Economic Fluctuations and the shadow Economy: A global study

Nguyen Canh

University of Economics Ho Chi Minh City

Christophe Schinckus (✉ Christophe.Schinckus@taylors.edu.my)

Taylor's University Taylor's Business School <https://orcid.org/0000-0002-0977-7428>

Su Di Thanh

University of Economics Ho Chi Minh City

Research

Keywords: Economic Fluctuations, Shadow Economy, Economic Stability.

Posted Date: March 24th, 2020

DOI: <https://doi.org/10.21203/rs.3.rs-18365/v1>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License. [Read Full License](#)

Abstract

The recent economic crisis re-emphasizes the importance of the economic fluctuations. This study investigates the role of shadow economy in combination with economic factors on the economic instability for 133 economies between 1991 and 2015. Using the system-GMM estimations, this article shows that a larger shadow economy increases the fluctuations of GDP growth rate in relation to the size and the volatility of shadow economy. Notably, the shadow economy presents an inverted-U relationship with economic instability and this relationship is strongest for low- and lower-middle income economies. Our results identify two categories of drivers for economic fluctuations: the stabilizing factors (the labour force and the TFP) and the enhancing factors (capital investment, consumption, government spending, trade and FDI inflows). Interestingly exports increase economic fluctuations while imports decrease them. Finally, we discuss differences in the determinants of economic instability across low, middle and high incomes countries.

Introduction

What generates economic fluctuations is an important issue in macroeconomics. A huge literature deals with the determinants of economic fluctuations from both demand and supply sides; in the short- and the long-run (Kose and Riezman 2001, Wen 2006). The 2008 global financial crisis re-emphasized this issue by generating a lot of debates (Christiano, Motto, and Rostagno 2010). This article contributes to these debates by investigating the role of shadow economy in the economic instability. According to Blackburn, Bose, and Capasso (2012), the shadow economy refers to a pervasive feature of the economies throughout the world, which includes all unregistered economic activities that would contribute to the official output if counted (Schneider and Williams 2013). Medina and Schneider (2018) documented that the average size of shadow economy in 158 countries is 31.9 percent over 1991 to 2015, the largest ones (in 2015) are Zimbabwe and Bolivia with respectively 60.6 percent and 62.3 percent of GDP, while the lowest ones are Austria and Switzerland with 8.9 percent and 7.2 percent, respectively. In this context, a key question is: does shadow economy influence economic fluctuations? If yes, to what extent? Does shadow economy enhance economic fluctuations or does it act as a “buffering activity” stabilizing the economies facing with economic fluctuations? This article aims at investigating these questions.

Some previous studies have built some theoretical frameworks supported by empirical evidence linking economic fluctuations and informal activities. Restrepo-Echavarria (2014), for instance, showed that shadow economy can affect the measurement of the official economic fluctuations. Ferreira-Tiryaki (2008) found that larger shadow economies tend to induce a higher volatility in output, investment and consumption over the business cycle in a sample of 22 economies over the period 1961–2002. Recently, Horvath (2018) noticed a positive relationship between the relative volatility of the ratio consumption to output and the size of the informal economy. As explanation, the literature usually claims that unofficial businesses are mostly small, they cannot benefit from the economies of scale and have a limited financial access (Ferreira-Tiryaki 2008). Consequently, informal businesses are likely to be more exposed to economic instability leading to higher economic fluctuations. However, the shadow economy may not always be a driver of economic instability if we look it in a more holistic way and its links with official sectors. One of the most important nature of shadow economy is the untaxed economic activities, which is hiding from governments for tax evasion (Tanzi 1982). Such activities may bring other unexpected benefits to economic agents. Second, the informal businesses are small, which mean they are more flexible in changing production, business model (Liao and Barnes 2015). Third, the cost and the side effects of a failure to the economy of the informal small businesses is likely to be smaller than the failure of large official firms (Audia and Greve 2006). In other words, the informal businesses under recessions may fail, but their failure might have a weaker marginal impact on the economy. Overall, shadow economy may act as a buffer (i.e. with less cost and weaker impacts) for official economic activities in case of economic fluctuations. However, these influences of shadow economy in the macroeconomic instability have been largely ignored in the literature. Given the importance of shadow economy in the global economy (31.9% according to Medina and Schneider (2018)), this question must be investigated further. This is the objective of this study.

This article uses annual macroeconomic data from World Development Indicators Database (World Bank) and the shadow economy estimations provided by Medina and Schneider (2018). The data for the 133 economies have been divided into 3 categories: 62 low- and lower-middle income economies (LMEs), 31 upper-middle income economies (UMEs), and 40 high-income economies (HIEs) in line with the World Bank classification. Using the system-GMM estimations, this article shows that a larger shadow economy increases the fluctuations of GDP growth rate in relation to the size and the volatility of shadow economy. Interestingly, the shadow economy presents an inverted-U relationship with economic instability and this relationship is strongest for LMEs.

The study is structured as follows: the Sect. 2 reviews the literature; the Sect. 3 presents our methodology and data while our results are discussed in Sect. 4. The final section ends this study with conclusions and recommendations.

Literature Review

Economic fluctuations have always been a key issue in macroeconomics (Gambacorta and Marques-Ibanez 2011). The empirical literature identified several drivers of economic instability from both side: demand shocks (Hall 1986) and supply shocks (Gali 1999) but also shocks from economic integration as trade activities and capital flows (Kose and Riezman 2001), shocks from fiscal policy and monetary policy (Creal and Wu 2017) and shocks from the financial sphere (credit supply or stock prices) (Chauvet and Guo 2003, Christiano, Motto, and Rostagno 2010). More recently, Furlanetto, Ravazzolo, and Sarferaz (2014) found that financial shocks are actually the major driver of fluctuations while Gilchrist, Yankov, and Zakrajšek (2009) showed that credit market shocks contributed significantly to the US economic fluctuations for the period of 1990–2008. On

another point, Konstantakis, Michaelides, and Tsionas (2016) documented that the ten-year bond yields and the elections can play a pro-cyclical role on the Greek business cycle in the period of 1995–2004.

Economic fluctuations are also related to human expectations and how the market perceives the level of uncertainty associated with the economic context under consideration. Using survey data in US, Leduc and Sill (2013) found that changes in expected future economic activity act as an important driver for economic fluctuations. Creal and Wu (2017) documented that uncertainty contributes negatively to economic activity when they investigated the relationship between uncertainty about monetary policy and economic fluctuations. Related to this aspect, Forni, Gambetti, and Sala (2017) explained that the Great Recession were exacerbated by the uncertain context generated by media and news.

A particular way of characterizing the uncertainty of a country is to investigate the importance of its shadow economy. Surprisingly, the influence of shadow economy on economic fluctuations is still relatively under-investigated in the literature despite the existence of some research: Mai & Friedrich, 2016; Medina & Schneider, 2018. Because agents operating in shadow economy do not wish to be identified, the estimation of such economy can be tricky. Schinckus (2009) explained that uncertainty is probably the major driver of all economic activities despite the difficulty to estimate it. Fortunately, recent databases about shadow economy (Medina and Schneider 2018) have been developed offering new opportunities for academic research.

Shadow economy refers to all currently unregistered economic activities which if counted, would contribute to the official output (Schneider and Williams 2013). Mai and Friedrich (2016) specifically defined shadow economy as the legal economic and productive activities that would contribute to national GDP if recorded, but it does not include illegal, criminal activities, do-it-yourself, charitable or household activities. In other words, shadow activities refers to all these legal economic activities actually refer to market-based production of goods and services that are deliberately concealed from public authorities to avoid payment of income, value added, other taxes or costs related to legal labour market policy (social security, minimum wages, maximum working hours, safety standards, etc.) (Schneider and Williams 2013).

Shadow economy can also be related to (i) tax evasion since economic agents are not willing to pay when taxes or social security burdens are high (see Tanzi (1999), Schneider (1994)) and (ii) the quality of government in implementing and enforcing their regulations (La Porta et al. 1999). A weak institutional quality (associated with bureaucracy, regulatory discretion, rule of law, corruption, and a weak legal system) usually paved the way to a higher level of shadow activities (Friedman et al. 2000). Several studies examined the effects of shadow economy on other economic aspects. While Dreher, Kotsogiannis, and McCorriston (2009) found that corruption and shadow markets have a substitution effect in 145 countries over the period of 2000–2002; Choi and Thum (2005) documented that shadow sectors can be perceived as a complementary element to the official economy. In the light of these findings one can question remains: how does shadow economy influence the economic instability?

There exist few studies detailing the link between these two aspects. (Granda-Carvajal 2010, Shapiro 2015). Broadly speaking, the literature explains that unofficial businesses are mostly small and therefore 1) they cannot benefit from economies of scale; and 2) they have a limited financial access (Ferreira-Tiryaki 2008). As a result, informal businesses are likely more exposed to economic instability, which resulting in the fail and overall higher economic fluctuations.

In this study, we use the few existing studies to investigate further these aspects by adding the economic reasoning eventual influence of the shadow economy on the economic instability. First, a higher shadow economy might reduce the government's capability to implement a fiscal policy, especially a counter-cyclical fiscal policy. In other words, an increase of shadow economy reduces government's revenue implying therefore a negative impact on the ability of government to provide public goods and services. Paradoxically, such situation might lead the government to react by increasing the tax rates (Talvi and Végh 2005). Consequently, shadow economy distorts and weakens government roles in its allocation, redistribution and stabilization function (Κάτσοις 2015).

It is also worth mentioning the possible link between shadow economy and the effectiveness of monetary policy. Both fiscal and monetary policies require a precise estimation of the key macroeconomic indicators related to output and unemployment. In this context, shadow economy and its non-declared activities become an important issue. (Fleming, Roman, and Farrell 2000). For instance, the velocity of currency in the official sector is quite difficult to value but it becomes totally impossible to estimate when the shadow economy activities are important (Schneider 2000) leading to the use of biased estimations in conducting monetary policies. Furthermore, shadow banking (Gennaioli, Shleifer, and Vishny 2013) or informal credit (Barslund and Tarp 2008) have also severely misled decision related to monetary policy. In this challenging context, a higher shadow economy implies a higher economic uncertainty complicating the role of central banks in the implementation of monetary policy (that have often been blamed for the turbulences in recent crisis, (Duncan, 2014; (Creal and Wu 2017). Related to that, economic activities taking place in the shadow economy are not protected by any legal framework but these activities are rather ruled by the informal trust between economic agents who usually focus on a short-term horizon. However, a higher shadow economy generally leads to a lower generalized trust in the overall economy (D'Hernoncourt and Méon 2012). All these aspects influence the investors mood and it might exacerbate economic fluctuations (Forni, Gambetti, and Sala 2017).

In overall, the shadow economy may induce higher economic fluctuations through the links with the effectiveness of macroeconomic policies and the nature of informal businesses, which are far from economies of scales or optimal mix of labor/capital in production, and moreover face with financial constraints. Restrepo-Echavarria (2014) showed that shadow economy can affect on the measurement of official economic fluctuations. Ferreira-Tiryaki (2008) found that larger shadow economies tend to induce the volatility in output, investment and consumption over the business cycle in a

sample of 22 economies over the period 1961–2002. Recently, Horvath (2018) notice a positive relationship between the relative volatility of consumption to output and the size of the informal economy.

However, the link between shadow economy and economic fluctuations must be treated in different ways. We mentioned above the potential influence of shadow economy on economic instability. There are also other reasons why shadow economy may have a positive influence in reducing the economic fluctuations. We detail hereafter the reasons for why we decided to investigate further the relationship between shadow economy and economic fluctuations.

Tax evasion, for instance, can actually bring to economic agents additional unexpected benefits offering therefore an advantage for informal sectors in case of economic fluctuations. Second, the informal businesses are small, which mean they are more flexible in changing their production or business model. Third, the cost and the spread effects to the economy of the fail in small businesses will be much more smaller than the fail of large firms so that the informal businesses under recessions may be fail but their failure would have a weaker marginal impact on the economy. Overall, shadow economy may act as a buffer or a complement for official economic activities in case of large economic fluctuations with less cost and weaker spread impacts. As a result, there is a surprising claim according to which shadow economy in some circumstances, may be useful for the economy depending on its size and the development of the national economy. This study investigates further this surprising claim.

Methodology

In fact, there are several studies examining the fluctuations in economic factors in the linkages with economic fluctuations (McConnell and Perez-Quiros 2000, Ahmed 2003). While recent studies concern pay more attention to the changes or shocks in the levels of economic factors to economic fluctuations (Petrosky-Nadeau 2014, Creal and Wu 2017, Forni, Gambetti, and Sala 2017). To catch up with recent trend in literature, this study concerns the changes in both level (size) and volatility of shadow economy and the impacts of economic fluctuations. In this framework, the changes in levels of other economic factors from both demand and supply side are added as control variables. The drivers from supply and demand side including private consumption, private investment, fiscal policy, technological progress, capital flows, trade openness have been mobilized for our study. The selection of these variables results from the existing literature on the topic while our panel data concerns 133 economies for the period form 1991–2015. Generally speaking, the economic fluctuations of a country will be estimated through the following relationship,

$$evo_{it} = \beta_0 + \beta_1 evo_{it-1} + \delta_j ef_{jit-1} + \varepsilon_{it}$$

1

in which: i, t denote the country i at year t ; evo is the economic fluctuation that is proxied by the 3-year standard deviations of real GDP growth rate; ef is the vector of economic explanatory variables including: logarithm of real GDP per capita ($Mgdppc$), trade openness to GDP ($Mtrade$), FDI inflow to GDP ($Mfdi$), domestic credit to private sector to GDP ($Mcredit$), population age 15–65 to total ($MIlabor$), general government final consumption to GDP ($Mgove$), gross capital formation to GDP ($Mcap$), annual growth rate of household final consumption ($Mconsu$), and annual growth rate of real GDP per person employed ($Mtfp$). These explanatory variables are calculated as 3-year mean value to proxy the income level, changes in trade, capital flow, labour, fiscal policy, capital investment, and TFP, respectively, as recorded as drivers of economic fluctuations in the literature (Christiano, Motto, and Rostagno 2010, Konstantakis, Michaelides, and Tsionas 2016, Fosu 2001, Sordi and Vercelli 2006, Jallab, Gbakou, and Sandretto 2008). β, δ are the usual coefficients and ε is the classical residual term. Details on these data are presented in the table 1.

Table 1
Variables, definitions, and sources

Variables	Denote	Definitions	Sources
Dep. var.	evo	3-year standard deviation of real GDP growth	WDI
Independent vars.		<i>3-year mean of:</i>	<i>Calculation from</i>
Economic factors (ef)	Mgdppc	Logarithm of GDP per capita (constant 2010 US\$)	WDI
	Mtrade	Trade (% of GDP)	WDI
	Mexport	Exports of goods and services (% of GDP)	WDI
	Mimport	Imports of goods and services (% of GDP)	WDI
	Mfdi	Foreign direct investment, net inflows (% of GDP)	WDI
	Mlabor	Population ages 15-64 (% of total population)	WDI
	Mgove	General government final consumption expenditure (% of GDP)	WDI
	Mcap	Gross capital formation (% of GDP)	WDI
	Mconsu	Annual growth rate of Household final consumption expenditure (%)	WDI
	Mtftp	Annual growth rate of real GDP per person employed	WDI
Shadow economy (se)	Mse	Size of Shadow economy (% to GDP)	Medina and Schneider (2018)
	Stdse	3-year standard deviation of shadow economy's size	

In first step, the influence of economic drivers on the economic instability is investigated. It is worth mentioning that all the lags for explanatory variables are used to avoid the endogenous problem in our dynamic panel data. Therefore, the trade openness is replaced by the 3-year mean of exports to GDP (Mexport) and imports to GDP (Mimport) to examine the channel of trade shocks to economic fluctuations. Next, the shadow economy (se) under three aspects as the 3-year mean of shadow economy to GDP (Mse), the standard deviation of shadow economy to GDP (Stdse) and the square of 3-year mean of shadow economy to GDP, are incorporated in Eq. 1 to examine the roles of the shadow economy in relation to its size, its volatility, and its non-linear relationship with economic fluctuations. The Eq. 2 hereafter details this estimation,

$$evo_{it} = \beta_0 + \beta_1 evo_{it-1} + \delta_j ef_{jit-1} + \gamma_1 Mse_{it-1} + \gamma_2 (Mse_{it-1})^2 + \gamma_3 Stdse_{it-1} + \varepsilon_{it}$$

2

The data concerning the shadow economy are coming from Medina and Schneider (2018), all other economic variables are extracted from World Development Indicators (World Bank). The data description, unit root test and correlation matrix are presented in table 2 and 3 hereafter,

Table 2
Data description

Variable	Obs	Mean	Std. Dev.	Min	Max	Levin-Lin-Chu unit-root test
evo	3,015	2.484	2.552	0.034	24.216	-13.05***
Mgdppc	3,021	8.452	1.586	5.123	11.594	-3.728***
Mtrade	3,010	83.032	50.574	14.902	433.055	-8.644***
Mexport	3,010	39.834	27.777	4.582	225.355	-9.020***
Mimport	3,010	43.198	24.592	7.254	216.205	-8.662***
Mfdi	2,934	4.063	6.387	-9.759	113.526	-11.61***
Mlabor	3,055	61.972	7.119	45.926	85.721	-19.43***
Mgove	3,009	15.595	5.759	3.797	58.891	-8.450***
Mcap	3,007	23.118	7.424	1.061	66.990	-9.301***
Mconsu	2,865	6.714	8.650	-48.979	55.476	-10.86***
Mtftp	2,926	1.470	3.598	-34.798	36.602	-10.03***
Mse	3,059	31.472	13.327	6.487	70.937	-2.048**
Stdse	3,059	1.067	0.918	0.010	10.849	-15.68***

Note: in Levin-Lin-Chu unit-root test: Ho: Panels contain unit roots, Ha: Panels are stationary. **, *** are significant levels at 5% and 1%, respectively.

Table 3
Correlation matrix

Correlation	<i>Stdgdpg</i>	<i>Mtrade</i>	<i>Mexport</i>	<i>Mimport</i>	<i>Mfdi</i>	<i>Mlabor</i>	<i>Mgove</i>	<i>Mcap</i>	<i>Mconsu</i>	<i>Mtftp</i>	<i>Mse</i>
<i>evo</i>	1.000										
<i>Mtrade</i>	0.049***	1.000									
	0.008										
<i>Mexport</i>	0.035*	0.970***	1.000								
	0.057	0.000									
<i>Mimport</i>	0.061***	0.961***	0.865***	1.000							
	0.001	0.000	0.000								
<i>Mfdi</i>	0.032*	0.515***	0.479***	0.520***	1.000						
	0.085	0.000	0.000	0.000							
<i>Mlabor</i>	-0.075***	0.311***	0.381***	0.209***	0.162***	1.000					
	0.000	0.000	0.000	0.000	0.000						
<i>Mgove</i>	0.008	0.037**	0.036**	0.035*	0.021	0.131***	1.000				
	0.664	0.044	0.049	0.055	0.249	0.000					
<i>Mcap</i>	-0.085***	0.156***	0.117***	0.189***	0.150***	0.322***	0.023	1.000			
	0.000	0.000	0.000	0.000	0.000	0.000	0.201				
<i>Mconsu</i>	-0.087***	0.031*	0.020	0.042**	0.065***	0.030	-0.144***	0.154***	1.000		
	0.000	0.097	0.298	0.025	0.001	0.104	0.000	0.000			
<i>Mtftp</i>	-0.175***	0.051***	0.029	0.072***	0.126***	0.104***	-0.070***	0.247***	0.354***	1.000	
	0.000	0.006	0.115	0.000	0.000	0.000	0.000	0.000	0.000		
<i>Mse</i>	0.165***	-0.205***	-0.273***	-0.113***	-0.119***	-0.544***	-0.286***	-0.242***	0.025	-0.055***	1.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.188	0.003	

The data show that the size of the shadow economy is average ranged from over 6% to nearly 71% of official GDP in 133 economies with the average of 31.472% for the whole period of 1991–2015. These results also indicate that there are huge differences in terms of economic integration among countries. Meanwhile, the Levin-Lin-Chu unit-root test (Levin, Lin, and Chu 2002) shows that all variables are stationary at level, which are suitable for panel estimations.

The Fig. 2 shows that a higher economic fluctuations tends to appear in higher income economies with high trade openness, high imports to GDP, high FDI inflows, low level of household consumption, low gross capital formation, low domestic credit level, high government expenditure, and labor forces around 50% and 65% percent of total population. To provide a more detailed analysis, we follow the classification proposed by the World Bank to decompose our sample into 62 low- and lower-middle income economies, 31 upper-middle income economies, and 40 high-income economies basing on their average GDP per capita (for the period 1991–2015). We then ran new estimation for our three sub-samples for robustness purposes.

Econometrically, the estimation of dynamic panel data is faced to the issue of endogeneity (Roodman 2006). Anderson and Hsiao (1982) propose first difference method to deal this issue in panel data by combining first differencing with instrumental variables in estimation. Arellano and Bond (1991) develop the GMM estimator and argues that it is a more efficient estimation. But the method in Arellano-Bond GMM estimator faces to the problem of asymptotically and considerable bias in unbalanced panel data (Roodman 2006). The system GMM estimator is then proposed by Arellano and Bover (1995) and extended by Blundell and Bond (1998) and Blundell and Bond (1998) to reduce the bias associated with the fixed effects in short panels as two-step system GMM (Roodman 2009). In this study, the standard two-step system GMM is applied by using one-year lags of independent variables are instrument variables.

Results And Discussion

As detailed in the previous section, we used here a GMM system for the estimations of our dynamic panel data. Related to this methodology, it is worth mentioning that the AR(2) and Hansen tests were not significant implying that our results are consistent and unbiased. The table 4 hereafter shows the determinants of economic fluctuations for the full sample of 133 economies.

Table 4
Determinants of Economic fluctuations

Dependent var:	Determinants of Economic fluctuations				
evo	Model 1	Model 2	Model 3	Model 4	Model 5
evo(-1)	0.578*** [0.003]	0.576*** [0.003]	0.576*** [0.003]	0.575*** [0.003]	0.577*** [0.003]
Mgdppc(-1)	-0.050*** [0.011]	-0.081*** [0.010]	-0.051*** [0.012]	-0.059*** [0.012]	-0.095*** [0.014]
Mcap(-1)	0.022*** [0.002]	0.018*** [0.001]	0.016*** [0.002]	0.017*** [0.002]	0.019*** [0.002]
Mconsu(-1)	0.025*** [0.001]	0.022*** [0.001]	0.023*** [0.001]	0.022*** [0.001]	0.022*** [0.001]
Mgove(-1)	0.007*** [0.002]	0.019*** [0.002]	0.016*** [0.002]	0.017*** [0.002]	0.020*** [0.003]
Mlabor(-1)	-0.004* [0.002]	-0.006*** [0.002]	-0.011*** [0.002]	-0.011*** [0.002]	-0.009*** [0.002]
Mtfp(-1)	-0.040*** [0.003]	-0.038*** [0.002]	-0.024*** [0.003]	-0.024*** [0.003]	-0.024*** [0.003]
Mtrade(-1)		0.002*** [0.0002]	0.001*** [0.0002]		
Mexport(-1)				0.002*** [0.0004]	0.008*** [0.001]
Mimport(-1)					-0.007*** [0.001]
Mfdi(-1)			0.020*** [0.002]	0.019*** [0.002]	0.021*** [0.002]
Constant	0.887*** [0.108]	1.039*** [0.099]	1.165*** [0.095]	1.201*** [0.093]	1.367*** [0.089]
N	2586	2702	2626	2626	2626
No. of countries	133	133	133	133	133
No. of IVs	121	124	125	125	126
AR(-2) test	0.208	0.411	0.389	0.389	0.387
Hansen test	0.211	0.236	0.246	0.246	0.259

Note: *, **, *** are the significant levels at 10%, 5%, and 1%, respectively. The standard errors are presented in [].

The positive significant effect of the lag economic volatility on the current ones implies that the economic fluctuations exhibit an exacerbated effect of volatility on the real GDP growth rate. This might lead to a difficult self-enforcing situation when the economic instability can not be stabilized. A higher volatility in a specific year t may stimulate a higher instability in the following period $(t + n)$ if nothing is done. This observation actually supports the Keynesian perspective according governments should take actions in fighting with economic crisis (Sharma 2004). However, such interventions must be planned and balanced since our empirical evidence suggest that a too high increasing in the government expenditures also increase the economic fluctuations. This empirical result is consistent with public theories stating that a large government size with the over public spending can be a major cause for economic crisis (Feldstein 2009).

The increase in gross capital formation, household consumption, trade openness and FDI inflows also increase the volatility of real GDP growth rates. However, the economies with higher income levels, higher level of labour force and TFP present less volatility in real GDP growth rates. The significant positive impacts of gross capital formation on economic volatility refers to the facts that higher capitalized economies face with higher economic

fluctuations (King et al. 1987) where shocks related to the marginal efficiency of new investment are stronger (Justiniano, Primiceri, and Tambalotti 2010). An increasing in the household final consumption expenditures significantly increases the volatility of real GDP growth rate implying that shocks in private consumption can also contribute to overall economic fluctuations (Hall 1986).

The significant negative effect of labour forces and TFP on economic fluctuations show some interesting relationships. Concretely, these results mean that economies with higher labour forces to total population have a better configuration to temper economic turbulences. Conversely, innovations and technological progress not only boost the economic growth but they also temper instability by reducing the economic fluctuations (Bilbao-Osorio and Rodríguez-Pose 2004). These results provide some significant policy implications that we will detail later in this study.

The significant positive impacts of FDI inflows and trade openness on the volatility of the real GDP growth rates confirm the previous empirical studies on the topic. Specifically, a higher level of FDI inflow increases economic fluctuations (Furceri, Guichard, and Rusticelli 2012). Such observation re-emphasizes the concerns about the “bad side” of capital flows on domestic economic activities (Furceri, Guichard, & Rusticelli, 2012). Regarding trade openness, the results indicate that international shocks may affect the domestic economic stability through the export channel which is consistent with previous documents (Schmitt–Grohé 1998). This observation is quite straightforward: higher exports to GDP indicate a higher dependence of domestic producers to international customers and therefore a higher volatility of overall economy. In contrast, a higher ratio of import to GDP decreases the volatility of real GDP growth rate. Our results are presented in the following table.

Table 5
Shadow economy and Economic fluctuations

Dependent var:	Shadow economy and Economic fluctuations				
evo	Model 6	Model 7	Model 8	Model 9	Model 10
evo(-1)	0.579*** [0.003]	0.579*** [0.003]	0.528*** [0.004]	0.528*** [0.004]	0.530*** [0.004]
Mgdppc(-1)	-0.013 [0.014]	0.028* [0.017]	-0.017 [0.017]	-0.027 [0.017]	-0.070*** [0.020]
Mcap(-1)	0.019*** [0.002]	0.019*** [0.002]	0.017*** [0.002]	0.017*** [0.002]	0.019*** [0.002]
Mconsu(-1)	0.023*** [0.001]	0.022*** [0.001]	0.019*** [0.001]	0.019*** [0.001]	0.019*** [0.001]
Mgove(-1)	0.014*** [0.002]	0.014*** [0.002]	0.020*** [0.002]	0.020*** [0.002]	0.023*** [0.002]
MLabor(-1)	-0.011*** [0.002]	-0.014*** [0.002]	-0.007** [0.003]	-0.007*** [0.003]	-0.005** [0.003]
Mtfp(-1)	-0.023*** [0.003]	-0.022*** [0.003]	-0.024*** [0.003]	-0.024*** [0.003]	-0.024*** [0.003]
Mtrade(-1)	0.001*** [0.0002]	0.001** [0.0002]	0.001*** [0.0003]		
<i>Mexport(-1)</i>				0.002*** [0.0004]	0.009*** [0.001]
<i>Mimport(-1)</i>					-0.008*** [0.001]
Mfdi(-1)	0.020*** [0.002]	0.022*** [0.002]	0.021*** [0.002]	0.020*** [0.002]	0.023*** [0.003]
Mse(-1)	0.006*** [0.002]	0.038*** [0.006]	0.024*** [0.006]	0.023*** [0.006]	0.021*** [0.007]
Mse(-1)^2		-0.0004*** [0.0001]	-0.0003*** [0.0001]	-0.0003*** [0.0001]	-0.0003*** [0.0001]
Stdse(-1)			0.279*** [0.010]	0.279*** [0.010]	0.278*** [0.009]
Constant	0.651*** [0.125]	-0.049 [0.193]	0.036 [0.203]	0.108 [0.203]	0.404 [0.222]
N	2626	2626	2626	2626	2626
No. of countries	133	133	133	133	133
No. of IVs	126	127	128	128	129
AR(-2) test	0.385	0.385	0.462	0.462	0.460
Hansen test	0.265	0.270	0.280	0.282	0.276

Note: *, **, *** are the significant levels at 10%, 5%, and 1%, respectively. The standard errors are presented in [].

The roles of shadow economy in driving economic fluctuations are investigated through three aspects: its size, its volatility and its non-linear relationships. The significant positive influence of shadow economy's size suggests that an important shadow economics may increase the

instability in the official sector. This result is consistent with the idea that shadow activities increase the overall uncertainty by limiting/altering the efficiency of fiscal and monetary policies that governments may implement to fight against economic turbulences.

Notably, the square of shadow economy's size has significant negative effects on the volatility of real GDP growth rate. In other words, it appears that we have an inverted-U relationships between the shadow economy and economic fluctuations. In this context, for countries with a low level of shadow economy, an increasing of these shadow activities increases the economic fluctuations contributing therefore to a high economic instability. In contrast, for countries with a relatively high level of shadow economy, an increase in these activities acts as a complement of the official sectors to help to stabilize the official growth. Such observation suggests that policy makers should implement strategies to keep shadow economy below a level for which the whole economy stability does not become dependent of shadow activities. The significant positive impact of shadow economy's volatility on the volatility of real GDP growth rate indicates that fluctuations in shadow economy can be transmitted to the official sector. Because the shadow economy is mainly composed by unknown variables for policy makers, these results also suggest to keep the shadow economy at a low level to reduce its potential impact on national economy.

After a general analysis of our data, we decomposed all results into three sub-samples referring to low- and lower-middle income, upper-middle income, and high-income economies. The results are presented in table 6, 7, and 8.

Table 6
Determinants of Economic fluctuations in difference income economies

Dependent var: evo	Low- and lower middle-income economies		Upper-middle income economies		High-income economies	
	Model 11	Model 12	Model 13	Model 14	Model 15	Model 16
evo(-1)	0.774*** [0.007]	0.585*** [0.008]	0.806*** [0.057]	0.834*** [0.059]	0.927*** [0.061]	0.908*** [0.069]
Mgdppc(-1)	-0.060* [0.034]	-0.182*** [0.060]	0.224* [0.122]	0.185 [0.115]	0.112 [0.081]	0.042 [0.072]
Mcap(-1)	-0.010*** [0.003]	-0.016*** [0.005]	0.035*** [0.012]	0.036*** [0.012]	0.044** [0.018]	0.039** [0.017]
Mconsu(-1)	0.016*** [0.002]	0.010*** [0.003]	0.021** [0.010]	0.026** [0.012]	0.013 [0.010]	0.024* [0.013]
Mgove(-1)	0.010*** [0.003]	0.018*** [0.006]	-0.001 [0.009]	-0.008 [0.008]	-0.016* [0.008]	-0.005 [0.008]
Mlabor(-1)	-0.008** [0.004]	-0.006 [0.007]	-0.023 [0.014]	-0.028* [0.015]	-0.049*** [0.013]	-0.049*** [0.017]
Mtfp(-1)	0.048*** [0.006]	0.060*** [0.008]	0.038 [0.053]	0.035 [0.054]	-0.035 [0.046]	-0.061 [0.051]
Mtrade(-1)	0.0023*** [0.009]	0.001 [0.001]	-0.001 [0.001]	-0.001 [0.002]	0.001 [0.001]	0.0001 [0.001]
Mfdi(-1)		0.047*** [0.008]		0.015 [0.017]		0.010 [0.006]
Constant	1.015*** [0.145]	2.180*** [0.313]	-1.044 [0.642]	-0.452 [0.707]	1.426* [0.745]	2.092** [0.959]
N	1193	1147	640	628	809	738
No. of countries	62	62	31	31	40	40
No. of IVs	47	48	10	11	10	11
AR(-2) test	0.208	0.179	0.731	0.468	0.793	0.827
Hansen test	0.440	0.278	0.095	0.423	0.397	0.075

Note: *, **, *** are the significant levels at 10%, 5%, and 1%, respectively. The standard errors are presented in [].

Table 7
Shadow economy and Economic fluctuations in difference income economies

Dependent var: evo	Low- and lower middle-income economies		Upper-middle income economies		High-income economies	
	Model 17	Model 17	Model 19	Model 20	Model 21	Model 22
evo(-1)	0.584*** [0.008]	0.595*** [0.008]	0.834*** [0.059]	0.824*** [0.060]	0.700*** [0.121]	0.693*** [0.120]
Mgdppc(-1)	-0.177*** [0.060]	-0.035 [0.081]	0.241* [0.125]	0.364** [0.153]	0.047 [0.161]	-0.043 [0.174]
Mcap(-1)	-0.015*** [0.005]	-0.023*** [0.005]	0.038*** [0.012]	0.038*** [0.011]	0.052** [0.023]	0.048** [0.022]
Mconsu(-1)	0.010*** [0.003]	0.009*** [0.003]	0.026** [0.012]	0.025** [0.011]	0.002 [0.013]	0.013 [0.014]
Mgove(-1)	0.018*** [0.006]	0.012** [0.005]	-0.008 [0.008]	-0.003 [0.010]	-0.011 [0.011]	-0.015 [0.011]
Mlabor(-1)	-0.006 [0.007]	-0.013 [0.008]	-0.026 [0.016]	-0.024 [0.017]	-0.041** [0.019]	-0.056*** [0.020]
Mtfp(-1)	0.059*** [0.008]	0.070*** [0.007]	0.034 [0.054]	0.026 [0.054]	-0.095 [0.063]	-0.108 [0.063]
Mtrade(-1)	0.001 [0.001]		-0.001 [0.002]		0.001 [0.001]	
Mexport(-1)		-0.012*** [0.002]		-0.010 [0.008]		0.015* [0.008]
Mimport(-1)		0.014*** [0.004]		0.009 [0.009]		-0.014* [0.008]
Mfdi(-1)	0.046*** [0.008]	0.035*** [0.008]	0.016 [0.017]	0.014 [0.021]	0.011 [0.007]	0.012 [0.008]
Mse(-1)	0.004 [0.004]	0.001 [0.004]	0.006 [0.006]	0.010 [0.006]	0.009 [0.012]	0.008 [0.011]
Constant	1.957*** [0.343]	1.623*** [0.365]	-1.276 [1.099]	-2.713* [1.465]	1.605 [2.248]	3.660 [2.332]
N	1147	1147	628	629	770	770
No. of countries	62	62	31	31	40	40
No. of IVs	49	50	12	13	12	13
AR(-2) test	0.179	0.176	0.468	0.457	0.965	0.853
Hansen test	0.291	0.302	0.418	0.244	0.232	0.069

Note: *, **, *** are the significant levels at 10%, 5%, and 1%, respectively. The standard errors are presented in [].

Table 8
Shadow economy and Economic fluctuations in difference income economies

Dependent var:	Low- and lower middle-income economies		Upper-middle income economies		High-income economies	
evo	Model 23	Model 24	Model 25	Model 26	Model 27	Model 28
evo(-1)	0.490*** [0.012]	0.499*** [0.012]	0.806*** [0.058]	0.828*** [0.061]	0.636*** [0.137]	0.680*** [0.170]
Mgdppc(-1)	-0.166*** [0.059]	-0.099 [0.065]	0.321** [0.143]	0.429** [0.187]	0.055 [0.258]	-0.019 [0.231]
Mcap(-1)	-0.003 [0.005]	-0.006 [0.006]	0.044*** [0.013]	0.039*** [0.012]	0.050** [0.023]	0.049** [0.021]
Mconsu(-1)	0.008*** [0.003]	0.008*** [0.003]	0.019* [0.011]	0.024** [0.012]	0.003 [0.012]	0.012 [0.015]
Mgove(-1)	0.015** [0.006]	0.012** [0.006]	-0.001 [0.010]	-0.004 [0.010]	-0.016 [0.018]	-0.034** [0.013]
Mlabor(-1)	-0.0003 [0.007]	-0.004 [0.008]	-0.021 [0.015]	-0.024 [0.017]	-0.046*** [0.015]	-0.067*** [0.016]
Mtfp(-1)	0.050*** [0.009]	0.056*** [0.008]	0.038 [0.051]	0.027 [0.055]	-0.102 [0.062]	-0.102 [0.065]
Mtrade(-1)	0.001 [0.001]		-0.002 [0.001]		0.002 [0.002]	
Mexport(-1)		-0.005*** [0.002]		-0.012 [0.009]		0.014 [0.010]
Mimport(-1)		0.007** [0.003]		0.010 [0.010]		-0.016 [0.009]
Mfdi(-1)	0.059*** [0.010]	0.050*** [0.010]	0.021 [0.014]	0.014 [0.022]	0.013* [0.007]	0.025 [0.016]
Mse(-1)	0.096*** [0.026]	0.088*** [0.027]	0.054 [0.045]	0.005 [0.039]	0.023 [0.106]	0.087 [0.058]
Mse(-1)^2	-0.001*** [0.0003]	-0.001*** [0.000]	-0.001 [0.001]	0.0001 [0.001]	0.0003 [0.003]	-0.002 [0.001]
Stdse(-1)	0.355*** [0.028]	0.354*** [0.027]	-0.104 [0.117]	-0.123 [0.119]	0.172 [0.372]	0.031 [0.448]
Constant	-0.441 [0.740]	-0.489 [0.754]	-3.148 [1.604]	-3.102* [1.723]	1.843 [3.179]	3.846 [2.878]
N	1148	1148	632	632	770	732
No. of countries	62	62	31	31	40	40
No. of IVs	51	52	14	14	14	15
AR(-2) test	0.223	0.218	0.719	0.480	0.900	0.948
Hansen test	0.332	0.344	0.173	0.258	0.181	0.156

Note: *, **, *** are the significant levels at 10%, 5%, and 1%, respectively. The standard errors are presented in [].

The results in the table 6 show that the impacts of economic factors on economic fluctuations are different for the three income groups. In the low- and lower-middle income economies, the capital investment and labor forces act as stabilizing factors showing that these countries are in lack of capital accumulations and that their production is mainly based on huge labour forces. Other factors such as the private consumption, government spending, TFP, trade openness and FDI inflows have a positive influence on the economic instability.

For the upper-middle income economies, the government expenditure, labour force, and trade openness act as stabilizing factors while the capital investment, private consumption, TFP and FDI inflow exhibit a positive relationship with economic fluctuations. Finally, for the high income economies, the trend is quite similar to the previous group except for the TFP that actually acts as a stabilizing factor.

These results show that economic fluctuations are actually directly related to countries' productive capabilities. In low-income economies where their productive power is mainly based on labour, an increase of capital accumulation can help to stabilize productions and therefore the economy. Fiscal policy and trade openness are noticed to play a significant role in the upper-middle and high-income income economies.

The table 7 presents other interesting facts related to the relationship between trade openness and economic fluctuations. In the low- and lower-middle income economies, exports can stabilize economic fluctuations whereas imports has a positive influence on economic fluctuations. In the upper-middle income economies, the story is same, but the insignificant coefficients suggest that these effects are weaker. In the high-income economies, imports act as a stabilizing factor while exports have a positive influence on economic fluctuations. This observation implies that international trade is an important stabilizing factor in high-income economies.

The positive effect of shadow economy on volatility of real GDP growth rate confirms our previous results: shadow economy increases economic fluctuations. Furthermore, results in the table 8 show that the role of shadow economy is strongest in low income economies while it does not significantly affect the economic fluctuations in upper-middle income and high-income economies. These results confirm that shadow economy is a severe problem for the low- and lower-middle income economies facing with a low institutional quality and a low economic development. In the upper middle income and high-income economies, the role of shadow economy on the economic fluctuations is quite limited.

Conclusion

This study contributes to the debates on the determinants of economic fluctuations by investigating the role of shadow economy. We used both demand and supply drivers of economic fluctuations and we worked with a sample of 133 economies (for the period 1991–2015) to provide some interesting contributions to the literature and policy makers.

First, the shadow economy is found to have a significant positive impact on economic fluctuations. Notably, shadow economy and economic instability have an inverted-U relationship implying that the former increases the latter in countries in which shadow activities are quite limited while shadow economy acts as a stabilizing factor for countries in which shadow activities are important. In addition, it has been shown that the volatility of shadow economy has increases the fluctuations of official economy. This relationship is stronger for the case of low- and lower-middle income economies.

Second, labour force and TFP are a stabilizing factor, while capital investment, consumption, government spending, trade and FDI inflows have a positive relationship with economic fluctuations. Interestingly, trade openness exhibits an opposite effect on the exports and imports dependently on the country under consideration: exports increase economic fluctuations in low and upper-middle income countries while imports contribute to reduce them in high-income countries.

Third, the determinants of economic fluctuations are different across countries depending on the income levels. In the low- and lower-middle income economies, capital investment, labour force and exports are stabilizing factors. The same tend (except for capital investment that exhibits a positive relationship with economic fluctuations) for in upper-middle income economies. Finally, for high-income economies, government expenditures, labour forces, TFP and imports act as stabilizing factors.

In terms of policy making, our empirical study shows that the stability of a national (low income) economy can actually be dependent of the shadow economy. Such situation can unfortunately create a growth trap for the poorest countries in which stability would depend on shadow activities that would put the official economy and all government actions in a position in which they cannot act properly to generate an economic growth for the country. In such context, our study suggests to keep shadow economy at a low level to reduce its potential impact on national economy.

Declarations

Availability of data and materials

Data can provided on request

Competing interests

No competing interests

Funding

We thank the University of Economics, Ho Chi Minh City for the support

Authors' contributions

Dr Canh Nguyen (data analysis and data collection), Prof Su Di Thanh (draft and literature review), Prof Christophe Schinckus (literature review, discussions)

Acknowledgements

N/A

References

- Ahmed S (2003) Sources of economic fluctuations in Latin America and implications for choice of exchange rate regimes. *J Dev Econ* 72(1):181–202
- Anderson TW, Cheng Hsiao (1982) Formulation and estimation of dynamic models using panel data. *Journal of econometrics* 18(1):47–82
- Arellano M, and Stephen Bond (1991) Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The review of economic studies* 58(2):277–297
- Arellano M, and Olympia Bover (1995) Another look at the instrumental variable estimation of error-components models. *J Econ* 68(1):29–51. doi:[http://dx.doi.org/10.1016/0304-4076\(94\)01642-D](http://dx.doi.org/10.1016/0304-4076(94)01642-D)
- Audia PG, Henrich RG (2006) Less likely to fail: Low performance, firm size, and factory expansion in the shipbuilding industry. *Management science* 52(1):83–94
- Barslund M, and Finn Tarp (2008) Formal and informal rural credit in four provinces of Vietnam. *J Dev Stud* 44(4):485–503
- Bilbao-Osorio B, Andrés Rodríguez-Pose (2004) From R&D to innovation and economic growth in the EU. *Growth Change* 35(4):434–455
- Blackburn K, Bose N, Capasso S (2012) Tax evasion, the underground economy and financial development. *J Econ Behav Organ* 83(2):243–253
- Blundell R, and Stephen Bond (1998) Initial conditions and moment restrictions in dynamic panel data models. *Journal of econometrics* 87(1):115–143
- Chauvet M, Jang-Ting Guo (2003) Sunspots, animal spirits, and economic fluctuations. *Macroecon Dyn* 7(1):140–169
- Choi JP, Marcel Thum (2005) Corruption and the shadow economy. *Int Econ Rev* 46(3):817–836
- Christiano L, Motto R, Massimo, Rostagno (2010) "Financial factors in economic fluctuations." ECB Working Paper No. 1192
- Creal DD, Jing Cynthia Wu (2017) Monetary policy uncertainty and economic fluctuations. *Int Econ Rev* 58(4):1317–1354
- D'Hernoncourt J, Pierre-Guillaume M (2012) "The not so dark side of trust: Does trust increase the size of the shadow economy?". *J Econ Behav Organ* 81(1):97–121. doi:<https://doi.org/10.1016/j.jebo.2011.09.010>
- Dreher A, Kotsogiannis C, Steve, McCorriston (2009) "How do institutions affect corruption and the shadow economy?". *Int Tax Public Finance* 16(6):773
- Feldstein M (2009) "Rethinking the role of fiscal policy". *American Economic review* 99(2):556–559
- Ferreira-Tiryaki G (2008) The informal economy and business cycles. *Journal of Applied Economics* 11(1):91
- Fleming MH, John Roman, and Farrell G (2000) "The shadow economy." *Journal of International Affairs*:387–409
- Forni M, Gambetti RECentL, Sala L (2017) News, Uncertainty and Economic Fluctuations (No News is Good News). University of Modena and Reggio E., Dept. of Economics" Marco Biagi"
- Fosu AK (2001) Economic Fluctuations and Growth in Sub-Saharan Africa: The Importance of Import Instability. *Journal of Development Studies* 37(3):71–85
- Friedman E, Johnson S, Kaufmann D, Pablo Zoido-Lobaton (2000) Dodging the grabbing hand: the determinants of unofficial activity in 69 countries. *Journal of public economics* 76(3):459–493
- Furceri D, Guichard S, Rusticelli E (2012) The effect of episodes of large capital inflows on domestic credit. *The North American Journal of Economics Finance* 23(3):325–344. doi:<http://dx.doi.org/10.1016/j.najef.2012.03.005>
- Furlanetto F, Ravazzolo F, Samad Sarferaz (2014) "Identification of financial factors in economic fluctuations". *Econ J*. doi:<https://doi.org/10.1111/ecoj.12520>
- Gali J (1999) "Technology, employment, and the business cycle: do technology shocks explain aggregate fluctuations?". *Am Econ Rev* 89(1):249–271
- Gambacorta L, Marques-Ibanez D (2011) The bank lending channel: lessons from the crisis. *Economic Policy* 26(66):135–182
- Gennaioli N, Shleifer A, Robert W, Vishny (2013) A model of shadow banking. *The Journal of Finance* 68(4):1331–1363
- Gilchrist S, Yankov V, Egon, Zakrajšek (2009) Credit market shocks and economic fluctuations: Evidence from corporate bond and stock markets. *Journal of monetary Economics* 56(4):471–493
- Granda-Carvajal C (2010) "The Unofficial Economy and the Business Cycle: A Test for Theories". *Int Economic J* 24(4):573–586. doi:10.1080/10168737.2010.525998
- Hall RE (1986) "The role of consumption in economic fluctuations." In *The American business cycle: Continuity and change*, 237–266. University of Chicago Press
- Horvath J (2018) Business cycles, informal economy, and interest rates in emerging countries. *J Macroecon* 55:96–116. doi:<https://doi.org/10.1016/j.jmacro.2017.10.002>
- Jallab M, Sadni, Monnet Benoît Patrick Gbakou, and René Sandretto. 2008. "Foreign direct investment, macroeconomic instability and economic growth in MENA countries." W/P, GATE, UMR 5824
- Justiniano A, Primiceri GE, Tambalotti A (2010) Investment shocks and business cycles. *Journal of Monetary Economics* 57(2):132–145

- King R, Plosser CI, Stock JH, Mark W, Watson (1987) Stochastic trends and economic fluctuations. National Bureau of Economic Research Cambridge, Mass.
- Konstantakis K, Michaelides P, Efthymios Tsionas (2016) "The Determinants of Economic Fluctuations in Greece: An Empirical Investigation (1995–2014)." In *A New Growth Model for the Greek Economy*, 265–273. Springer
- Kose M, Ayhan, Riezman R (2001) Trade shocks and macroeconomic fluctuations in Africa. *Journal of development Economics* 65(1):55–80
- La Porta, Rafael F, Lopez-de-Silanes A, Shleifer, and Robert Vishny (1999) "The quality of government". *The Journal of Law Economics Organization* 15(1):222–279
- Leduc S, Keith Sill (2013) Expectations and economic fluctuations: an analysis using survey data. *Rev Econ Stat* 95(4):1352–1367
- Levin A, Lin C-F, and Chia-Shang James Chu (2002) Unit root tests in panel data: asymptotic and finite-sample properties. *Journal of econometrics* 108(1):1–24
- Liao Y, Barnes J (2015) Knowledge acquisition and product innovation flexibility in SMEs. *Business Process Management Journal* 21(6):1257–1278
- Mai H, Schneider Friedrich (2016) Size and development of the shadow economies of 157 worldwide countries: Updated and new measures from 1999 to 2013. *Journal of Global Economics* 4(218):2
- McConnell MM, Perez-Quiros G (2000) "Output fluctuations in the United States: What has changed since the early 1980's?". *Am Econ Rev* 90(5):1464–1476
- Medina L, Friedrich Schneider (2018) "Shadow Economies Around the World: What Did We Learn Over the Last 20 Years?" IMF Working Paper 18/17
- Petrosky-Nadeau N (2014) Credit, vacancies and unemployment fluctuations. *Rev Econ Dyn* 17(2):191–205.
doi:<http://dx.doi.org/10.1016/j.red.2013.10.001>
- Restrepo-Echavarria P (2014) Macroeconomic volatility: The role of the informal economy. *Eur Econ Rev* 70:454–469.
doi:<https://doi.org/10.1016/j.euroecorev.2014.06.012>
- Roodman D (2006) "How to do xtabond2: An introduction to difference and system GMM in Stata". *The Stata Journal* 9(1):86–136
- Roodman D (2009) "How to do Xtabond2: An Introduction to Difference and System GMM in Stata". *The Stata Journal* 9(1):86–136.
doi:10.1177/1536867x0900900106
- Schmitt–Grohé S (1998) The international transmission of economic fluctuations:: Effects of US business cycles on the Canadian economy. *Journal of international Economics* 44(2):257–287
- Schneider F, Williams C (2013) *The Shadow Economy*. The Institute of Economic Affairs, Edward Elgar
- Schneider F (1994) "Measuring the size and development of the shadow economy. Can the causes be found and the obstacles be overcome?" In *Essays on economic psychology*, 193–212. Springer
- Schneider F (2000) "The increase of the size of the shadow economy of 18 OECD countries: some preliminary explanations."
- Shapiro AF (2015) "Institutions. Informal Labor Markets Business Cycle Volatility" *Economía* 16(1):77–112
- Sharma SD (2004) Government intervention or market liberalization: the Korean financial crisis as a case of market failure. *Progress in Development Studies* 4(1):47–57
- Sordi S, Vercelli A (2006) Financial fragility and economic fluctuations. *J Econ Behav Organ* 61(4):543–561
- Talvi E, Végh CA (2005) Tax base variability and procyclical fiscal policy in developing countries. *J Dev Econ* 78(1):156–190.
doi:<https://doi.org/10.1016/j.jdeveco.2004.07.002>
- Tanzi V (1982) *The underground economy in the United States and abroad*: Free Press
- Tanzi V (1999) "Uses and abuses of estimates of the underground economy". *Econ J* 109(456):338–347
- Wen Y (2006) Demand shocks and economic fluctuations. *Econ Lett* 90(3):378–383
- Κάτσιος Σταύρος (2015) "The shadow economy and corruption in Greece." *South-Eastern Europe Journal of Economics* 4 (1)

Figures

Figure 2

Real GDP growth rate (%), 3-year Standard deviation of real GDP growth rate, and the size of Shadow economy to official GDP (%)

Figure 4
economic factors and volatility of real GDP growth rates