

Economic Policy Uncertainty Index for Macao

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Abstract

This paper follows the literature to compile a news-based economic policy uncertainty (EPU) index for Macao. The monthly index begins in June 2000 and is being updated every month. It is intuitive and captures heightened uncertainty amid major economic and political events, from both the local economy and the external environment. The index is correlated with key macroeconomic quantities, such as the real GDP growth, private investment, gross gaming revenue and unemployment growth. In a vector auto-regressive analysis, we find that higher EPU dampens consumption and increases unemployment. Overall, the index is a useful measure to understand and forecast the Macao economy.

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1. Introduction

Recent economic literature has demonstrated the importance of economic policy uncertainty (henceforth EPU) in driving the economic cycle. For instance, the global financial crisis, the European sovereign debt crisis and the Brexit are perceived to be events that raised EPU, and these events are associated with weak domestic demand. Although the ways through which uncertainty affects the real economy are fairly established in the theoretical literature, empirical investigation and policy analysis based on EPU have been challenging because EPU is not directly observable from the data.

Baker, Bloom and Davis (2016) developed a novel way to construct an EPU index by text-mining using newspapers articles. This newspaper-based method has several key advantages. First, it captures a wide range of uncertainty in a timely manner, as newspapers are published on a daily basis. Second, newspaper archives can go back for decades. Researchers can retrieve a long time series of the EPU index up to several decades ago. This enables one to perform various empirical analyses to gauge the impact of EPU on macroeconomic fluctuations, which in turn helps researchers and policymakers to improve their forecast of the future state of the economy. Third, the EPU index is intuitive. The higher the uncertainty, the higher is the index. Spikes in the EPU index can be linked to particular events reflecting the heightening of uncertainty. Such information can be readily communicated to the general public.

Furthermore, similar indices have been constructed for major countries/regions around the world, including Australia, Brazil, Canada, Chile, China (Hong Kong), China (Mainland), Europe, France, Germany, Greece, India, Ireland, Italy, Japan, Korea, Mexico, the Netherlands, Russia, Singapore, Spain, Sweden, the UK and the US. Davis (2016) constructed a global EPU index using GDP-weighted average of national EPU indices. Since these indices are constructed using similar methods, they are comparable across countries or regions, and permit cross-country analyses (See Colombo (2013), Klößner and Sekkel (2014), and Luk et al. (2018) for example). These indices are public and downloadable at www.policyuncertainty.com, FRED and

Bloomberg. Therefore, cross-country analyses can be made easily. International organisations (such as the World Bank and the International Monetary Fund), policymakers, finance professionals and the media monitor EPU indices in major economies and use these indices for their economic forecasting and for other purposes.

Why is an EPU index relevant and important for Macao?

Since Macao returned to the Motherland in 1999, the Macao economy achieved an average real GDP growth of 10.6%. To a large extent, the fast growth was related to the *de jure* monopoly on gaming within China and the rapid rise in the spending power of Chinese tourists.

However, in 2014 the boom in gross gaming revenue came to an abrupt end with gaming exports contracting by 6.6% in 2014, 34.6% in 2015 and 4.7% in 2016 respectively. The sharp descent was driven by a marked fall in high-end or VIP gaming revenue, which broadly mirrored developments in luxury spending elsewhere in the region. Since then, Macao was in an adjustment period, gradually transitioning from a gaming-oriented economy to a more diversified economic model for sustainable development. Specific sectorial reforms included encouraging vertical diversification of the gaming industry, supporting small and medium local enterprises, activating cross-border E-commerce services and developing non-gaming tourism and financial services.

Going forward, with a more diversified economic model, shocks from the broader economy and external environment (rather than just shocks to the gaming sector) may have an increasingly important impact on the Macao economy. Though in the past few years the non-gaming economy was remarkably resilient, volatility in the broader economy can undermine long-run growth by increasing macroeconomic uncertainty. As the International Monetary Fund (2017) suggests, the Macao SAR Government has an increasing role to play in macro-prudential policy, financial supervision and monitoring, as well as establishing a medium-term framework to anchor fiscal policy.

To enhance policy-making, the authority may need to keep track of a broader set of macroeconomic indicators, such as our proposed EPU index.

The rest of the paper is organised as follows. Section 2 describes in detail the methodology we use to compile the EPU index for Macao. Section 3 discusses the resulting index and compares the index to regional EPU indices. Section 4 studies the relations between the EPU index and key macroeconomic variables in Macao. We estimate a VAR model to assess the macroeconomic impact of EPU on the Macao economy. The final section concludes.

2. Construction of the index

The construction of the index follows closely the method by Baker, Bloom and Davis (2016). This method involves counting the frequency of news articles that contains terms relating to uncertainty. We use the *Wisers Information Portal*, a digital archive of Chinese news media to search for relevant words.

The index is constructed using four Macao newspapers: *Jornal Do Cidadão* (市民日報), *Jornal Va Kio* (華僑報), *Macao Daily News* (澳門日報) and *Tai Chung Pou* (大眾報). These local-paid Chinese newspapers are published every day so that the index may instantly capture a wide range of EPU related to Macao. We do not include free newspapers such as *Exmoo News* (力報), *Hou Kong Daily* (濠江日報), *Jornal San Wa Ou* (新華澳報) and *Jornal Cheng Pou* (正報). The exclusion of free newspapers is in line with most of the existing EPU indices.

It is noted that some news in Macao is also reported by Hong Kong newspapers due to the geographical proximity of the two economies. However, we choose not to incorporate information in Hong Kong newspapers because coverage of Macao news by Hong Kong newspapers is infrequent and incomplete. Furthermore, Hong Kong

newspapers may choose to report Macao news that is more relevant to Hong Kong, which may bias the EPU index.²

The index is of monthly frequency. It starts in June 2000, runs through July 2018, and is being updated every month.

Table 1: Relevant Chinese terms (with translation into English) for Compiling the EPU Index

Criteria	English	Chinese
(1) Region	Domestic/Macao	澳門/本地/本澳
(2) Economic	Economic/Economy/Financial	經濟/金融
(3) Uncertainty	Uncertainty/Uncertain/Unclear/ Unstable/Volatile/Unpredictable	不確定/不明確/不明朗/ 未明/不穩/波動/ 難料/難以預料/難以預測/ 難以預計/難以估計
(4) Policy	Policy/measures Public Fiscal SAR government Politics Chief Executive Reform Deficit Tax Regulation/rules Monetary Authority of Macao Reserves The Linked Exchange Rate System	政策/措施/施政 公共 財政 當局/政府/特別行政區/特 區 政治 行政長官/特首 改革 赤字 稅 規管/規例/規則 金融管理局/金管局 儲備 聯繫匯率

Our index reflects the frequency of newspaper articles that contain at least one word in each of the four categories: (1) Region, (2) Economic, (3) Uncertainty, and (4) Policy. Table 1 shows the words associated with each category. Since newspapers in Macao typically have extensive Mainland China and international news sections, criterion (1) screens out uncertainty not directly related to

² In fact, such an index displays extreme volatility which makes meaningful economic analysis impossible.

Macao. Criteria (2) and (3) contain the key words on the Macao economy and uncertainty, while criterion (4) captures key words on major local policy issues.

The specific steps in constructing the index follows the EPU index for Hong Kong (described in detail in Wong et al. (2017)), and are enumerated as follows:

- i. Counting: For each month t and each newspaper i , we count the number of articles satisfying relevant Chinese terms in Table 1.³ We scale this number by the count of articles in the same newspaper and month that meet criteria (1) and (2), yielding a monthly scaled EPU count for each newspaper and call this EPU_raw_{it} .
- ii. Standardization: For each newspaper i , we compute the sample standard deviation of EPU_raw_{it} using data prior to December 2009. For each newspaper i and each month t , we compute:

$$standardized\ EPU_raw_{it} = \frac{EPU_raw_{it}}{std.(EPU_raw)_i}$$

- iii. Aggregation: For each month t , we compute the simple average across newspapers in print $i \in N$:

$$aggregated\ EPU_raw_t = N^{-1} \sum_{i \in N} standardized\ EPU_raw_{it}$$

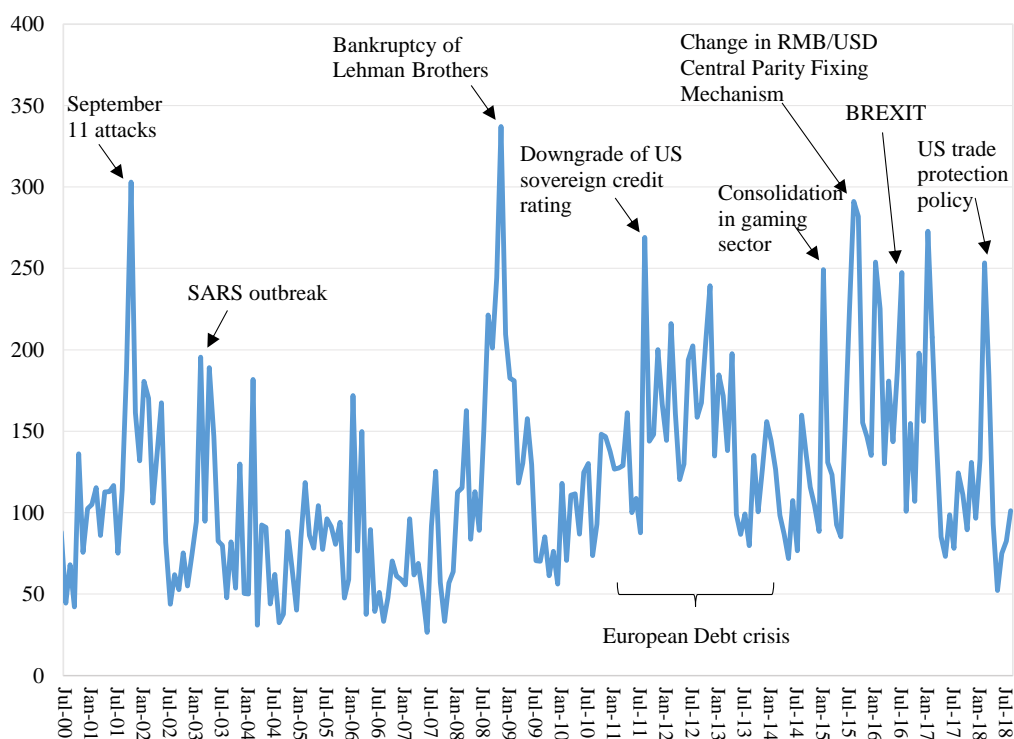
- iv. Normalisation: We then normalise the index to have a mean of 100 for the period June 2000 to December 2009. This is our monthly EPU index.

³ As a robustness check, we also tested another index construction method, in which case an article is counted only when there is a paragraph in the article such that all four keyword criteria are satisfied. The correlation between this index and the proposed index is 0.83, but with more restrictive selection criteria, the standard deviation of this index is larger, and there are a number of months with zero observation.

3. EPU index for Macao

Figure 1 shows the EPU index for Macao, annotated with key economic or policy related events matching the spikes. Intuitively, the index peaks during major global events such as September 11 attacks in 2001, bankruptcy of Lehman Brothers in 2008, downgrading of US sovereign credit rating and European debt crisis in 2011. Our index reflects local or regional events as well, such as the consolidation of gaming sector at the end of 2014 and changing in RMB/USD Central Parity Fixing Mechanism in 2015. In recent years, the EPU index for Macao shows greater fluctuations, possibly due to decreasing profitability of gaming industry, and higher sensitivity of investment or trading to international uncertainty.

Figure 1: EPU Index for Macao

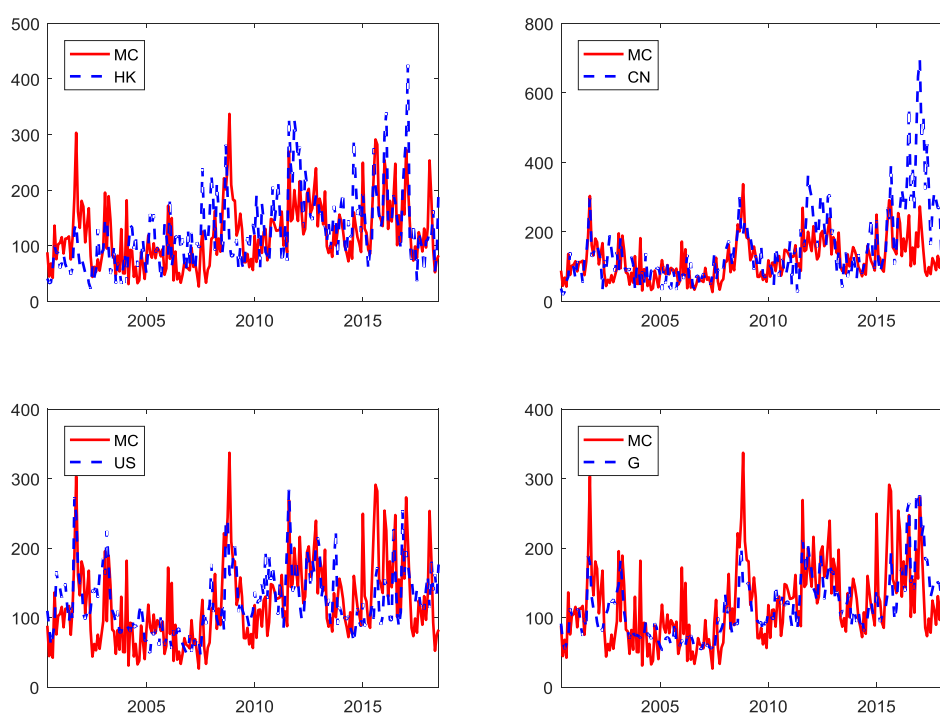


Correlations between MCEPU and other EPU indices

An interesting question is to what extent is uncertainty in Macao correlated with uncertainty in regional and international economies. Figure 2 plots the EPU index for Macao along with EPU indices of Hong Kong, Mainland China, the US and the Global. The first observation is that the EPU index in Macao appears to be more volatile than the US and global index. This is partly because only four newspapers are used to construct the EPU index for Macao. Therefore, idiosyncrasy in publishing pattern in each newspaper has a non-negligible effect on the index.

Second, the ups and downs of the Macao EPU series broadly track the other EPU indices. Especially, at times of heightened uncertainty (such as the SARS outbreak in early 2003 and the US election in November 2016) the peaks of all series are aligned. Table 2 reports the correlations of the four EPU indices. The Macao EPU index is positively correlated with the other three indices, confirming our observation.

Figure 2: EPU Index for Macao, Hong Kong, Mainland China, US, and the Global EPU index



Note: MC = EPU index of Macao, HK = EPU index of Hong Kong, CN = EPU index of Mainland China, US = EPU index of the US and G = the Global EPU index.

Third, the Macao EPU index is highly correlated with the Global EPU index ($Corr = 0.59$). Furthermore, the index is not only highly correlated with those in Mainland China and Hong Kong, but it is also highly correlated with the US index ($Corr = 0.53$). This reflects the small-open-economy nature of Macao, and that it receives spillovers of uncertainty from the rest of the world. We also observe that the correlation between Macao index and regional uncertainty indices seems to increase towards the second half of the sample, reflecting its greater regional dependence in recent years.

Table 2: Correlation Matrix

	MC	HK	CN	US	G
Macao (MC)	1.00				
Hong Kong (HK)	0.50	1.00			
Mainland China (CN)	0.48	0.47	1.00		
United States (US)	0.53	0.36	0.49	1.00	
Global (G)	0.59	0.53	0.86	0.80	1.00

Note: Correlations are computed using monthly EPU indices between June 2000 and July 2018. Data for Hong Kong, Mainland China, the US and Global EPU indices are available at (<http://www.policyuncertainty.com/>). All correlations are significantly different from zero at the 1% level.

But this is not to say that the Macao EPU index itself is of no importance. The correlation table shows that the correlation of Macao EPU index with that of Mainland China, Hong Kong and the US are around 0.5. These imply that local EPU is an independent force shaping the index. For instance, the consolidation in the gaming sector in 2014 was local, which had no effect on other regions' uncertainty.

4. Application of the Macao EPU index

This section demonstrates how the EPU index may be helpful to understanding Macao's macroeconomic fluctuations.

Table 3 computes the correlations between the Macao EPU index and key macroeconomic variables in Macao. Specifically, for macroeconomic variable X_t , we report $Corr(EPU_t, X_{t+j})$, where j is an integer between -4 and 4. The first row of the

table shows negative and statistically significant correlation of around -0.3 between the EPU index and real GDP growth. The higher the EPU index, the lower is the real output growth. This relationship appears to be stable if one replaces the contemporaneous growth by leading or lagging the GDP growth up to 3 quarters. The next two rows break down the real GDP growth into consumption growth and investment growth. It turns out that both consumption and investment growth are negatively correlated with the EPU index. The robust negative correlation between investment growth and uncertainty is consistent with theory. Bernanke (1983), Dixit and Pindyck (1994) and Bloom (2009) show that uncertainty can delay economic activities due to the real option value of ‘wait and see’ generated by the presence of adjustment costs or irreversibility of investment.

The EPU index has the expected correlations with other key variables. The rest of the table shows evidence that uncertainty is correlated with higher unemployment growth, lower housing price and lower growth of gaming revenue.

We now turn to a simple vector auto-regressive (VAR) model that exploits the time-series variation of the data to characterise key dynamic relationships. A representation of the VAR is:

$$B_0X_t = c + B_1X_{t-1} + B_2X_{t-2} + \dots + B_pX_{t-p} + \epsilon_t$$

where c is a vector of constants, B_0, B_1, \dots, B_p are coefficient matrices, and ϵ_t is a vector of structural innovations. The vector X_t contains the following endogenous variables: (1) EPU index (*MCEPU*), (2) real private consumption growth (*Consum*), (3) real private investment growth (*Invest*), (4) change in unemployment rate (*Unemp*), (5) real GDP growth (*rGDP*), and (6) CPI inflation (*CPI*). All growth rates are measured on a year-on-year basis.⁴ We estimate the VAR model using quarterly data from the first quarter of 2002 to the first quarter of 2018 (because most of the real variables are only available in quarterly frequency). We set the lag length of the VAR

⁴ Data on the real GDP, real private consumption, real private investment and unemployment rate are obtained from Macao Statistics and Census Service.

model to one, using the AIC and SIC as selection criteria. We use a standard Cholesky decomposition to recover the orthogonal shocks, with the ordering of the variables given above.

Table 3: Correlations between EPU and Macroeconomic Variables

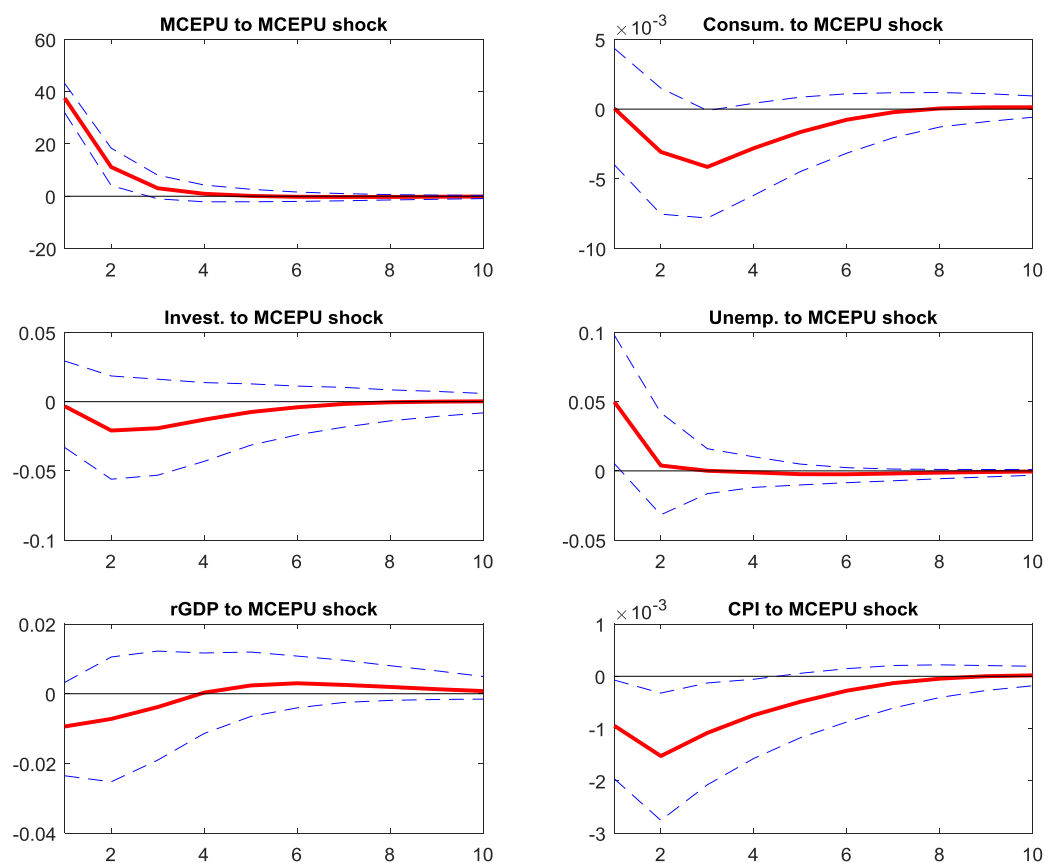
Period (j)	-4	-3	-2	-1	0	1	2	3	4
Real GDP Growth									
Corr.	-0.16	-0.23	-0.30	-0.39	-0.42	-0.38	-0.31	-0.20	-0.02
t-Stat	-1.27	-1.88	-2.44	-3.33	-3.64	-3.30	-2.57	-1.63	-0.17
Real Private Consumption Growth									
Corr.	0.12	0.02	-0.05	-0.18	-0.34	-0.33	-0.43	-0.39	-0.29
t-Stat	0.97	0.16	-0.38	-1.46	-2.90	-2.82	-3.81	-3.33	-2.38
Real Investment Growth									
Corr.	-0.28	-0.31	-0.30	-0.39	-0.31	-0.33	-0.37	-0.43	-0.41
t-Stat	-2.23	-2.58	-2.45	-3.35	-2.59	-2.74	-3.11	-3.80	-3.54
Change in Unemployment Rate									
Corr.	-0.03	0.01	0.19	0.20	0.33	0.30	0.19	0.01	-0.07
t-Stat	-0.21	0.11	1.61	1.72	2.91	2.65	1.58	0.04	-0.57
Inflation									
Corr.	0.29	0.36	0.24	0.11	0.02	-0.15	-0.16	-0.16	-0.14
t-Stat	2.44	3.16	2.05	0.88	0.14	-1.23	-1.33	-1.31	-1.18
Housing Price Growth									
Corr.	-0.18	0.12	-0.25	-0.18	-0.34	0.02	0.02	0.16	0.23
t-Stat	-1.12	0.78	-1.67	-1.20	-2.36	0.11	0.12	1.07	1.52
Gaming Revenue Growth									
Corr.	-0.07	-0.16	-0.27	-0.28	-0.32	-0.20	-0.02	0.05	0.04
t-Stat	-0.49	-1.18	-2.13	-2.20	-2.60	-1.55	-0.19	0.39	0.30

Note: This table reports $\text{Corr}(EPU_t, X_{t+j})$, where t is prior to 2018 Q1, and $j \in [-4, 4]$. Macroeconomic variables are obtained from Macao Statistics and Census Service. Growth rates of real GDP, private consumption, and fixed asset investment are measured as year-on-year change. Correlations computed are based on quarterly time series, where quarterly EPU index is the three-month average of the monthly index in each quarter. Significant correlation coefficients with at least 10% level of significance are highlighted with bold text.

Figure 3 shows the impulse responses to 40-point (one standard deviation) upward MCEPU innovation. It shows maximum estimated drop in real GDP growth of about 1% after the shock, and gradually returning to its pre-shock level after one year. The fall in output growth, however, is marginally statistically insignificant. Higher economic uncertainty also leads to a fall in investment and consumption, both

exhibiting hump-shaped responses, possibly reflecting costs in adjusting investment and habit formation in consumption. The fall in consumption is significant after three quarters. Unemployment increases immediately, but the effect is short-lived. In contrast, the effect to CPI inflation is more long-lasting, and is statistically significant up to one year after the shock, reflecting the stickiness in price adjustment. Overall, the EPU shock appears to act on the demand side more than the supply side, consistent with what is found in Leduc and Liu (2016).

Figure 3: Impulse Responses to One Standard Deviation Innovation in the EPU Index



Note: The figure presents estimated impulse response functions for the six-variable recursive VAR (*MCEPU*, *Consum.*, *Invest.*, *Unemp.*, *rGDP*, *CPI*) with 1 lag. The solid red lines denote the median IRFs. The dashed blue lines denote 14% and 86% bootstrapped confidence intervals, based on 1000 replications. Each period is a quarter.

5. Concluding remarks

Macao is shifting from a gaming-oriented economy to a more diversified economic model in recent years, and it has been subject to heightened uncertainty amid a series of international economic and political events. To facilitate macro-financial surveillance, we follow Baker et al. (2016) to construct a news-based economy uncertainty index for Macao. We find that such index is intuitive, where a rise of the index corresponds to heightening of uncertainty. Our analysis suggests that higher EPU would dampen economic activities and increase unemployment, in line with theories and empirical evidences in other countries. Overall, we demonstrate that the EPU index enhances our understanding of the macro-economy and is a helpful tool to enhancing economic policymaking.

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