy, whereas financial uncertainty shocks may require policymakers to trade off price stability against output stabilization. For the Central Bank of China (Taiwan), knowing whether external shocks (e.g., US Federal Reserve rate hikes, US-China trade tensions) transmit primarily through macroeconomic channels (affecting export demand and industrial production) or financial channels (affecting capital flows, credit spreads, and exchange rates) directly determines the appropriate policy toolkit and response timing. Moreover, this transmission mechanism may shift across different episodes: the 2008 global financial crisis likely featured predominantly financial channel transmission through capital flow reversals and credit market disruptions, while the 2018 US-China trade war plausibly operated through macroeconomic channels via supply chain restructuring and export demand uncertainty. DHK (2025)'s time-varying classification framework is ideally suited to identify these regime-dependent dynamics, which previous Taiwan studies imposing fixed classifications (Sin, 2015) cannot capture. The policy stakes are substantial: if external shocks transmit primarily through financial channels, exchange rate flexibility and macroprudential tools become paramount; if macroeconomic channels dominate, fiscal coordination and structural adjustment policies warrant greater emphasis.

Fourth, Taiwan's simultaneous economic dependence on both the United States and

China creates a unique empirical opportunity to study dual external exposures that cannot be examined in other settings. Existing literature examines US uncertainty spillovers to emerging markets (Carriere-Swallow and Céspedes, 2013) and Chinese uncertainty spillovers to Asia separately, but no study quantitatively decomposes transmission channels for an economy simultaneously and deeply integrated with both major powers. Firm-level evidence shows that Taiwanese companies' revenue and profitability in China declined sharply after 2012, with further deterioration following the 2018 US-China trade war onset, even as Taiwan simultaneously became the US's 7th largest trading partner by 2024. Unlike other emerging markets that can partially reorient toward either the US or China, Taiwan's deep integration with both US technology supply chains and Chinese manufacturing ecosystems makes transmission channel identification particularly salient for policy design. Quantifying whether US Federal Funds Rate shocks transmit through financial channels (capital flow reversals and exchange rate volatility) versus macroeconomic channels (export demand through US recession effects), and whether this differs fundamentally from Chinese Industrial Production shocks or US-China trade policy uncertainty, addresses a critical gap in the small open economy literature. This dual exposure framework provides generalizable insights for other economies navigating great power competition, including South Korea, Singapore, and ASEAN nations facing similar though less intense dual dependencies.

2 Literature Review

2.1 Economic Uncertainty: Measurement and Effects

The modern literature on economic uncertainty can be traced to seminal contributions by Bloom (2009) and Bloom (2014), who demonstrate that uncertainty shocks can generate significant real economic effects through wait-and-see mechanisms and risk premia channels. Subsequent research has developed various uncertainty measures, including implied volatility indices (Baker et al., 2016), forecast disagreement metrics (Boero et al., 2008), and model-based stochastic volatility estimates (Jurado et al., 2015).

A critical methodological debate concerns whether to use reduced-form proxies (e.g., VIX, policy uncertainty indices) versus model-based structural measures. Ludvigson et al. (2021) argue that structural uncertainty measures derived from factor-augmented VAR models provide more reliable identification of uncertainty shocks. The DHK approach extends this structural perspective by explicitly modeling heterogeneous uncertainty sources within a unified framework.

2.2 Uncertainty in Small Open Economies

Research on uncertainty in small open economies remains relatively scarce. Carriere-Swallow and Céspedes (2013) examine uncertainty effects in Canada using a small-scale SVAR, while Cesa-Bianchi et al. (2014) investigate multiple European countries. However, these studies typically employ models with 10–30 variables and may therefore suffer from the omitted variable bias documented by DHK.

For Taiwan specifically, Sin (2015) provides the most directly comparable existing study, employing a six-variable structural VAR (four Taiwan variables: output, price level, exchange rate, stock prices; plus two China variables: economic policy uncertainty and industrial production) to examine Chinese uncertainty spillovers. Sin finds that Chinese EPU significantly affects Taiwan's output and exchange rate, with shocks explaining approximately 15% of Taiwan's output forecast error variance. However, this small-scale approach—with only six variables and no US or global variables—likely suffers from the omitted variable bias that DHK's large-model framework was designed to overcome. Additionally, Sin's fixed variable classification cannot capture potential time-varying characteristics of key variables like exchange rates and stock prices.

Huang et al. (2019) construct a Taiwan-specific Economic Policy Uncertainty (EPU) index using newspaper-based text analysis, providing a valuable reduced-form uncertainty proxy. The World Uncertainty Index (Ahir et al., 2022) offers quarterly uncertainty coverage for Taiwan dating to 1956, enabling long-horizon historical analysis. However, neither study employs structural identification methods capable of distinguishing macroeconomic from financial uncertainty channels.

Table 1 presents a systematic comparison between the most directly comparable existing Taiwan study and the proposed research, highlighting the methodological advances this study offers.

Table 1: Comparison with Existing Taiwan Uncertainty Research

Dimension	**Sin (2015)**	**This Study**
Number of variables	6	43+
Taiwan variables	4	28+
China variables	2 (EPU, IPI)	3+
US variables	0	4+
Global indicators	0	4+
Methodology	SVAR	OI-SVMVAR
Variable classification	Fixed (researcher-imposed)	Time-varying (data-driven)
Order-invariance	No	Yes
Stochastic volatility	No	Yes
Research question	Impact magnitude	Transmission channels
Policy guidance	"China matters"	"Which channel to respond to"

2.3 SVMVAR Models and Order Invariance

The use of stochastic volatility in mean (SVM) specifications within VAR frameworks has gained prominence following Clark and Ravazzolo (2016) and Carriero et al. (2016). These models allow time-varying volatility to directly affect the conditional mean of variables, capturing the notion that heightened uncertainty can depress economic activity.

A critical challenge in large VAR models is the order-dependence problem. Traditional approaches like Carriero et al. (2019) use triangular identification schemes that impose arbitrary variable orderings. Chan (2020) partially address this through Minnesota-type priors, but their approach still maintains sequential processing of variables.

DHK (2025) make a crucial methodological advance by developing a novel MCMC algorithm that achieves complete order invariance while maintaining computational tractability in large systems. Furthermore, their framework allows variables to be classified as "macroeconomic," "financial," or "unclassified," with the model endogenously determining time-varying probabilities that unclassified variables belong to each category. This innovation is particularly valuable for Taiwan, where the macroeconomic versus financial

nature of key variables (exchange rates, policy rates, equity indices) may shift across different economic regimes.

2.4 US-China Relations and Taiwan's Economy

Taiwan's economy is uniquely exposed to US-China dynamics. Liu et al. (2020) document that US-China trade tensions affect Taiwan through both direct trade diversion effects and indirect supply chain impacts, with Taiwanese firms experiencing significant revenue declines in China following the 2018 trade war onset. Chen et al. (2022) examine how cross-strait political relations influence Taiwan's financial markets, finding that geopolitical events generate significant but short-lived volatility spikes. However, no existing study has formally incorporated US-China relationship indicators into a structural uncertainty framework for Taiwan that can identify time-varying transmission channels.

3 Research Questions and Hypotheses

This research addresses the following primary questions:

3.1 Primary Research Questions

RQ1: Through which transmission channels—macroeconomic or financial—do external uncertainty shocks from the U.S. and China impact Taiwan's economy? And how does this transmission mechanism change over time?

Specifically, when external shocks (e.g., US Federal Funds Rate changes, US-China trade tensions, Chinese credit conditions, global risk sentiment) hit Taiwan, do they primarily transmit through:

- **Macroeconomic channels**: Affecting Taiwan's real economy (industrial production, exports, employment) via trade linkages, supply chain effects, and export demand?
- **Financial channels**: Affecting Taiwan's financial markets (TAIEX, credit spreads, exchange rates) via capital flows, risk premia, and investor sentiment?

This question exploits DHK (2025)'s "unclassified variables" feature in a novel way: by placing *all external shock sources* in the unclassified category, the model endogenously reveals which transmission channel each external variable uses to impact Taiwan at each point in time.

Hypothesis 1: We hypothesize that transmission channels are **time-varying and shock-dependent**:

- US monetary policy (FFR) transmits primarily through **financial channels** during normal periods (affecting capital flows and exchange rates) but shifts to **macroeconomic channels** during global recessions (affecting export demand).
- Chinese economic shocks (IPI, credit conditions) transmit predominantly through **macroeconomic channels** (trade and supply chain effects) given Taiwan's deep manufacturing integration with China.
- US-China relationship tensions (trade policy uncertainty, geopolitical risk) transmit through **both channels**, with the dominant pathway depending on whether shocks manifest as trade disruptions (macro) or risk premium changes (financial).
- Global risk sentiment (VIX, GPR) transmits primarily through **financial channels** (capital flow reversals, portfolio rebalancing).

Hypothesis 2: We hypothesize **structural breaks in transmission mechanisms** around major episodes:

- 2008 Global Financial Crisis: External shocks predominantly transmit through financial channels.
- 2018 US-China Trade War: Shift toward macroeconomic channel transmission.
- 2020 COVID-19 Pandemic: Mixed transmission depending on shock type (lockdowns via macro, flight-to-safety via financial).

RQ2: What is the relative importance of different external shock sources—US variables, China variables, and US-China relations—in generating Taiwan's macroeconomic versus financial uncertainty?

Using forecast error variance decomposition (FEVD), we quantify what percentage of Taiwan's domestic macroeconomic uncertainty ($h_{m,t}$) and financial uncertainty ($h_{f,t}$) is attributable to each external source.

Hypothesis 3: We hypothesize that:

- US variables (FFR, IPI, credit spreads) explain a larger share of Taiwan's **financial uncertainty** than macroeconomic uncertainty.
- China variables (IPI, PPI, credit conditions) explain a larger share of Taiwan's **macroeconomic uncertainty** than financial uncertainty.
- US-China relations indicators contribute significantly to both types of uncertainty, with time-varying relative importance.

RQ3: How do Taiwan's domestic ambiguous variables (exchange rates, policy rates, TAIEX index level) shift between macroeconomic and financial classifications in response to external shocks?

Variables such as the TWD/USD exchange rate, TAIEX index level, and CBC policy rate may exhibit time-varying characteristics. When external shocks hit Taiwan, do these domestic variables respond through macro fundamentals or financial market mechanisms?

Hypothesis 4: We hypothesize that:

- The TWD/USD exchange rate classifies as macroeconomic when external shocks operate through trade channels but as financial when shocks trigger capital flow reversals.
- The TAIEX index level shifts toward macroeconomic classification during periods when external shocks primarily affect corporate earnings expectations rather than risk premia.
- CBC policy rate classification depends on whether the central bank responds to external shocks through conventional monetary policy (macro) versus financial stability interventions (financial).

RQ4: Does model size matter for Taiwan as it does for the US?

Following DHK's methodology, we will estimate both small-scale models (approximately 30 variables) and large-scale models (43+ variables) to assess whether inference about uncertainty effects differs substantially across specifications.

Hypothesis 5: Consistent with DHK, we hypothesize that small-scale models will:

- Overestimate the impact of external shocks due to omitted variable bias (excluding key US, China, or global variables).
- Misattribute transmission channels (e.g., incorrectly attributing financial channel effects to macro channels or vice versa).
- Fail to detect time-varying transmission mechanisms that are apparent in large models.

This is particularly critical for Taiwan: omitting external variables would severely bias estimates, potentially attributing externally-driven volatility to Taiwan's domestic uncertainty factors.

3.2 Policy-Relevant Questions

PQ1: When external shocks hit Taiwan, which transmission channel (macroeconomic vs. financial) should the Central Bank of China (Taiwan) prioritize responding to, and which policy tools are most appropriate?

For example:

- If US FFR shocks transmit primarily through financial channels (capital flows), should CBC focus on exchange rate management and macroprudential tools?
- If China shocks transmit primarily through macro channels (trade), should CBC coordinate with fiscal policy and structural adjustment measures?

PQ2: Which external indicators provide the most reliable early warning signals of damaging uncertainty shocks for Taiwan—US variables, China variables, or US-China relationship indicators?

PQ3: How has Taiwan's vulnerability to external shocks evolved across different historical episodes, and through which channels did shocks transmit during each episode?

- 1997 Asian Financial Crisis: Financial channel (capital flow reversals)?
- 2008 Global Financial Crisis: Mixed transmission?
- 2015 Chinese stock market crash: Financial spillovers?
- 2018 US-China Trade War: Macro channel (trade disruption)?
- 2020 COVID-19: Shock-dependent (lockdowns via macro, flight-to-safety via financial)?

4 Methodology

4.1 The Order-Invariant SVMVAR Framework

Following DHK (2025), we specify an order-invariant stochastic volatility in mean vector autoregression for the $N \times 1$ vector of endogenous variables y_t (where $N = 43$ in our baseline specification):

$$y_t = c + \Phi_1 y_{t-1} + \cdots + \Phi_p y_{t-p} + \Psi h_t + \varepsilon_t, \quad \varepsilon_t \sim N(0, \Sigma_t) \tag{1}$$

where $h_t = (h_{m,t}, h_{f,t})'$ is a 2×1 vector of latent uncertainty factors (macroeconomic and financial), Ψ is an $N \times 2$ matrix of factor loadings, and Σ_t is the time-varying covariance matrix.

The stochastic volatility processes follow:

$$h_{j,t} = \mu_j + \phi_j(h_{j,t-1} - \mu_j) + \eta_{j,t}, \quad \eta_{j,t} \sim N(0, \sigma^2_{\eta,j}), \quad j \in \{m, f\} \tag{2}$$

The key innovation in DHK's approach is the order-invariant treatment of the covariance matrix Σ_t and the classification scheme for variables.

4.2 Variable Classification

Variables are classified into three categories:

1. **Macroeconomic variables (y_t^m)**: Taiwan domestic real economy variables that are clearly macroeconomic in nature (industrial production, employment, retail sales, CPI, exports, etc.)

2. **Financial variables (y_t^f)**: Taiwan domestic financial market variables that are clearly financial in nature (stock returns, stock volatility, credit growth, interest rate spreads, etc.)

3. **Unclassified variables (y_t^u)**: This category serves two distinct purposes:

   - **External shock sources** (KEY INNOVATION): *All* external variables—US variables (FFR, IPI, credit spreads, EPU), China variables (IPI, PPI, credit conditions), global indicators (VIX, GPR), and US-China relationship measures—are placed in this category. The model's endogenous classification of these variables reveals their **transmission channels** to Taiwan.
   - **Taiwan domestic ambiguous variables**: Variables with potentially time-varying macro/financial characteristics (TWD/USD exchange rate, policy rates, monetary aggregates, TAIEX index level, housing prices).

For unclassified variables, the model estimates time-varying probabilities $\pi_{i,t}$ that variable i belongs to the macroeconomic category (with probability $1-\pi_{i,t}$ for financial). This classification is data-driven and allows variables to shift their predominant characteristics across different economic regimes.

Critical Innovation: By placing all external variables in the unclassified category, we exploit DHK's time-varying classification mechanism to identify whether external shocks transmit to Taiwan through macroeconomic channels (if $\pi_{i,t} \to 1$) or financial channels (if $\pi_{i,t} \to 0$). This is fundamentally different from DHK's application: whereas DHK use unclassified variables to resolve domestic variable ambiguity, we use them to identify external shock transmission pathways.

4.3 Identification

Identification of the two uncertainty factors ($h_{m,t}$ and $h_{f,t}$) is achieved through sign and magnitude restrictions:

- Macroeconomic uncertainty $h_{m,t}$ is required to load more heavily (in absolute value) on predetermined macroeconomic variables
- Financial uncertainty $h_{f,t}$ is required to load more heavily on predetermined financial variables
- The model allows data to determine the loading patterns for unclassified variables

4.4 Estimation

The model is estimated using Bayesian methods with Markov Chain Monte Carlo (MCMC) simulation. Following DHK, we implement a novel MCMC algorithm that achieves order invariance through:

1. Joint sampling of all volatility states and covariance parameters
2. Symmetric treatment of variables within classification categories
3. Data-driven classification updating for unclassified variables

Prior specifications follow DHK:

- Minnesota-type priors on VAR coefficients Φ_i
- Conjugate priors on h_t evolution parameters
- Dirichlet priors on classification probabilities for unclassified variables

We will run the MCMC sampler for 50,000 iterations with a burn-in period of 25,000 draws, retaining every 5th draw to reduce autocorrelation, yielding 5,000 posterior draws for inference.

4.5 Model Comparison

To assess the importance of model size (RQ4), we estimate three specifications:

1. **Small model**: 30 variables (comparable to typical existing studies)
2. **Large model**: 43+ variables (our baseline specification)
3. **Robustness checks**: Alternative variable selections and classifications

Model comparison will be conducted using marginal likelihood approximations, out-of-sample forecasting performance, and substantive comparison of impulse response functions.

4.6 Sample Period and COVID-19 Handling

Sample Period Strategy:

- **Baseline sample**: 1995M1–2024M12 (robust data availability for all variables)
- **Extended sample**: 1990M1–2024M12 (where data permits, for longer historical perspective)
- **Pre-COVID robustness**: 1995M1–2019M12 (to assess COVID period influence)

COVID-19 Period Treatment:

The COVID-19 pandemic (2020–2021) created extreme outliers that could potentially dominate estimation results. We address this challenge through multiple approaches:

1. **Dummy variable approach**: Include COVID dummy variables (2020M2–2020M6 for acute phase; 2020M2–2021M12 for extended period) interacted with key parameters to allow temporary parameter shifts.
2. **Outlier-robust estimation**: Apply Winsorization at the 1st and 99th percentiles for the COVID period observations as a robustness check.

3. **Split-sample analysis**: Estimate models separately for pre-COVID (1995–2019) and full sample (1995–2024) to assess whether COVID fundamentally alters transmission channel conclusions.

4. **Interpretation framework**: Recognize that COVID represents an "unprecedented shock" where transmission channels may have operated differently; focus policy conclusions on non-COVID periods while documenting COVID-specific dynamics as a distinct episode.

This multi-pronged approach ensures that findings are not artifacts of COVID-period outliers while still providing insight into how transmission channels operated during this exceptional period.

5 Data

5.1 Data Requirements

Following DHK's emphasis on model size, we aim to construct a dataset with 43+ monthly frequency variables. Given data availability constraints, we specify:

- **Baseline sample**: 1995M1–2024M12 (360 observations)
- **Extended sample**: 1990M1–2024M12 (420 observations, where available)

This section outlines the proposed variables organized by classification category.

5.2 Macroeconomic Variables (19 variables)

Output and Activity:

1. Industrial Production Index (IPI)
2. Manufacturing Production Index
3. Export Orders Index

4. Real Retail Sales
5. Real Food Service Sales
6. Real Exports (USD)
7. Real Imports (USD)
8. Manufacturing PMI (M-Score)
9. Non-Manufacturing PMI (NMI)
10. Business Cycle Signal Score ()

Prices:

11. CPI (year-over-year growth)
12. Core CPI (year-over-year growth)
13. Wholesale Price Index (WPI, year-over-year growth)
14. Import Price Index (USD-denominated, year-over-year growth)
15. Export Price Index (USD-denominated, year-over-year growth)

Labor Market:

16. Unemployment Rate (seasonally adjusted)
17. Manufacturing Employment (seasonally adjusted)
18. Services Employment (seasonally adjusted)
19. Real Manufacturing Wage (year-over-year growth)

5.3 Financial Variables (9 variables)

These are Taiwan domestic financial market variables that are clearly financial in nature.

Interest Rates and Spreads:

1. Overnight Call Loan Rate
2. 10-Year Government Bond Yield
3. Term Spread (10Y yield - overnight rate)
4. Credit Spread (corporate bond - government bond yield, if available)

Equity Markets:

5. TAIEX Monthly Return
6. TAIEX Daily Average Trading Volume
7. TAIEX Monthly Volatility (computed from daily data)
8. Net Foreign Investment in Taiwan Stocks (monthly net inflows)
9. Margin Trading Balance (year-over-year change)

Note: VIX is classified as an external/global variable and placed in the unclassified category to identify its transmission channel to Taiwan.

5.4 Unclassified Variables (16+ variables)

This is the **key innovation category**. Following our research strategy, all external shock sources are placed here to identify their transmission channels to Taiwan.

A. External Shock Sources (10+ variables) — *All external variables are unclassified*

US Variables:

1. US Federal Funds Rate (FEDFUNDS)
2. US Industrial Production Index (INDPRO, year-over-year growth)

3. US BAA-AAA Credit Spread (corporate credit risk)

4. US Economic Policy Uncertainty Index (Baker-Bloom-Davis EPU)

China Variables:

5. China Industrial Production (year-over-year growth)

6. China Producer Price Index (PPI, year-over-year growth)

7. China Total Social Financing (credit conditions, year-over-year growth)

Global Risk and US-China Relations:

8. VIX (CBOE Volatility Index, global risk sentiment)

9. Geopolitical Risk Index (Caldara-Iacoviello GPR)

10. Global Economic Policy Uncertainty (composite index)

11. US-China Trade Policy Uncertainty (Davis et al., or related measure)

B. Taiwan Domestic Ambiguous Variables (6+ variables) — *Domestic variables with potentially time-varying classification*

Policy and Money:

12. CBC Rediscount Rate (policy rate)

13. M1b growth (year-over-year)

14. M2 growth (year-over-year)

Asset Prices and Exchange Rates:

15. TWD/USD Exchange Rate (spot, log level)

16. TAIEX Level (index value, log level—not return)

17. Housing Price Index (year-over-year growth)

Rationale for Classification: Placing all external variables (Group A) in the unclassified category allows the model to endogenously reveal whether each external shock transmits to Taiwan through macroeconomic channels ($\pi_{i,t} \to 1$) or financial channels ($\pi_{i,t} \to 0$). Taiwan domestic ambiguous variables (Group B) may also exhibit time-varying classification in response to external shocks.

5.5 Data Sources

Primary data sources will include:

- Taiwan: National Statistics, R.O.C. (DGBAS), Central Bank of China (Taiwan), Taiwan Stock Exchange, Taiwan Economic Journal (TEJ)
- US variables: Federal Reserve Economic Data (FRED)
- China variables: National Bureau of Statistics of China, CEIC
- Global indicators: CBOE (VIX), Caldara-Iacoviello (GPR), Baker-Bloom-Davis (EPU)
- US-China relations: Policy uncertainty indices, news-based measures

5.6 Data Transformations

Following DHK and standard practice in VAR literature:

- Growth rates: Compute year-over-year log differences for most quantity variables
- Seasonal adjustment: Apply X-13-ARIMA-SEATS where needed
- Stationarity: Transform variables to ensure stationarity (verified by ADF and KPSS tests)
- Outlier treatment: Identify and address extreme outliers (especially COVID-19 period, see Section 4.6)
- Standardization: Standardize all variables to have mean zero and unit variance

6 Expected Outcomes and Contributions

6.1 Methodological Contributions

1. First application of "unclassified variables" to identify external shock transmission channels

This research makes a novel methodological contribution by repurposing DHK (2025)'s "unclassified variables" feature for a fundamentally different purpose than originally intended:

- **DHK's application**: Use unclassified variables to resolve ambiguity about *domestic* variables (e.g., is the S&P 500 a macro or financial indicator for the US?).
- **Our application**: Place *all external shock sources* in the unclassified category to identify which **transmission channels** (macroeconomic vs. financial) these shocks use to impact Taiwan.

This demonstrates that DHK's framework can answer questions beyond macro vs. financial uncertainty decomposition—specifically, it can identify time-varying external shock transmission mechanisms for small open economies.

2. Application of order-invariant SVMVAR to small open economy contexts

Taiwan's small open economy characteristics make methodological rigor even more critical than for large economies:

- **Omitted variable bias is more severe**: Excluding external variables (US, China, global factors) would misattribute externally-driven volatility to Taiwan's domestic uncertainty, yielding completely incorrect conclusions.
- **Order-dependence is more problematic**: With 40+ variables including multiple external sources, arbitrary variable ordering would produce unreliable inference about transmission channels.

- **Large model necessity**: Our demonstration that model size matters for Taiwan provides evidence on the generalizability of DHK's findings to different economic contexts.

3. Framework for analyzing dual external exposures in small open economies

Taiwan's simultaneous deep integration with both the US and China provides a unique empirical setting. Our framework can be applied to other economies navigating dual or multiple external dependencies (e.g., South Korea, Singapore, ASEAN nations facing US-China competition).

6.2 Empirical Contributions

1. Data-driven identification of external shock transmission channels to Taiwan

This research will provide the first rigorous, model-based evidence on *which channels* (macroeconomic vs. financial) external shocks use to impact Taiwan, answering a fundamentally different question than existing studies:

- **Existing studies** (e.g., Sin 2015): Show *that* US/China shocks affect Taiwan (impact magnitude).
- **Our contribution**: Identify *how* these shocks transmit (transmission mechanism), which is more policy-relevant for designing appropriate responses.

2. Time-varying transmission mechanisms across major historical episodes

We will document how external shock transmission channels evolved across critical episodes:

- **1997 Asian Financial Crisis**: Predominantly financial channel transmission (capital flow reversals)?
- **2008 Global Financial Crisis**: Mixed transmission (financial crisis real economy contagion)?

- **2015 Chinese stock market crash**: Financial spillovers vs. trade impacts?
- **2018-2019 US-China Trade War**: Shift to macroeconomic channel dominance (trade/supply chains)?
- **2020 COVID-19**: Shock-dependent transmission (lockdowns via macro, flight-to-safety via financial)?
- **2022-2023 Global tightening**: US FFR transmission through financial channels (capital flows)?

This historical analysis will reveal whether transmission channels are stable or regime-dependent.

3. Relative importance quantification: US vs. China vs. US-China relations

Using FEVD, we will decompose Taiwan's domestic uncertainty into contributions from:

- US macroeconomic shocks (FFR, IPI) $\rightarrow$ Taiwan's $h_{m,t}$ and $h_{f,t}$
- US financial shocks (credit spreads, EPU) $\rightarrow$ Taiwan's uncertainties
- China real economy shocks (IPI, PPI, credit) $\rightarrow$ Taiwan's uncertainties
- Global risk shocks (VIX, GPR) $\rightarrow$ Taiwan's uncertainties
- US-China relations shocks (trade policy uncertainty) $\rightarrow$ Taiwan's uncertainties

This answers: "Is Taiwan more vulnerable to US shocks, China shocks, or bilateral relationship deterioration?"

4. Detection of model size bias in Taiwan uncertainty research

By comparing small-model (30 variables, excluding key external variables) versus large-model (43+ variables) estimates, we will demonstrate:

- How severely small models misattribute transmission channels

- Whether existing Taiwan studies (using 6–20 variable models) suffer from omitted variable bias
- The necessity of large-scale models for credible small open economy research

6.3 Policy Contributions

1. Transmission channel-specific policy guidance for the Central Bank of China (Taiwan)

Our findings will provide actionable policy guidance that depends on which transmission channel dominates:

- **If external shocks transmit primarily through financial channels**:
  - Prioritize exchange rate management and capital flow monitoring
  - Deploy macroprudential tools (loan-to-value ratios, capital buffers)
  - Coordinate with financial supervisory authorities
  - Consider foreign exchange intervention during extreme episodes
- **If external shocks transmit primarily through macroeconomic channels**:
  - Focus on conventional monetary policy (interest rate adjustments)
  - Coordinate with fiscal authorities for demand management
  - Support structural adjustment policies (industrial diversification, supply chain resilience)
  - Monitor trade-intensive sectors and employment
- **For time-varying transmission**:
  - Develop real-time indicators of which channel is dominant
  - Design state-contingent policy rules
  - Build institutional capacity for rapid policy toolkit switching

2. External shock source prioritization

Our FEVD analysis will clarify which external monitoring should receive priority:

- If US variables dominate CBC should closely track Fed policy, US credit conditions
- If China variables dominate Monitor Chinese credit cycles, PPI, industrial production
- If US-China relations dominate Develop early warning systems for bilateral tensions

This allows CBC to allocate limited monitoring and forecasting resources efficiently.

3. Evidence for exchange rate regime design

By revealing whether TWD/USD movements reflect macro fundamentals vs. financial market pressures:

- Informs when exchange rate flexibility helps absorb shocks vs. when intervention is needed
- Provides evidence for optimal degree of managed floating
- Clarifies the "fear of floating" vs. "fear of appreciation" trade-offs specific to Taiwan's dual US-China exposure

4. Generalizable framework for small open economy policymakers

Taiwan's experience provides lessons for other economies navigating great power competition:

- South Korea (US-China exposure)
- Singapore (financial hub vulnerable to external shocks)
- ASEAN nations (diversifying between US and China)
- Eastern European economies (EU-Russia dynamics)

7 Computational Requirements and Timeline

7.1 Computational Resources

DHK (2025) report that estimating a 43-variable model requires approximately 30 hours of computation time per specification. Our research design requires multiple estimation runs:

Table 2: Estimated Computational Requirements

Specification	**Runs**	**Hours**
Baseline large model (43 variables)	1	30
Small model comparison (30 variables)	1	15
Pre-COVID sample robustness	1	30
Alternative variable classifications	2	60
COVID dummy specifications	2	60
Total	**7**	**∼195**

Mitigation strategies:

- Secure access to high-performance computing cluster
- Parallelize independent estimation runs across multiple nodes
- Optimize MCMC code for computational efficiency
- Prioritize baseline specification; conduct robustness checks sequentially as results emerge

7.2 Timeline

The proposed research will be conducted over 18 months:

Months 1–3: Data Collection and Preparation

- Assemble 43+ variable database for Taiwan
- Obtain US variables and construct US-China relationship indicators
- Implement all data transformations and stationarity checks

- Create complete documentation of data sources and definitions

Months 4–6: Model Implementation

- Obtain and study DHK's MCMC algorithm code (MATLAB/R/Python)
- Adapt code for Taiwan dataset and variable classification scheme
- Conduct initial estimation runs and convergence diagnostics
- Validate implementation against DHK's published results (using US data)

Months 7–10: Estimation and Analysis

- Estimate baseline large-model specification (43+ variables)
- Estimate small-model specification (30 variables) for comparison
- Conduct robustness checks with alternative specifications
- Compute impulse response functions, variance decompositions, and historical decompositions
- Analyze time-varying classification patterns for external variables

Months 11–14: Interpretation and Policy Analysis

- Interpret findings in Taiwan's economic and institutional context
- Compare results across different historical episodes
- Develop policy implications for CBC and other stakeholders
- Conduct counterfactual analyses

Months 15–18: Writing and Dissemination

- Write complete research paper
- Prepare presentations for conferences
- Prepare policy brief for CBC and government agencies
- Revise based on feedback and submit to journals

8 Potential Challenges and Mitigation Strategies

8.1 Data Availability

Challenge: Some Taiwan variables may not have sufficiently long time series (e.g., before 1995).

Mitigation:

- Prioritize most critical variables with longest available series
- Use 1995 as baseline start date (post-Asian Financial Crisis buildup)
- For variables with shorter series, assess whether they can be proxied or excluded without materially affecting results
- Consult with Taiwan Economic Journal (TEJ) and academic data centers for historical data access

8.2 Computational Complexity

Challenge: Multiple specifications require approximately 200 hours of computation time.

Mitigation:

- Secure access to high-performance computing resources
- Optimize code implementation for parallel processing
- Implement efficient MCMC sampling techniques
- Prioritize most critical model specifications; conduct secondary robustness checks only if baseline results warrant

8.3 Model Adaptation

Challenge: Adapting DHK's framework requires careful implementation to maintain order-invariance properties.

Mitigation:

- Begin with exact replication of DHK's framework using their US data
- Validate our implementation reproduces their published results before applying to Taiwan
- Introduce Taiwan data gradually and validate each step
- Maintain close communication with DHK authors if implementation questions arise

8.4 Interpretation and Policy Relevance

Challenge: Ensuring that findings are policy-relevant rather than purely methodological.

Mitigation:

- Frame research questions around specific Taiwan policy puzzles from the outset
- Engage with CBC researchers and policymakers during project to ensure relevance
- Translate technical findings into clear policy narratives
- Provide both academic paper and accessible policy brief deliverables

9 Conclusion

This research proposal outlines an ambitious but feasible study to investigate economic uncertainty in Taiwan using state-of-the-art econometric methods. By applying the methodologically rigorous, order-invariant SVMVAR framework of Davidson, Hou, and Koop (2025) to Taiwan's unique economic context, this research will:

1. Provide the first credible identification of **transmission channels** (macroeconomic vs. financial) through which external uncertainty shocks from the US and China impact Taiwan
2. Reveal how these transmission mechanisms **vary over time** across different economic regimes and crisis episodes

3. Quantify the **relative importance** of US variables, China variables, and US-China relations in generating Taiwan's domestic uncertainty

4. Demonstrate the importance of **model size and methodological rigor** for small open economy uncertainty research

5. Deliver **actionable policy insights** for the Central Bank of China (Taiwan) based on transmission channel identification

The research addresses critical gaps in both the methodological and empirical literature on uncertainty, while providing substantial policy value for Taiwan's unique economic and geopolitical position. The combination of cutting-edge econometric methods, comprehensive data collection, and careful attention to policy relevance positions this project to make significant contributions to both academic knowledge and real-world economic policy.

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