Testing the External Shock Narrative of the Conflict on Transition Towards Knowledge Economy in Syria

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TESTING THE EXTERNAL SHOCK NARRATIVE
OF THE CONFLICT ON THE TRANSITION
TOWARD A KNOWLEDGE-BASED ECONOMY IN SYRIA

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Abstract

The external shocks narrative in the existing literature suggests that the underdevelopment of a knowledge-based economy in low-income countries is due to external shocks of an economic or political nature. This study aims to analyze the real causes that hinder the Syrian economy from transitioning toward a knowledge-based economy. We apply the Documentary Research Method (DSM) to analyze the existing literature of the external shock theory as well as studies that investigated the transition process toward a knowledge-based economy. We also apply the Structural Vector Autoregression (SVAR) to measure the impact of internal and external shocks on some innovation and knowledge creation-related variables. Our results indicate that, in the short and long run, external shocks do not provide a comprehensive explanation of the failure to build a knowledge-based economy in Syria. On the other hand, internal shocks, whether the shock of liberal policies or the internal conflict, provide better insights. The results also show that internal shocks in general and the shock of liberal policies in particular are largely responsible for Syria's failure in transitioning to a knowledge-based economy, and for the outbreak and development of the conflict. A set of economic policies were proposed for the reconstruction of Syria based on a non-classical approach that orients the reconstruction process toward building a knowledge-based economy and raising the pace of convergence with other countries in the region, whether in terms of digitization or changing the sectoral structure of the economy.

Keywords: External shocks, internal shocks, knowledge-based economy, conflict, SVAR, economic reconstruction, Syrian economy.
JEL Classifications: O20.

ملخص

في الأدبيات الحالية، يشـير سرد الصـدمات الخارجية إلى أن تخلف الاقتصـاد القائم على المعرفة في البلدان منخفضـة الدخل يرجع إلى الصدمات الخارجية من مختلف الأنواع سواء الاقتصادية أو السياسية. تسـعى هذه الدراسـة إلى تحليل الأسـباب الحقيقية التي أعاقت وتعوق الاقتصاد السـوري عن التحول إلى الاقتصـاد القائم على المعرفة. ونطبق طريقة البحث الوثائقي (DSM) لتحليل الأدبيات الحالية لنظرية الصـدمة الخارجية والدراسـات التي بحثت في عملية الانتقال نحو اقتصـاد قائم على المعرفة. نقوم أيضًـا بتطبيق الانحدار التلقائي للناقل الهيكلي (SVAR) لقياس تأثير الصـدمات الداخلية والخارجية على بعض المتغيرات المتعلقة بالابتكار وخلق المعرفة. تشـير نتائجنا إلى أن الصـدمات الخارجية، على المدى القصير والطويل، لا تقدم تفسيراً شاملاً للفشل في بناء اقتصاد قائم على المعرفة في سوريا. ومن ناحية أخرى، توفر الصدمات الداخلية، سواء كانت صدمة السياسات الليبرالية أو الصراع الداخلي، رؤى أفضل. تظهر النتائج أيضًا أن الصـدمات الداخلية بشـكل عام، وصـدمة السـياسـات الليبرالية، مسـؤولة إلى حد كبير عن فشل سـوريا في الانتقال إلى اقتصاد قائم على المعرفة، وعن اندلاع الصراع وتطوره. تم اقتراح مجموعة من السياسات الاقتصادية لإعادة إعمار سوريا على أساس نهج غير كلاسيكي يوجه عملية إعادة الإعمار نحو بناء اقتصاد قائم على المعرفة وزيادة سرعة التماثل مع دول أخرى في المنطقة من حيث الرقمنة وتغيير الهيكل القطاعي للاقتصاد.

Introduction

Small economies are characterized by their vulnerability to political and economic events in major global countries as well as neighboring ones. In the economic literature, this is referred to as "external shocks." Several studies have analyzed the role and impact of external shocks on the performance of macroeconomic indicators (Hsing, 2012; James & Lawler, 2010; Maćkowiak, 2007). The more open the economy, the more vulnerable it is to external shocks (Raghavan & Athanasopoulos, 2019).

Another strand of literature has examined the impact of internal shocks (Rasaki & Malikane, 2015), both in terms of shifts in adopted economic policies (Gerlach-Kristen, 2006) and in response to internal conflicts and civil wars and the shock they pose to economic and social indicators (D'Souza & Jolliffe, 2013; Fenske & Kala, 2017; Hull & Imai, 2013).

Arab countries in general can be classified into two broad groups: (1) rich countries that are resource-abundant (oil and gas), such as Algeria and Gulf Cooperation Council (GCC) countries, and (2) poor countries that depend mainly on agriculture and tourism as well as remittances from relatives working in oil-rich countries as the main source of income of the remaining Arab countries (Jamshidi, 2014).

Syria, a member of the second group, has an economic structure that is susceptible to external shocks due to its relatively small manufacturing sector and overdependence on the agricultural and tourism sectors. The current state of Syria can be summarized by its move from 48th place in the Fragile States Index in 2010 to fourth place in 2020.

The Syrian economy has witnessed several events in the period before and after 2011. In this study, we are interested in investigating the impact of two shocks: one before 2011 and one after, in addition to the Arab spring shock as an external shock.

This study aims to test the narrative of external shocks on the transition toward a knowledge-based economy in countries experiencing political and social instability, particularly Syria. We believe that analyzing the impact of external and internal shocks on the knowledge-based economy in Syria is crucial to identify the sources of transition system failure.

To this end, we will examine the impact of the internal liberal policy shock on knowledge-based economy indicators since 2005, as well as the impact of internal conflict shocks in 2011. We will then test the impact of the external shock of Arab revolutions in 2010 on the transition to a knowledge-based economy in Syria.

This study contributes to the existing literature by expanding the boundaries of external shock studies beyond the macroeconomy; it explores a new domain of the external shock narrative in the context of knowledge-based economy building.

This study is structured as follows. First, we revise the literature of external shock studies in different economic and social domains. Second, we illustrate the data and methodology used in this study. Third, we present and discuss the results of this study. Finally, we conclude.

Literature review

The existing literature focuses on the impact of different types of external shocks on the indicators of developing economies. Those external shocks include interest rate and term of trade shocks (Calvo et al., 2006; Muhanji & Ojah, 2011), exchange rate shocks (J. P. Allegret & Benkhodja, 2015), the US monetary shock (Hirakata et al., 2011), international financial crises (the Asian crisis and the subprime crisis) (Josifidis et al., 2014), oil price shocks (Cross & Nguyen, 2017; Ong & Sato, 2018), the real GDP growth in the US and Japan (Morita, 2014), and financial shocks (e.g. the volatility of the MSCI World Index) (J. P. Allegret et al., 2012).

Political instability is defined as the propensity of a government collapse and state failure (Mommsen, 1989). Such a collapse may be due to internal competition between certain government stakeholders or from other conflicts (Alesina et al., 1996). It ranges from certain violence incidents and social unrest to the extreme of civil war.

Political instability disrupts the economic system and undermines economic growth. Many articles relate political instability to loose institutional capacity, weak economic growth, and lower investment inflows (Alesina et al., 1996; Bano et al., 2019; Feng, 1997).

Several channels are suggested in the literature to describe how political instability affects a country's innovation and technological activities and consequently impairs its transition toward to a knowledge-based economy. First, trust and certainty are crucial for the triple helix model to flourish in the economy. Political instability creates an atmosphere of mistrust between essential units of innovation and both formal and informal institutions, which undermines innovation (Allard et al., 2012; Amankwah-Amoah, 2016; Leydesdorff, L. L. & Meyer, 2003). Second, the uncertainty caused by political instability discourages both local and foreign investors from making investments (Bano et al., 2019; Feng, 1997). Globerman and Shapiro (2003) argue that political instability reduces Foreign Direct Investment (FDI) inflows and human capital development, which consequently impair innovation rates and investment (Allard et al., 2012). Third, the migration of skilled individuals due to political instability is another source of impairment to the process of transitioning to a knowledge-based economy (Amankwah-Amoah, 2016). The "brain drain" of trained professionals, academics, and scientists (also called innovation migration by Cuhls (2007)) will impair innovation activities and surely slow down the transition toward a knowledge-based economy. In addition, entrepreneurs will escape unstable countries because they will not be able to run businesses in them (Brück et al., 2011; Koh, 2007). Fourth, the shift in resources from research and development investments to unproductive costs and military expenditures in politically unstable countries would hinder their efforts in transitioning toward knowledge economies.

Interestingly, the narrative of external shocks in the literature in general and in studies on Arab countries in particular is dominant (Abdel-Latif, 2019; Hossain, 2016; Kim & Hammoudeh, 2013). This dominance makes the validity of this narrative questionable.

There are several studies on Arab countries in which the external narrative has a dominant position. Expectedly, oil price shocks significantly affect GDP and the trade balances of GCC countries (Nasir et al., 2018). Moreover, the financial sector development of GCC countries is subject to noticeable boom and bust closely linked to oil price fluctuations (Arezki & Nabli, 2012). In addition, the spread of Information and Communication Technology (ICT) in Arab countries, which constitutes a pillar for a knowledge-based economy, disrupts the political-economic environment. Khondker (2015) refers to Internet technology as "a double-edged sword" because it upgrades the economy on the one hand and disrupts the political system on the other hand. Moreover, the implementation of neoliberalization programs suggested by the IMF, which resulted in a cut-off on government subsidies on food and fuel, caused anger and riots (Jamshidi, 2014). Global warming and drought could also hurt economies that depend on agriculture and reduce agricultural production and livestock, therefore potentially leading to internal migration, although Selby et al. (2017) refuse this hypothesis in the Syrian case.

On the other hand, there are many other studies in the existing literature that explain the failure in the economic, social, and political Arab systems by internal shocks and factors. Arezki and Nabli (2012) attribute the political instability of the so-called Arab Spring to social instability caused by a failure in job creation and economic diversification. Jamshidi (2014) argues that Arab countries suffer from poor political institutions as well as stagnant and undiversified economies that are overly dependent on oil revenues. He adds: "The health of many Arab economies was intimately tied to volatile international oil markets" (Jamshidi, 2014).

It is obvious that the previous studies on external shocks have been limited to the analysis and measurement of the impact of external shocks on macroeconomic indicators such as GDP (Gunasinghe et al., 2020), inflation rates (Moreira, 2012; Muhanji et al., 2013), unemployment rates (Siwach, 2018), and inequality (Gunasinghe et al., 2020; Reardon & Taylor, 1996).

However, in our opinion, the impact of external and internal shocks is not limited to macroeconomic indicators; it includes other indicators associated with the transition toward a knowledge-based economy. To the best of our knowledge, no previous study has examined or analyzed the impact of external or internal shocks on the transition toward a knowledge-based economy; therefore, we attempt to investigate such an impact.

Date and methodology
This study includes data of basic knowledge economy indicators available from 2000 to 2018 (Table 1 in the appendix). In light of the scarcity of data about the knowledge economy in Syria, only 19 observations were covered and only seven variables were used as a proxy for three dimensions of a knowledge-based economy: (1) education index and published scientific articles as a proxy for human capital building and knowledge generation, (2) the number of

patent and trademark applications as a proxy for innovation activities and knowledge commercialization, and (3) Internet subscribers, mobile subscribers, and broadband subscribers as a proxy for ICT infrastructure.

These seven variables were aggregated by running the Principal Factor Analysis (PCA) to produce one dependent variable representing a proxy for the knowledge economy in Syria. The results of the PCA analysis are presented in Table 2 in the appendix.

The Syrian economy has witnessed several events in the period prior to 2011. First, it witnessed a quick transition from a centrally planned economy to a "social" market economy. This shift included cutting on state subsidies, particularly fuel (De Châtel, 2014).

We divide shocks that disturb the Syrian economy into two groups:
- **Internal shocks,** which include the internal liberal policy shock since 2005 and the internal shock of conflict since 2011.
- **External shocks,** which represent the Arab Spring that began in 2010.

A set of dummy variables were created to represent the internal and external shocks. According to the Jarque-Bera test results shown in Table 1, all variables are normally distributed. The null hypothesis of this test states that the time series are normally distributed.

In order to analyze the impact of internal and external shocks on the knowledge economy in Syria, a Structural Vector Autoregression (SVAR) model was used.

First, the general specification of the SVAR model is as follows:

$$BY_t = \sum_{i=1}^{L} A_i Y_{t-i} + \varepsilon_t$$

Y_t represents the endogenous variables of study, which include: knowledge economy (KE), internal policy shock (IPSh), internal conflict shock (IC), and external conflict shock (ExC). ε_t is a vector of structural shocks that is identically distributed. L is the number of lags. A_i is a coefficient matrix, and B is the contemporaneous interaction matrix. The matrix of structural shocks is supposed to be orthogonal ($\sum \varepsilon = I$) and to have a unitary variance to make it possible to isolate the effects of shocks from each other.

Furthermore, the absence of the effect of internal shocks on external ones can be represented as zeros in the A_i matrix.

$$A_i = \begin{bmatrix} IPSh & 1 & 0 & 0 & 0 \\ ExC & 0 & 1 & 0 & 0 \\ IC & NA & NA & 1 & 0 \\ KE & NA & NA & NA & 1 \end{bmatrix}$$

Second, we imposed a set of short-run and long-run restrictions in the SVAR models. Restrictions were imposed on the relationship between variables based on economic theory. Therefore, the short-run form of the SVAR model can be written as follows:

$$
\begin{bmatrix} IPSh_t \\ ExC_t \\ IC_t \\ KE_t \end{bmatrix} = \begin{bmatrix} A_{11} & 0 & 0 & 0 \\ 0 & A_{22} & 0 & 0 \\ 0 & A_{32} & A_{33} & 0 \\ A_{41} & A_{42} & A_{43} & A_{44} \end{bmatrix} \begin{bmatrix} KE_{t-1} \\ IPSh_{t-1} \\ ExC_{t-1} \\ IC_{t-1} \end{bmatrix} + \begin{bmatrix} R_1 & 0 & 0 & 0 \\ 0 & R_2 & 0 & 0 \\ 0 & R_3 & R_4 & 0 \\ R_5 & R_6 & R_7 & R_8 \end{bmatrix} \begin{bmatrix} \varepsilon_t^{IPSh} \\ \varepsilon_t^{ExC} \\ \varepsilon_t^{IC} \\ \varepsilon_t^{KE} \end{bmatrix}
$$

In the short run, the liberal policy adopted in 2005 in Syria does not show a significant effect on the internal conflict. Therefore, we imposed a restriction on this relationship in the short run matrix. We also restricted the impact of the external conflict shock on the internal policy shock since the shift in policy happened before the Arab Spring.

Regarding the long-run form of the SVAR model, we activated the impact of the internal liberal policy shock on the internal conflict and knowledge economy, since five to ten years are enough to evaluate the effect of this shock on both the knowledge economy and internal conflict.

 it can be written as follows:

$$
\begin{bmatrix} IPSh_t \\ ExC_t \\ IC_t \\ KE_t \end{bmatrix} = \begin{bmatrix} A_{11} & 0 & 0 & 0 \\ 0 & A_{22} & 0 & 0 \\ A_{31} & A_{32} & A_{33} & 0 \\ A_{41} & A_{42} & A_{43} & A_{44} \end{bmatrix} \begin{bmatrix} KE_{t-1} \\ IPSh_{t-1} \\ ExC_{t-1} \\ IC_{t-1} \end{bmatrix} + \begin{bmatrix} R_1 & 0 & 0 & 0 \\ R_2 & R_3 & 0 & 0 \\ 0 & R_4 & R_5 & 0 \\ R_6 & R_7 & R_8 & R_9 \end{bmatrix} \begin{bmatrix} \varepsilon_t^{IPSh} \\ \varepsilon_t^{ExC} \\ \varepsilon_t^{IC} \\ \varepsilon_t^{KE} \end{bmatrix}
$$

Using the Cholesky factorization of the estimated covariance matrix, we computed the R matrix. In order to perform the SVAR analysis, a set of assumptions must be fulfilled. First, we conduct a stationarity test where all variables should be stationary at the first difference. Table 3 shows the results of the unit root test for all studied variables.

Table 3. Unit root test results

	Augmented Dickey-Fuller test	
Variable	**Level** **I(0)**	**1st diff** **I(1)**
Knowledge Economy (KE)	0.345	-2.808**
Internal Policy Shock (IPSh)	-1.69	-4.12***
Internal Conflict Shock (IC)	-0.79	-4.12***
External Conflict Shock (ExC)	-1.60	-3.87**

***, **, * represent significance at the one, five, and ten percent levels of significance, respectively.

As shown in Table 2, according to the Augmented Dickey-Fuller test and the Phillips-Perron test, all variables are stationary at the first difference I (1).

Second, we run an optimal lags selection. Various criteria were used to choose the optimal lags of the model as shown in Table 4.

Table 4. Lag selection

| Lag	LogL	LR	FPE	AIC	SC	HQ
0	-16.87519	-	0.00016*	2.681645	3.647381	2.61929*
1	-1.453162	21.20529	0.000187	2.60939*	2.80254*	2.731099
2	14.58383	14.03236	0.000309	2.677022	4.415346	2.766038

* indicates lag order selected by the criterion.

The result in Table 4 shows that the first lag is the optimal lag according to AIC and SC.

Third, we test the stability of the model by conducting the inverse roots of AR characteristic polynomial. The results shown in Figure 1 indicate the stability of the model and the reliability of the coefficients.

Figure 1. Inverse roots of AR characteristic polynomial

Inverse Roots of AR Characteristic Polynomial
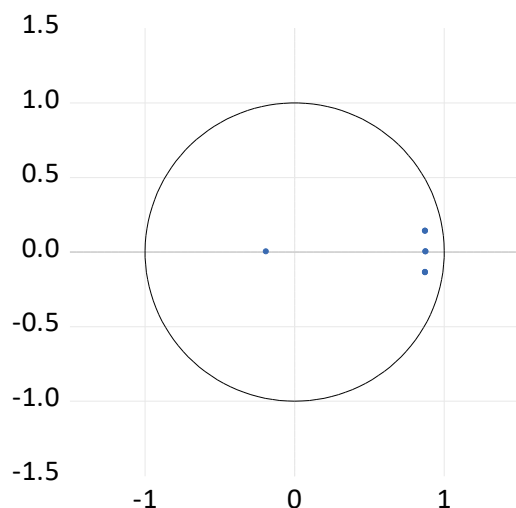
Fourth, we run VAR residual serial correlation LM tests, the results of which indicate that the residuals of the model are not serially correlated (Table 5).

Table 5. VAR residual serial correlation LM tests

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	6.446130	16	0.9825	0.323125	(16, 15.9)	0.9849

Fifth, we run a normality test of the residuals. Since all the shocks' variables are dummy variables and logically distributed, the normality test of the residuals is not necessary in this case.

After checking all the SVAR requirements, we build our model for both the short and long run. Table 6 shows the results of the short-run SVAR model.

Table 6. SVAR Short-run results

	Short-run Matrix			
C(1)	0	0	0	
0	C(3)	0	0	
0	C(4)	C(6)	0	
C(2)	C(5)	C(7)	C(8)	
	Coefficient	Std. Error	z-Statistic	Prob.
C(1) [IPSh→IPSh]	0.350640***	0.061985	5.656853	0.0000
C(2) [IPSh→KE]	0.256325**	0.099821	2.567853	0.0102
C(3) [ExC→ExC]	0.324996***	0.057452	5.656853	0.0000
C(4) [ExC→IC]	0.090081	0.048567	1.854761	0.0636
C(5) [ExC→KE]	0.166235	0.096486	1.722899	0.0849
C(6) [IC→IC]	0.183531***	0.032444	5.656853	0.0000
C(7) [IC→KE]	-0.094207	0.089165	-1.056541	0.2907
C(8) [KE→KE]	0.349932***	0.061860	5.656853	0.0000
	Estimated S matrix:			
0.350640	0.000000	0.000000	0.000000	
0.000000	0.324996	0.000000	0.000000	
0.000000	0.090081	0.183531	0.000000	
0.256325	0.166235	-0.094207	0.349932	
	Estimated F matrix			
0.369109	-0.084102	0.028647	-0.063507	
-0.119192	0.193834	0.195569	-0.239541	
-0.170957	0.236801	0.158809	-0.028392	
-0.204061	0.225487	-0.353589	0.505604	

The results in Table 6 show that, in the short run, there is not a significant relationship between the internal and external shocks and the knowledge economy variable. However, the results show that there is a significant positive relationship between the internal liberal policy shock and the knowledge economy in the short run. This can be explained by the fact that the dynamics of both external and internal conflict did not develop enough to affect knowledge creation and commercialization in the short run. On the other hand, the results show that there is a positive significant relationship between external shocks and internal conflicts in Syria, indicating that the Arab conflict participated in accelerating the conflict in Syria in the short run.

To identify the impact path of shocks on the knowledge economy in the short run, we analyzed the impulse response of the knowledge economy to all shocks. The results are shown in Figures 2, 3, and 4.

Figure 2. Short-run restricted impulse response of the knowledge economy to the internal policy shock
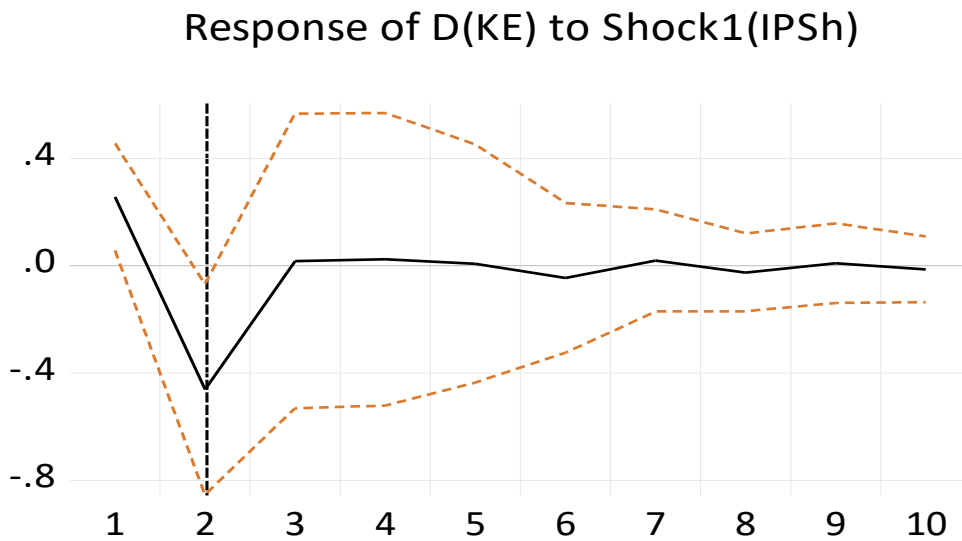

Response of D(KE) to Shock1(IPSh)

Figure 2 shows that the internal liberal policy shock in Syria contributed to a decrease in the knowledge economy in the first two years, but it quickly reverted to positive (but not significant) – especially in the fourth year of adoption of policies (2009). This negative impact of liberal policies on the knowledge economy is due to the absence of a national economic strategy aiming to transform the Syrian economy toward a knowledge-based economy. This is confirmed by the absence of a national strategy for science, technology, and innovation until late 2019.

As for the impact of the external conflict shock in the Arab countries on the knowledge economy, the results in Figure 3 show that the knowledge economy was affected by the external shock after two years of conflict in the Arab countries (2012), where we note a significant decline in the first two years.

Figure 3. Short-run restricted impulse response of the knowledge economy to the external conflict shock

Response of D(KE) to Shock2(ExC)
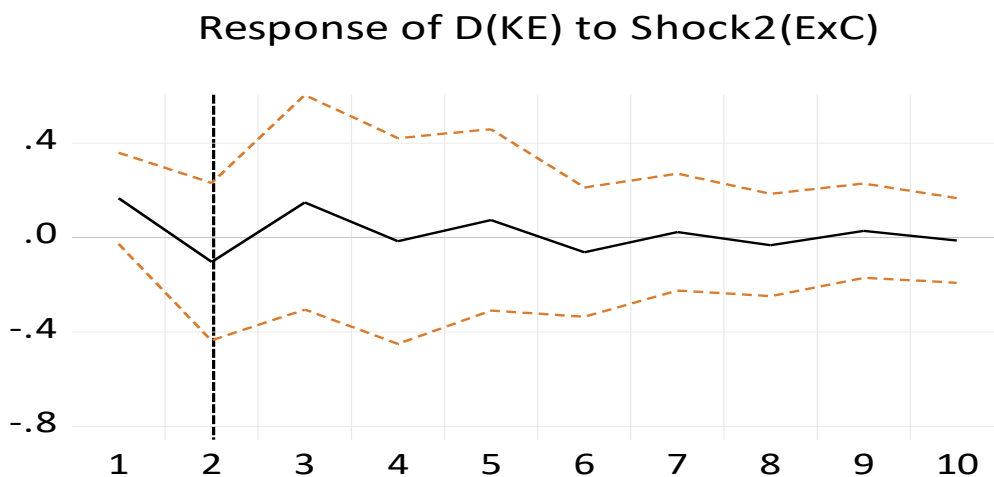
It should be noted that after the fifth year of external conflict in the Arab countries (2015), where the situation in those countries began to stabilize and their political instability decreased, the impact of the external shock has significantly disappeared.

Regarding the impact of the internal conflict on the knowledge economy, it had a direct impact on the knowledge economy only during the first three years of the conflict as shown in Figure 4.

Figure 4. Short-run restricted impulse response of the knowledge economy to the internal conflict shock


Response of D(KE) to Shock3(IC)
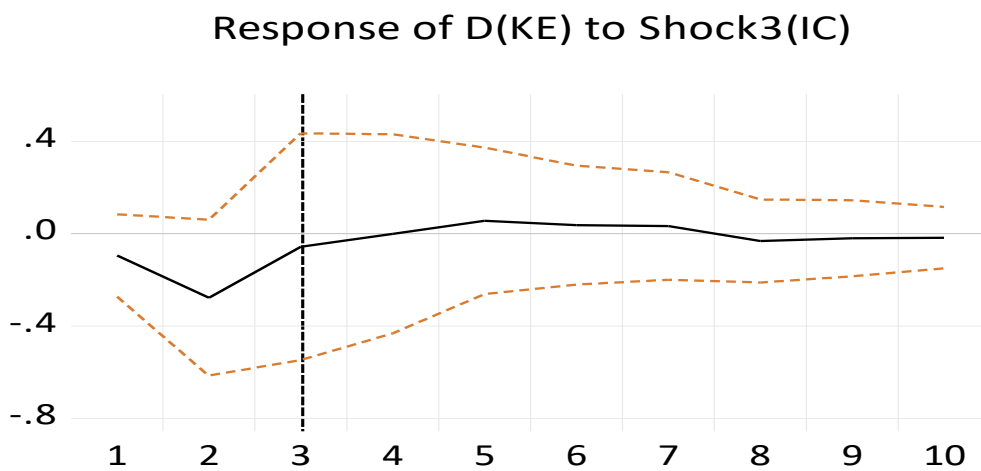
In sum, the accumulative impact of the internal liberal policy shock and the internal conflict was significantly negative during the first two years, and then this impact decreased. However, the overall impact of these two shocks on the short run is negative. On the other hand, the accumulative impact of the external shock on the knowledge economy was negative only during the first two years, but not significant. It then reverted in the following years, as illustrated by Figures 5, 6 and 7.

Figure 5. Short-run accumulated impulse response of the knowledge economy to the internal policy shock

Accumulated Response of D(KE) to Shock1(IPSh)
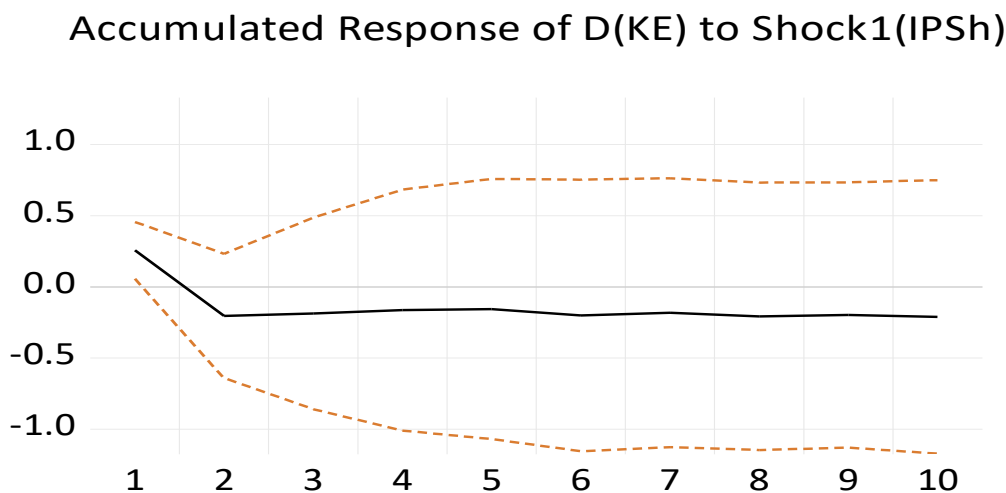
Figure 6. Short-run accumulated impulse response of the knowledge economy to the external conflict shock

Accumulated Response of D(KE) to Shock2(EXC)
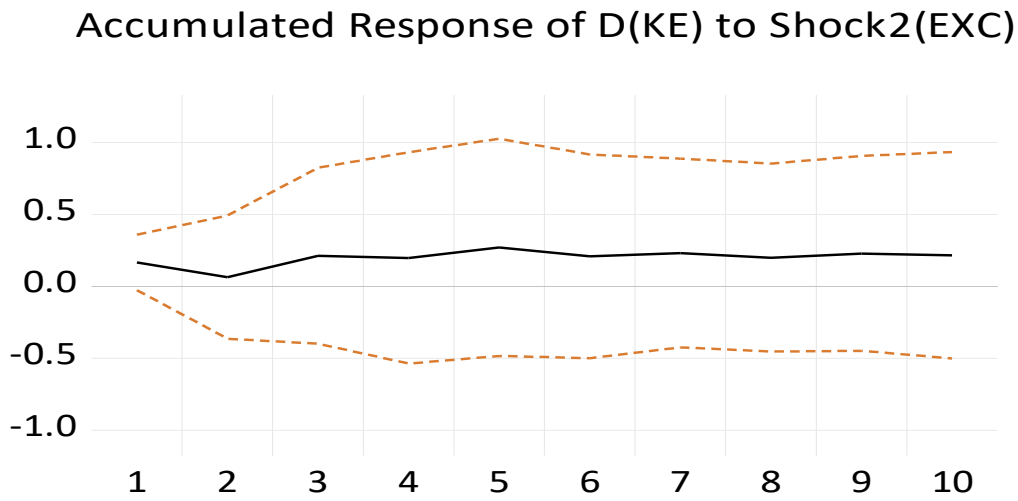
Figure 7. Short-run accumulated impulse response of the knowledge economy to the internal conflict shock

Accumulated Response of D(KE) to Shock3(IC)
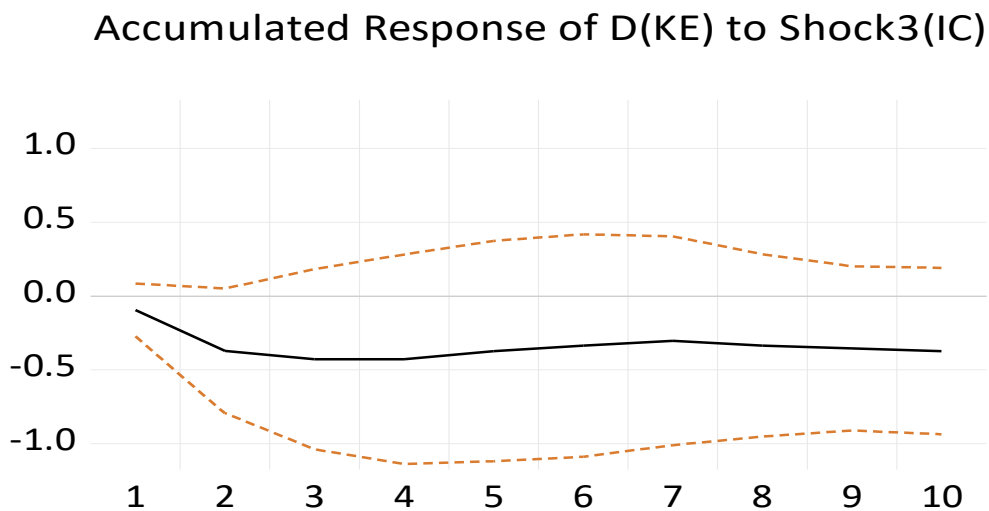
The results of the short-run SVAR model also showed that the external shock affected the internal conflict in the first two years, as shown in Figure 8, and then its impact decreased over time. This is due to the way the dynamics of the conflict in Syria evolved afterwards.

Figure 8. Short-run restricted impulse response of the internal conflict to the external conflict shock

Response of D(IC) to Shock2(EXC)
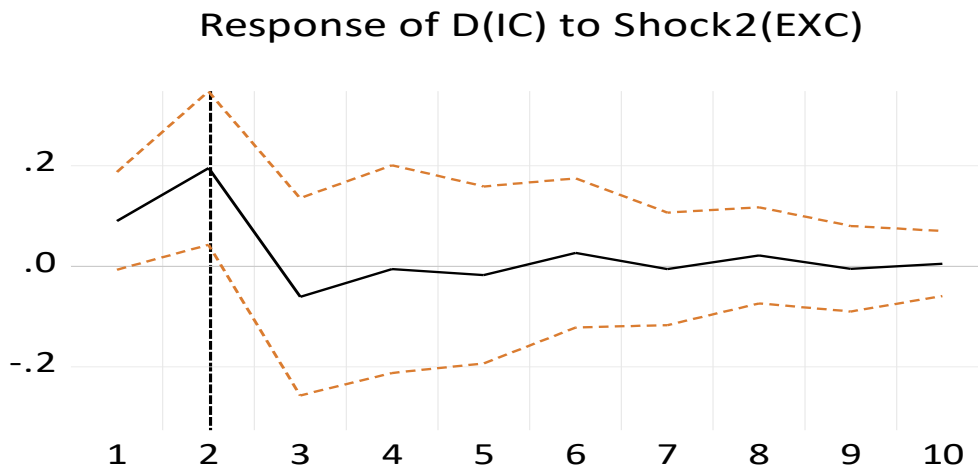
In order to determine the contribution of each shock to the interpretation of variances in the knowledge economy variable, we conducted a variance decomposition analysis of the short-run impact of shocks in Table 6.

Table 6. Variance decomposition of the knowledge economy (short-run SVAR)

	Variance Decomposition of D (KE)				
Period	S.E.	Shock1(IPSh)	Shock2 (EXC)	Shock3 (IC)	Shock4 (KE)
1	0.473988	29.24485	12.30013	3.950293	54.50472
2	0.738750	50.95887	6.999192	15.71573	26.32621
3	0.767126	47.31074	10.26182	15.11674	27.31070
4	0.770441	46.99936	10.21303	14.98694	27.80066
5	0.776685	46.25623	10.96197	15.25868	27.52312
6	0.786097	45.49044	11.33264	15.11654	28.06038
7	0.787665	45.37035	11.37334	15.23256	28.02375
8	0.789522	45.25885	11.48504	15.32322	27.93289
9	0.791551	45.04109	11.55532	15.30925	28.09433
10	0.791976	45.02275	11.56832	15.34164	28.06729

The results in Table 6 show that the internal policy shock has the highest explanatory power in the short run (ten years), with 45 percent of the variances in the knowledge economy. Meanwhile, the external shock and the internal conflict shock contribute to explaining 11.6 and 15.3 percent of the variation of the knowledge economy indicator, respectively.

These results indicate that, in the short run, the internal liberal policy shock plays a more important role than the internal conflict shock in interpreting changes in the knowledge economy in Syria. This can be explained by the nature of the liberal policy adopted by the Syrian government; this policy was not well-structured at the first stage of its implementation. In this context, it can be said that the liberal economic policy in Syria was neither liberal enough

nor pro-innovation enough to activat intensive knowledge-based activities in Syria in that period.

To analyze the nature of the long-run relationship between shocks and the knowledge economy, we built a long-run SVAR model after releasing the restriction of the internal policy shock's impact on the internal conflict shock since the long run. Table 7 shows the results of the long-run SVAR model.

Table 7. Long-run SVAR results

Long-run Matrix			
C(1)	0	0	0
0	C(4)	0	0
C(2)	C(5)	C(7)	0
C(3)	C(6)	C(8)	C(9)
	Coefficient	Std. Error	z-Statistic	Prob.

	Coefficient	Std. Error	z-Statistic	Prob.
C(1) [IPSh→IPSh]	0.399991***	0.070709	5.656854	0.0000
C(2) [IPSh→IC]	-0.152872***	0.045713	-3.344139	0.0008
C(3) [IPSh→KE]	-0.549002***	0.139966	-3.922410	0.0001
C(4) [ExC→ExC]	0.391264***	0.069166	5.656850	0.0000
C(5) [ExC→IC]	0.237633***	0.055894	4.251531	0.0000
C(6) [ExC→KE]	-0.458736***	0.129413	-3.544746	0.0004
C(7) [IC→IC]	0.139692***	0.024694	5.656853	0.0000
C(8) [IC→KE]	0.286178***	0.081032	3.531670	0.0004
C(9) [KE→KE]	0.253199***	0.044760	5.656853	0.0000

Estimated S matrix:			
0.330494	-0.022191	0.075246	0.053521
-0.070450	0.155582	0.185104	0.187510
0.036357	0.149984	0.121077	-0.082576
0.038372	-0.250148	0.346394	0.131448

| Estimated F matrix			
0.399991	0.000000	0.000000	0.000000
0.000000	0.391264	0.000000	0.000000
-0.152872	0.237633	0.139692	0.000000
-0.549002	-0.458736	0.286178	0.253199

The results in Table 7 show that the internal policy shock and external conflict have a significant negative impact on the knowledge economy. On the other hand, the results also show that the internal conflict shock has a positive relationship with the internal conflict. This can be explained by the fact that some variables of the knowledge economy, such as mobile subscriptions, broadband subscriptions, and published scientific articles, were not affected by the mechanisms of internal conflict because of two reasons: (1) the main infrastructure of mobile phone was not affected by the armed conflict in most areas, and (2) the effect of the conflict on the performance of the education sector in terms of the number of published articles was limited to the period between 2012 and 2014, and then it increased.

The results also show that the external shock has a significant impact on the internal conflict in Syria in the long run. This can be explained by the fact that the mechanisms of the internal conflict took two directions: (1) internal mechanisms started to revolutionize themselves with internal accumulated factors due to the way the conflict developed over time, (2) the internationalization of the conflict through interventions from several parties/countries in the region and from Europe.

Similarly, we analyzed the impulse response of the knowledge economy to all shocks in the long run. The results are shown in the Figures 9, 10, 11, and 12.
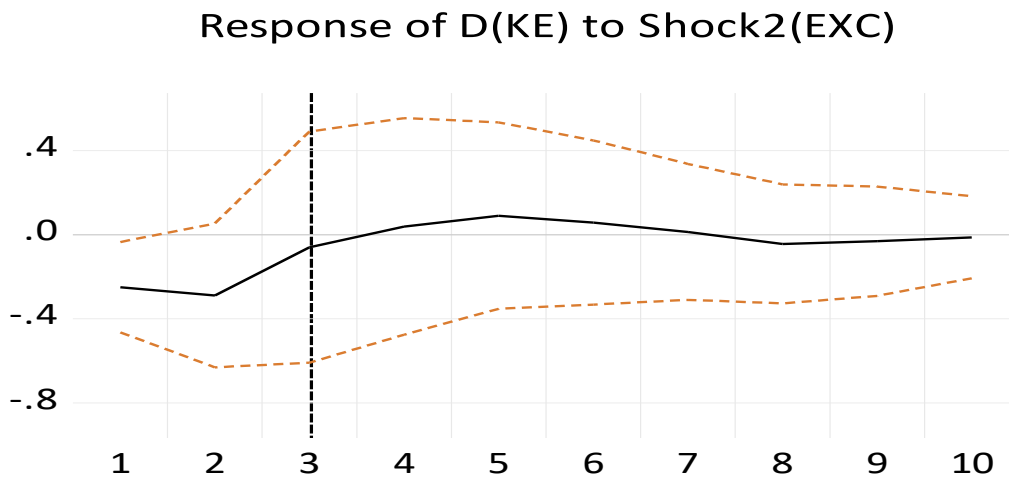
Figure 9. Long-run restricted impulse response of the knowledge economy to the internal policy shock

Response of D(KE) to Shock1(IPSh)
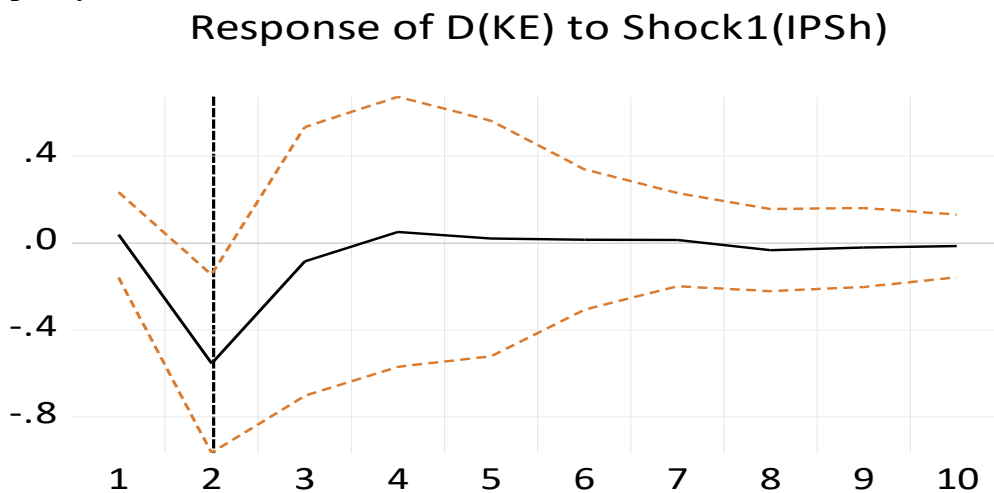
Similar to Figure 2, the internal liberal policy shock in Syria decreased the variances of the knowledge economy in the first two years. However, after that, the effect of the internal liberal policy disappeared. This indicates that liberal policies – which were supposed to expand the prospects of knowledge-intensive activities that require a certain level of economic liberalism and openness – have not been properly implemented. This has adversely affected the performance of the key indicators of the knowledge economy in Syria.

Regarding the long-run impact of the external shock, the results shown in Figure 10 indicate that the negative impact lasted for three years before becoming non-significant in the long run.
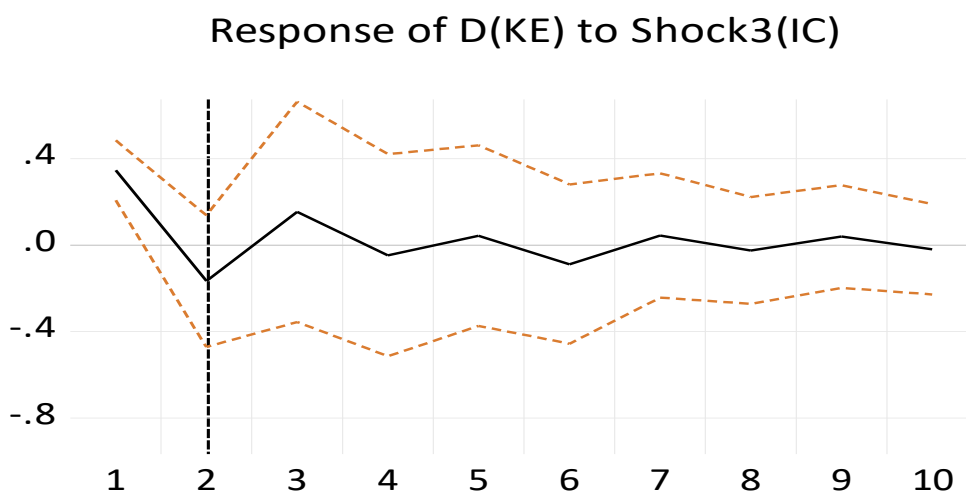
Figure 10. Long run restricted impulse response of the knowledge economy to the external conflict shock

Response of D(KE) to Shock2(EXC)

Here, it should be noted that the decreasing long-run impact of the external shock on the knowledge economy is due to an increase in the impact of internal shocks on the knowledge economy compared to external shocks.
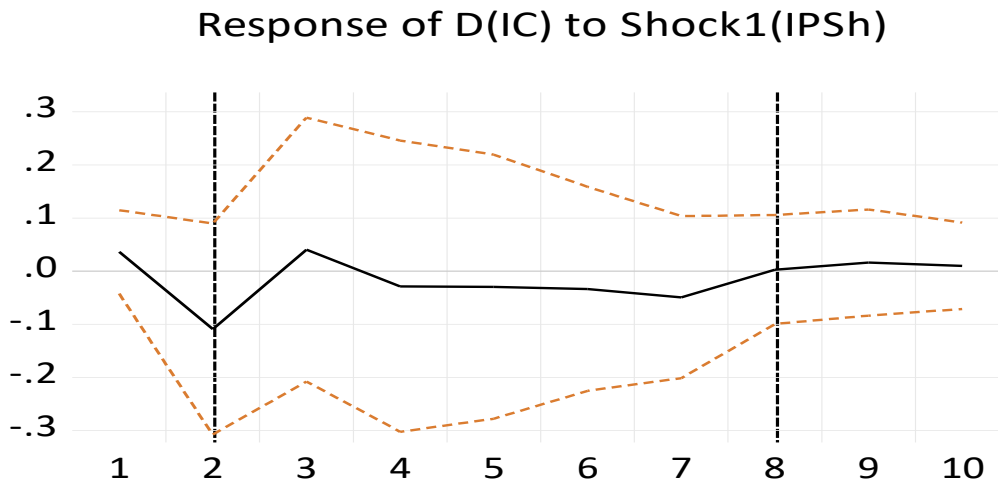
Figure 11 shows the impact of the internal conflict on the knowledge economy. The results show that the internal conflict shock had a significant negative impact on the knowledge economy in the first two years.

Figure 11. Long run restricted impulse response of the knowledge economy to the internal conflict shock

Response of D(KE) to Shock3(IC)

Figures 12 and 13 show the long-run path of the impact of both internal policy shocks and external shocks on the internal conflict in Syria.

Figure 12. Long-run restricted impulse response of the internal conflict to the internal policy shock

Response of D(IC) to Shock1(IPSh)

Figure 13. Long-run restricted impulse response of the internal conflict to the external conflict shock

Response of D(IC) to Shock2(EXC)
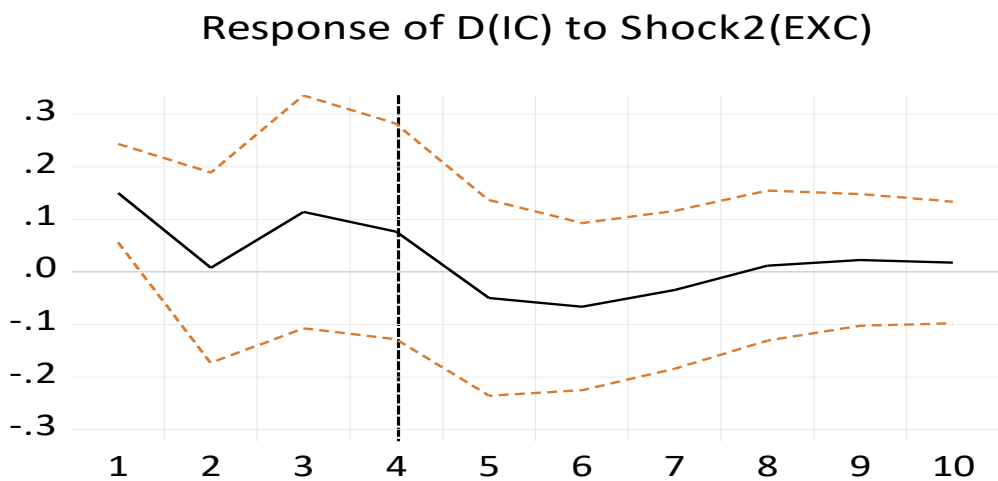
Figures 12 and 13 show that the impact of the external shock affects the internal conflict more than the internal policy shock in the long run. This can be explained by: (1) the nature of the Syrian conflict, which has taken an international dimension, and (2) the unstable and unstudied liberal policies that widened social polarization and marginalized a huge fraction of the society leading to the erosion of its human capital. In this context, it is worth mentioning that poverty rates have risen from 30.1 percent in 2004 to 33.6 percent in 2007, without neglecting the fact that some rural regions in Syria, such as the North-Eastern region, witnessed high poverty rates of 36 percent (Abu-Ismail et al., 2011).

The results of the decomposition variances analysis of the long-run impact of shocks on the knowledge economy are shown in Table 8.

Table 8. Variance decomposition of the knowledge economy (Long-run SVAR)

Period	S.E.	Shock1(IPSh)	Shock2(EXC)	Shock3(IC)	Shock4(KE)
		Variance Decomposition of D(KE)			
1	0.448680	0.731408	31.08283	59.60289	8.582873
2	0.788380	49.65424	23.52131	23.74151	3.082939
3	0.816385	47.38154	22.46074	25.69321	4.464514
4	0.820373	47.31676	22.47436	25.77653	4.432345
5	0.826872	46.63767	23.33082	25.65443	4.377080
6	0.835381	45.72850	23.33903	26.25265	4.679824
7	0.836877	45.59664	23.28026	26.43789	4.685202
8	0.839057	45.51245	23.43527	26.39062	4.661665
9	0.841146	45.34767	23.45455	26.48118	4.716608
10	0.841588	45.32684	23.45062	26.50820	4.714348

The results of the variance decomposition of the knowledge economy show that, in the long run, the internal shocks, the internal policy shock, and the internal conflict shock have a large influence on the knowledge economy and contribute to explaining the variances of the knowledge economy in Syria by 45.3 and 26.5 percent, respectively. In other words, the internal shocks account for about 72 percent of the differences in the knowledge economy in Syria in the long run. On the other hand, the external shock explains only 23.5 percent of the variances of the knowledge economy.

Regarding the accumulated impact of both internal liberal policy shocks, the results shown in Figure 14 show that the internal liberal policy shock has a significant negative long-run impact on the knowledge economy. This can be explained by the absence of a strategic national policy for the transition of the Syrian economy toward a knowledge-based economy.

Figure 14. Long-run restricted accumulated response of the knowledge economy to the internal liberal policy shock

Accumulated Response of D(KE) to Shock1(IPSh)
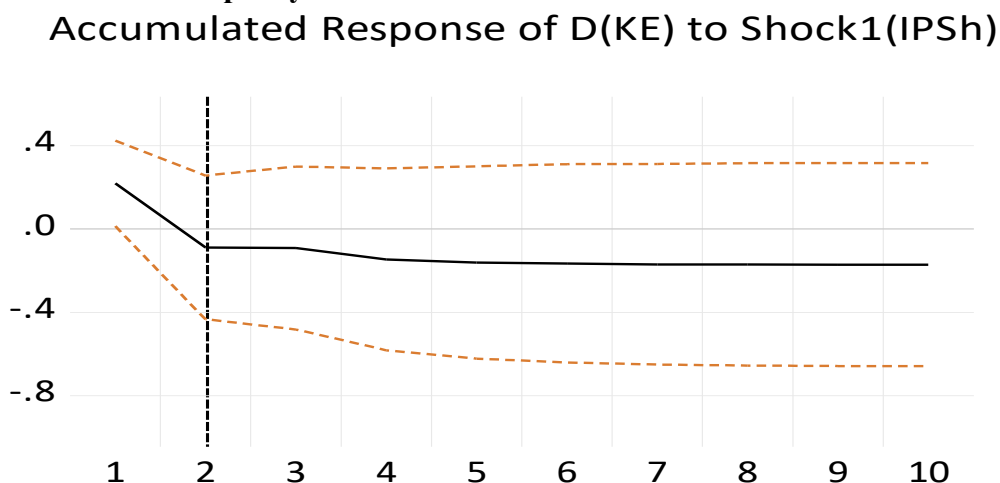
On the other hand, the long-run impact of the external shock on the knowledge economy in Syria, as shown in Figure 15, differs from its short-run impact.

Figure 15. Long-run restricted accumulated response of the knowledge economy to the external shock

### Accumulated Response of D(KE) to Shock2(EXC)
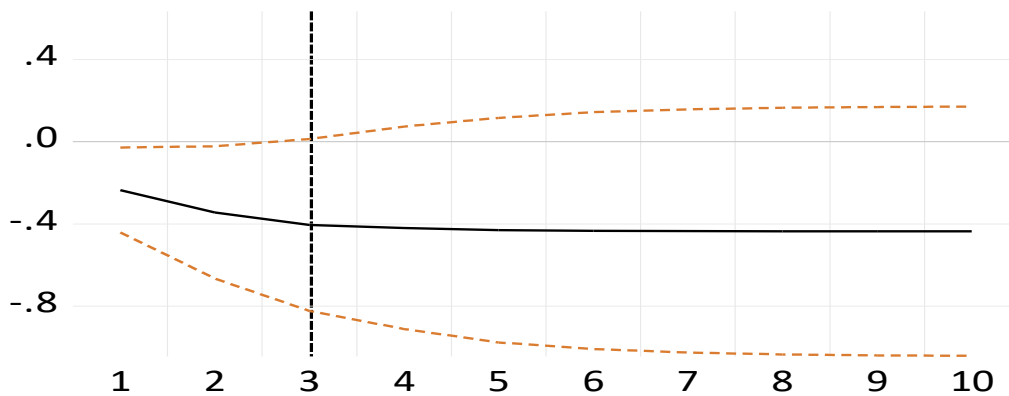
The results in Figure 15 show a significant negative impact of the external shock on the knowledge economy. This result is understandable when we take into consideration the international economic sanctions that prevent the establishment of regional and international partnerships in the field of innovation and knowledge creation.

As for the accumulated long-run impact of the internal conflict shock on the knowledge economy, the results in Figure 16 show a steady negative impact after the second year of the conflict.

Figure 16. Long-run restricted accumulated response of the knowledge economy to the internal conflict shock

Accumulated Response of D(KE) to Shock3(IC)
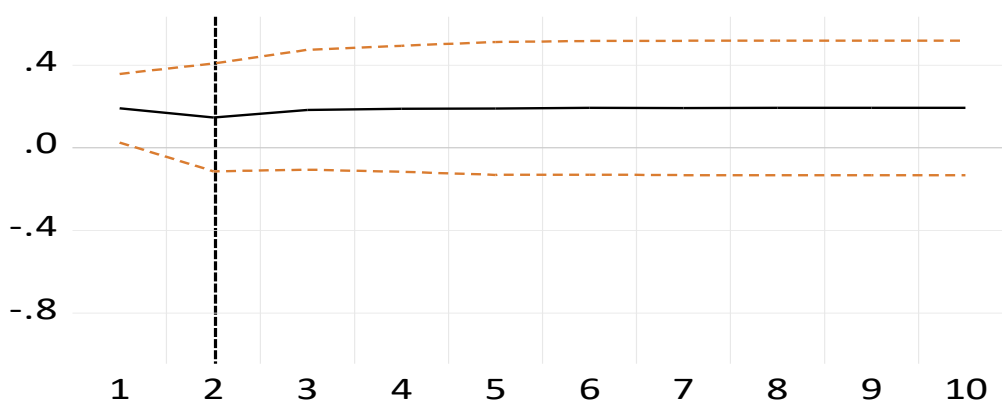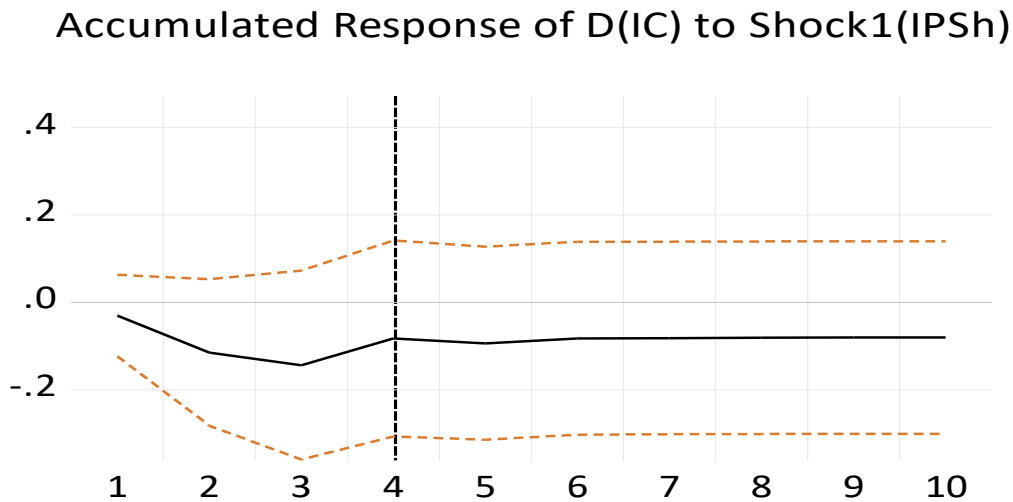

Moreover, the accumulated impact of the internal conflict on the internal liberal policy and external shock shows different patterns. The accumulated impact of internal liberal policy on the internal conflict shows a negative relationship during the first four years. However, as a result of unstable and distorted liberal policy and the catastrophic social results of the adopted

policy, social instability was inevitable. Therefore, we see in Figure 17 the internal liberal policy's positive impact on the internal conflict in the long run.

Figure 17. Long-run restricted accumulated response of the internal conflict shock to the internal liberal policy shock

Accumulated Response of D(IC) to Shock1(IPSh)

On the other hand, the accumulated long-run impact of the external shock on the internal shock in Syria was significantly positive, especially during the first two years, as shown in Figure 18.

Figure 18. Long-run restricted accumulated response of the internal conflict shock to the external shock

Accumulated Response of D(IC) to Shock2(EXC)
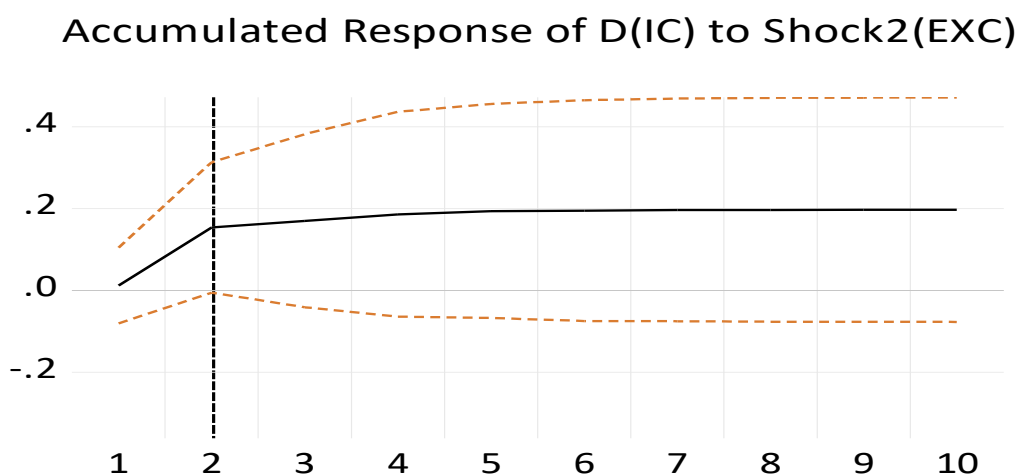
Consequently, it can be concluded that the narrative of external shocks and their impact on the knowledge economy in Syria are valid only in the short run. In the long run, however, the narrative of external shocks cannot provide a comprehensive explanation of the changes in the knowledge economy. Internal shocks, whether associated with political instability and insecurity or with poorly implemented national economic policies, are the ones that have the

greatest impact on the process of building and transitioning toward a knowledge economy in Syria in the long term.

Based on the above results, it can be argued that building national policies for innovation, technology, and science (Alnafrah et al., 2020; Alnafrah & Mouselli, 2019), as well as achieving a political settlement and agreeing on the identity of the national economy within the framework of a clear and comprehensive strategy, are essential steps in building a knowledge-based economy in post-conflict Syria. Moreover, all narratives that link the failure of the process of building or transitioning toward the knowledge economy to external shocks or external factors are unreliable.

Conclusion

In this study, we provided a test for the external shock narrative and its role in building the knowledge-based economy in Syria in both the short and long run by using SVAR models.

The results showed that the knowledge-based economy in Syria is affected by internal shocks in the short and long run, especially those associated with the liberal policy and their implementation.

The study also revealed that, in the long run, internal conflict in Syria is more determined by internal factors than by external shocks. This is because of the way in which the dynamics of the conflict evolved as well as the type of economic policies adopted in the conflict period, particularly those associated with cutting subsidies and the marginalization of the middle class.

Regarding the limitations of the study, it can be said that including more variables in the knowledge-based economy proxies would provide more insight to the results. Thus, there is room for future scholars to integrate more variables that represent other dimensions of the knowledge-based economy and study their relationship with external and internal shocks.

Finally, it can be noted that limiting the explanation of the failure in transitioning toward a knowledge-based economy to external shocks alone does not reflect reality. Therefore, taking the internal shocks into account, especially in countries that suffer from political and social instability and fluctuating national policies, is a fundamental step toward understanding reality and identifying the shortcomings in the system. This step is important to orient national innovation policy toward accelerating the process of building a knowledge-based economy in a country that is struggling to put an end to the spiral of conflict.

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Appendix 1

Table 1. Descriptive statistics

	Education Index	Trademarks	Patents	Articles	Broadband	Internet	Mobile	IPSh	IC	EXC
Mean	0.48	6038.4	213.5	5.26E-11	-5.26E-11	5.26E-11	5.26E-11	0.74	0.42	0.26
Median	0.46	5533	228	0.08	-0.58	0.04	0.09	1.	0.00	0.00
Maximum	0.56	15829	295	1.47	2.46	1.47	1.79	1.0	1.00	1.0
Minimum	0.41	1353	112	-1.5	-0.64	-1.39	-1.39	0.00	0.00	0.00
Std. Dev.	0.05	3905.16	47.7	1.02	1.03	1.03	1.028	0.45	0.51	0.45
Jarque-Bera	2.06	2.83	1.77	1.99	7.51	1.73	1.3	4.22	3.17	4.22
Probability	0.35	0.2	0.41	0.36	0.02	0.4	0.51	0.12	0.2	0.12
Ob	19	19	19	19	19	19	19	19	19	19

Table 2. PCA Results

Total Variance Explained						
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.556	65.080	65.080	4.556	65.080	65.080
2	1.445	20.639	85.719			
3	.541	7.735	93.454			
4	.376	5.370	98.824			
5	.047	.672	99.496			
6	.031	.436	99.933			
7	.005	.067	100.000			