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Drivers of the Underground Economy around the Millienium: A Long Term Look for the United States

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ABSTRACT

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This paper provides a long term analysis of the determinants of the shadow economy. Using data for the United States over the years 1870–2014 we examine economic and political factors driving the underground sector. Results show that among the economic factors, greater economic prosperity increased the shadow sector, while greater openness to trade and a bigger government reduced it, with the effects of inflation being statistically insignificant. Politically, the efficacy of presidential vetoes and the effect of congressional party homogeneity are statistically insignificant. Further, the U.S. shadow economy increased during both world wars, but was lower during the great depression. However, in the short run, the relationship between the shadow economy and its determinants exhibit some remarkable differences.

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1. Introduction

The shadow or the underground sector has persisted across developed and developing nations for a long time. Yet formal empirical investigations of its causes and effects are relatively recent and mostly limited to the years after the middle of the twentieth century (see Buehn and Schneider (2012), Gërxhani (2004), Schneider (2011), Schneider and Enste (2000), Schneider et al. (2010), Tanzi (1982)).

A major issue limiting formal investigations of the shadow economy pertains to the measurement of the extent of the underground sector. Informal sector activities encompass many forms including unlicensed service sector providers, work for kind, undocumented cash transactions, illegal gambling and smuggling, etc. that are nearly impossible to effectively track (see Frey and Weck-Hannemann (1984), Kirchgässner (2016), Restrepo-Echavarria (2015), Schneider and Buehn (2013)). Yet economists have been able to provide some reliable estimates of the shadow sector across nations using different measurement techniques (see Alm and Embaye (2013), Schneider et al. (2010)) that span two-three decades. Recently, Géidigh et al. (2016) provide estimates on the prevalence of the shadow economy for 3-4 nations over more than a century.

This paper examines the determinants of the U.S. shadow economy over nearly a century and a half (from 1870-2014), paying attention to economic as well as political factors. This long term analysis enables us to consider the effects of some unprecedented and significant shocks such as the two world wars and the great depression. Beyond that, the United States presents an interesting and informative case study. It is a developed country, that is pretty much insulated from bordering nations (except for neighbors Canada and Mexico) and yet the shadow sector has persisted in double-digits over some time (see Table 1). Further, the substantial autonomy that the federalist structure of the U.S. government grants individual states in terms of setting regulations and taxes provides differing incentives to individuals and firms to operate in the underground sector. In recent years, a number of studies have been conducted focusing on the U.S. shadow economy (see Berdiev et al. (2015), Goel and Saunoris (2016), Tanzi (1982)). However, these studies are limited to 2-3 decades and do not provide a long-term view. Equally important, none of the studies examine the set of political factors and external shocks that are considered here. Hence, we argue that the United States are an proper example to study long term effects of the shadow economy.

Figure 1 illustrates the size of the U.S. shadow economy over time with the four shaded areas denoting the four major events that occurred during this time period: World War I (1914-1918), The Great Depression (1929-1939), World War II (1939-1945), and the Great Recession (2007-2009). The average size of the U.S. shadow economy over this time period is 15.3% of GDP with a peak in 1914 of 36.9% and reaching a minimum in 2009-2010 of 5.4%. The size of the shadow economy increased significantly shortly after the turn of the century before declining following the end of World War I. Interestingly, the significant rise in the shadow economy followed the passage of the Gold Standard Act in 1900, which ended bimetallism and established the gold standard for redeeming paper currency. Despite prohibition, the shadow economy experienced a steady decline during the affluent 1920's, only to be reversed by the onset of the Great Depression and further expanded during World War II. Not surprisingly, the growth in the shadow economy during this time was a result of the slack in the official economy for consumer

goods and services that were then absorbed by the development of black markets. The size of the shadow economy continued to shrink post-World War II due to a robust private sector and the shrinking of the public sector; however, the shadow economy saw a resurgence during the 1950's to the mid-1970's during a period when the US saw an expansion of the government as part of President Johnson's Great Society Program and the high inflation in the early 1970's. After that, the drastic tax cuts and deregulation during the Reagan Administration as well as the overall health in the official economy contributed to the steady decline in the size of the shadow economy.

Figure 1: Prevalence of the U.S. Shadow Economy (%of GDP) from 1870-2014
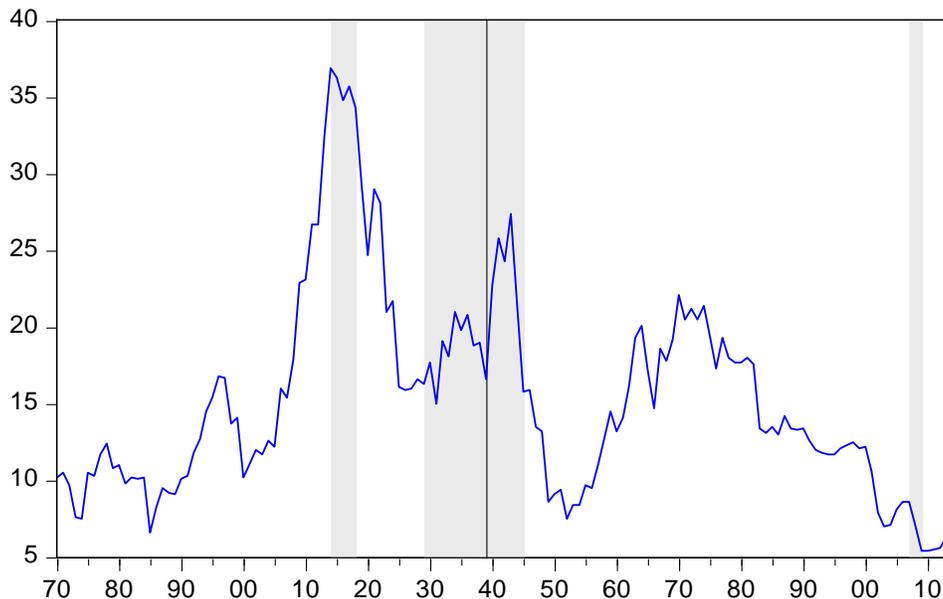
The next section outlines our empirical strategy to formally examine the determinants of the U.S. shadow economy over 1870-2014.

2. Empirical setup

2.1 The main causes determining the shadow economy

The determinants of the shadow economy are based on the extant literature (see, e.g., Gërxhani (2004) Goel and Nelson (2016), and Schneider and Enste (2000)). In general, the incentives of firms and individuals to operate in the underground or the informal sector stem from the desire to evade government regulations (see Djankov et al. (2002) and/or avoid paying taxes (see Busato et al. (2011), Neck et al. (2012)). The level of government's desire to check these incentives via enforcement serve as counterbalances. In rare cases, unexpected external shocks (e.g., wars, natural disasters) bear upon both these incentives and disincentives. What are the most important determinants influencing a shadow economy? Table 2 presents an overview. Our long time series for the United States enables us to uniquely take account of some of these influences.

Table 2: The main causes determining the shadow economy

Causal variable	Theoretical reasoning	References
(1) Tax and Social Security Contribution Burdens	The distortion of the overall tax burden affects labor-leisure choices and may stimulate labor supply in the shadow economy. The bigger the difference between the total labor cost in the official economy and after-tax earnings (from work), the greater is the incentive to reduce the tax wedge and to work in the shadow economy. This tax wedge depends on social security burden/payments and the overall tax burden, making them to key determinants for the existence of the shadow economy.	E.g. Thomas (1992), Johnson, Kaufmann, and Zoido-Lobatón (1998a,b), Giles (1999), Tanzi (1999), (2003, 2005), Dell'Anno (2007), Dell'Anno, Gomez-Antonio and Alanon Pardo (2007), Buehn and Schneider (2012)
(2) Quality of Institutions	The quality of public institutions is another key factor for the development of the informal sector. Especially the efficient and discretionary application of the tax code and regulations by the government plays a crucial role in the decision to work underground, even more important than the actual burden of taxes and regulations. In particular, a bureaucracy with highly corrupt government officials seems to be associated with larger unofficial activity, while a good rule of law by securing property rights and contract enforceability increases the benefits of being formal. A certain level of taxation, mostly spent in productive public services, characterizes efficient policies. In fact, the production in the formal sector benefits from a higher provision of productive public services and is negatively affected by taxation, while the shadow economy reacts in the opposite way. An informal sector developing as a consequence of the failure of political institutions in promoting an efficient market economy, and entrepreneurs going underground, as there is an inefficient public goods provision, may reduce if institutions can be strengthened and fiscal policy gets closer to the median voter's preferences.	E.g. Johnson et al. (1998a,b), Friedman, Johnson, Kaufmann, and Zoido-Lobaton (2000), Dreher and Schneider (2009), Dreher, Kotsogiannis and Macorriston (2009), Schneider (2010), Buehn and Schneider (2012), Teobaldelli (2011), Teobaldelli and Schneider (2012)
(3) Regulations	Regulations, for example labor market regulations or trade barriers, are another important factor that reduces the freedom (of choice) for individuals in the official economy. They lead to a substantial increase in labor costs in the official economy and thus provides another incentive to work in the shadow economy: countries that are more heavily regulated tend to have a higher share of the shadow economy in total GDP. Especially the enforcement and not the overall extent of regulation – mostly not enforced – is the key factor for the burden levied on firms and individuals, making them operate in the shadow economy.	E.g. Johnson, Kaufmann, and Shleifer (1997), Johnson, Kaufmann, and Zoido-Lobatón (1998b), Friedman, Johnson, Kaufmann, and Zoido-Lobaton (2000), Kucera and Roncolato (2008)
(4) Public Sector Services	An increase of the shadow economy may lead to fewer state revenues, which in turn reduce the quality and quantity of publicly provided goods and services. Ultimately,	E.g. Johnson, Kaufmann, and Zoido-Lobatón (1998a,b)

	this may lead to increasing tax rates for firms and individuals, although the deterioration in the quality of the public goods (such as the public infrastructure) and of the administration continues. The consequence is an even stronger incentive to participate in the shadow economy. Countries with higher tax revenues achieved by lower tax rates, fewer laws and regulations, a better rule of law and lower corruption levels, should thus have smaller shadow economies.	
(5) Tax Morale	The efficiency of the public sector also has an indirect effect on the size of the shadow economy because it affects tax morale. Tax compliance is driven by a psychological tax contract that entails rights and obligations from taxpayers and citizens on the one hand, but also from the state and its tax authorities on the other hand. Taxpayers are more heavily inclined to pay their taxes honestly if they get valuable public services in exchange. However, taxpayers are honest even in cases when the benefit principle of taxation does not hold, i.e. for redistributive policies, if such political decisions follow fair procedures. The treatment of taxpayers by the tax authority also plays a role. If taxpayers are treated like partners in a (tax) contract instead of subordinates in a hierarchical relationship, taxpayers will stick to their obligations of the psychological tax contract more easily. Hence, (better) tax morale and (stronger) social norms may reduce the probability of individuals to work underground.	E.g. Feld and Frey (2007), Kirchler (2007), Torgler and Schneider (2009), Feld and Larsen (2005, 2009)
(6) Development of the official economy	The development of the official economy is another key factor in the shadow economy. The higher (lower) the unemployment quota (GDP-growth), the higher the incentive to work in the shadow economy, ceteris paribus.	Schneider and Williams (2013) Feld and Schneider (2010)
(7) Self-employment	The higher the rate of self-employment, the more activities can be performed in the shadow economy, ceteris paribus.	Schneider and Williams (2013) Feld and Schneider (2010)

The general form of the estimated relation for causes of the U.S. shadow economy may be written as (see Table 1 for variable details)

Shadow economy $= f$ (economic factors$_m$, political factors$_k$, shocks$_j$)

where

$m = GDP$, $INFL$, $OPEN$, $GOVSIZE$

$k = VETOES$, $PARTY$

$j = WWI$, WWII, $Depression$

Among economic factors, we include the inflation rate measured as the percent change in the GDP deflator (*INFL*), government expenditures as percent of GPD (*GOVSIZE*), trade openness measured as imports plus exports as a percent of GDP (*OPEN*), and the log of per capita GDP (*GDP*). These factors have rather consistently been identified in the literature to affect the spread of the shadow economy (see Goel and Nelson (2016)).

Among the main contributors driving individuals and firms underground include government regulations and taxes (see Friedman et al. (2000)). While obtaining data on tax rates and regulations over the long span of this study was problematic with all the changes in bureaucracies that affect regulations and the tax codes (and deductions), we attempt to broadly capture these by including a measure for the overall size of government (*GOVSIZE*).

On the one hand, greater government spending presents opportunities for outsourcing to the underground sector (e.g., unlicensed subcontractors in highway construction), plus greater red tape associated with a bigger government induces some firms to operate underground. On the other hand, a larger government size might arise due greater spending on enforcement. In that case the underground sector would decline. Moreover, these effects might differ over time. The long time series in this study enables us to capture these influences. Hence, we cannot formulate a clear-cut hypothesis H1 about the effect of the size of government on the shadow economy.

The rate of inflation (*INFL*) can be seen as accounting for inflation tax. With regard to the shadow economy, inflation increases individuals discount rates that might induce them to increase short term returns by not paying taxes and operate underground (see Goel and Nelson (2016)). Our hypothesis H2 is:

> *The higher the inflation rate, the higher is the shadow economy, ceteris paribus.*

Another important determinant of shadow economy development is the strength of the official sector including the quality of official institutions (see Dreher et al. (2009)). To capture these important aspects we include *GDP*. The pro-cyclicality of the shadow economy is a result of the income effect that increase demand for small scale goods and services that are easily provided by the shadow economy, whereas the counter-cyclicality results from the substitution effect as depressed incomes incentivize individuals to seek out cheaper alternatives in the shadow economy to save money. However, over the longer term institutions improve with the level of economic development thus raising the opportunity costs of producing underground. Hence, hypothesis H3 reads:

The higher the official GDP, the lower is the shadow economy, ceteris paribus.

Finally, we include a measure for the amount of trade openness (*OPEN*) in the U.S. Foreign producers act as competitors to both domestic formal and informal sectors. These effects too can vary over time. For example, trade openness increases competition in the short run, but over time trade can influence economic and political institutions (see, for example, Do and Levchenko (2009)). Consequently we cannot formulate a clear-cut hypothesis H4 about the effect of trade-openness on the shadow economy.

Turning to political factors, we uniquely consider two influences: (i) *VETOES*: the number of congressional bills vetoed by the sitting president each year; and (ii) *PARTY*: a dummy variable identifying the years in which the U.S. House and the Senate were held by the same political party. Both these variables capture the strength of the government and signal resolve in (potentially) tacking illegal activity including the informal sector.[1] Again, here we cannot formulate a clear-cut hypothesis H5 about the influence of these variables on the shadow economy.

Finally, the long period under study enables us to take account of the significant and unprecedented disturbances due to the two world wars and the great depression. These shocks likely diverted government attention to other matters, leaving less attention to controlling the underground sector. Plus, immediate demands of rapid and specialized production during war years might have necessitated outsourcing to the informal sector to meet deadlines.[2] On the other hand, the Great Depression can be seen as a shock to GDP with resulting effect on institutions and less resources for formal sector production (and consequently, less outsourcing to the informal sector). Here we can again formulate a clear-cut hypothesis H6:

The more intense exogenous shocks like wars, the higher is the shadow economy, ceteris paribus.

The data and estimation used to formally analyze equation (1) are discussed in the following section.

3. Data and Estimation

We first discuss the data employed before turning to the estimation strategy.

3.1 Data

Measuring the size of the shadow economy is difficult because shadow participants wish to remain anonymous for obvious reasons. These obstacles inhibit understanding of the determinants of the shadow economy, especially over long time periods. Recently, however, Géidigh et al. (2016) use the currency method to estimate the size of the U.S. shadow economy as a percent of GDP from 1870 to 2014.[3] This long time series allows us to examine the short-run

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[1] These variables can be seen as proxying for enforcement variables such as police or judicial employment.
[2] The war years also limited foreign competition.
[3] See Alm and Embaye (2013) for cross-national estimates of the shadow economy based on the currency demand method for a limited number of years.

and long-run determinants of the shadow economy. Undoubtedly, the incentive to engage in underground work is time dependent, as the costs and benefits differ in the short run compared to the longer run. The shadow economy series is estimated by the Currency Demand Approach: The Currency Demand Approach was first used by Cagan (1958), who considered the correlation between currency demand and tax pressure (as one cause of the shadow economy) for the United States over the period 1919 to 1955. Cagan's approach was further developed by Tanzi (1980, 1983), who econometrically estimated a currency demand function for the United States for the period 1929 to 1980 in order to calculate the size of the shadow economy. His approach assumes that shadow (or hidden) transactions are undertaken in the form of cash payments so as to leave no observable traces for the authorities. An increase in the size of the shadow economy will therefore increase the demand for currency. To isolate the resulting excess demand for currency, an equation for currency demand is estimated over time. All possible conventional factors, such as the development of income, payment habits, interest rates, credit and other debt cards as a substitute for cash and so on, are controlled for. Additionally, variables such as direct and indirect tax burdens, government regulation, etc., which are assumed to be major factors causing people to work in the shadow economy, are included in the estimation equation.

Of course, there is also an amount of criticism about the Currency Demand approach:

(i)   Not all transactions in the shadow economy are paid in cash. Hence, the size of the total shadow economy may be larger.
(ii)   The Currency Demand approach is only applicable for domestic currency and if a currency is used in other countries it has to be corrected for, like the dollar or the euro.
(iii)   Increases in currency demand deposits are largely caused by a slowdown in demand deposits rather than an increase in currency.
(iv)   Another weak point is the assumption of the same velocity of money in both types of economies (official and unofficial).
(v)   Ahumada and Canavese (2004) show that the assumption of the equal income velocity of money in both economies is only correct if income elasticity is one.
(vi)   Finally, the assumption of no shadow economy in the base year is open to criticism.

We are aware of these critical points, but still we think that the Currency Demand Approach is a useful tool to investigate the size and development of the shadow economy of the United States of almost 150 years.

The other data are from the sources listed in Table 1. The estimation procedure(s) outlined below will shed light on the relationship between the shadow economy and its determinants.

3.2 Estimation

Prior to estimation we perform some preliminary tests to test the stationarity properties of our variables over this long time period (see Table 3). To test for unit roots we use the augmented Dickey-Fuller test under the null that that series contains a unit root. To control for serial correlation lagged first differences are added to the test equation. We set the max number of lags to 13 and allow the Schwarz Information Criterion (SIC) to choose the optimal lag length. We also report a modified version of the Augmented Dickey-Fuller tests that allows for an endogenously determined structural break.

According to these results the variables *Shadow*, *OPEN*, *VETOES* and *GDP* contain a unit root in levels and are stationary in first differences, therefore these variables are integrated of order 1 (I(1)). In contrast, *INFL* and *GOVSIZE* are stationary in levels and thus integrated of order 0 (I(0)). One thing to note is that many of the endogenously determines structural breaks occur during the Great Depression World War I or World War II.

Although the variables are of different orders of integration it is still possible that there exists a stationary long-run, or cointegrated, relationship between the size of the shadow economy and its determinants. To test for the existence of a cointegrated relationship among variables of different orders of integration we use the Bounds testing procedure developed by Pesaran et al. (2001). The Bounds testing procedure requires us to operationalize equation (1) by converting it to an autoregressive distributed lag (ARDL) model:

$$\Delta Shadow_t = \alpha_0 + \sum_{i=1}^{p_1} \gamma_{1i}\Delta Shadow_{t-i} + \sum_{i=1}^{p_2} \gamma_{2i}\Delta GDP_{t-i} + \sum_{i=1}^{p_3} \gamma_{3i}\Delta OPEN_{t-i} +$$
$$\sum_{i=1}^{p_4} \gamma_{4i}\Delta INFL_{t-i} + \sum_{i=1}^{p_5} \gamma_{5i}\Delta GOVSIZE_{t-i} + + \sum_{i=1}^{p_6} \gamma_{6i}\Delta VETOES_{t-i} +$$
$$+ \sum_{i=1}^{p_7} \gamma_{7i}\Delta PARTY_{t-i} + \pi_1 Shadow_{t-1} + \pi_2 GDP_{t-1} + \pi_3 OPEN_{t-1} + \pi_4 INFL_{t-1} +$$
$$+\pi_5 VETOES_{t-1} + \pi_6 PARTY_{t-1} + Shocks_t^j + \varepsilon_t \qquad (2)$$

When selecting the lag lengths it is important to include enough lags to capture the necessary dynamics but too many lags could lead to overparamaterization. To choose the individual lag lengths for the ARDL (p_1, p_2, p_3, p_4, p_5, p_6 , p_7) model we rely on the Akaike Information Criterion (AIC) assuming a max lag length of 8.

Once specified, this equation is used to test the null hypothesis of no cointegration ($\pi_1 = \pi_2 = \pi_3 = \pi_4 = \pi_5 = \pi_6 = \pi_7 = 0$) against the alternative of cointegration ($\pi_1 \neq 0, \pi_2 \neq 0, \pi_3 \neq 0, \pi_4 \neq 0, \pi_5 \neq 0, \pi_6 \neq 0, \pi_7 \neq 0$). This partial F-test is non-standard, thus Pesaran et al. (2001) develop critical values for an upper bound, assuming the variable are all I(0), and a lower bound, assuming all the variables are I(1). If the F-statistic exceeds the upper bound then the null is rejected, if the F-statistic falls below the lower bound then we fail to reject the null, and if the F-statistic falls between the upper and lower bound the test is inconclusive. The results for the Bounds test are reported in Panel B of Table 4. Notice that the F-statistic clearly exceeds the upper bound at the 1% significance level indicating the variables are indeed cointegrated.

After establishing cointegration we proceed by estimating the ARDL error correction model, which reports the short-run dynamics and the error correction term (ECT).

$$\Delta Shadow_t = \alpha_0 + \sum_{i=1}^{p_1} \gamma_{1i}\Delta Shadow_{t-i} + \sum_{i=1}^{p_2} \gamma_{2i}\Delta GDP_{t-i} + \sum_{i=1}^{p_3} \gamma_{3i}\Delta OPEN_{t-i}$$
$$+ \sum_{i=1}^{p_4} \gamma_{4i}\Delta INFL_{t-i} + \sum_{i=1}^{p_5} \gamma_{5i}\Delta GOVSIZE_{t-i} + \sum_{i=1}^{p_6} \gamma_{6i}\Delta VETEOS_{t-i}$$
$$+ \sum_{i=1}^{p_7} \gamma_{7i}\Delta PARTY_{t-i} + \phi_1 ECT_{t-1} + Shocks_t^j$$
$$+ \varepsilon_t \qquad\qquad\qquad ...(3)$$

Where the coefficients on the first differenced variables provide the short-run response of *Shadow* to a short-run change in each determinant. The ECT is the error correction term calculated as the residual from the cointegration equations lagged one period. Thus, the ECT captures disequilibrium and ϕ_1 measures the shadow economy's short-run response to long-run disequilibrium. Finally, we include dummy variables to account for major shocks that occur during this period including World War I (1914-1918), The Great Depression (1929-1939), and World War II (1939-1945).

3.3 Diagnostic tests

To ensure the model is correctly specified we report several diagnostic tests. First, the Q-statistic, under the null of no serial correlation, is reported at 36 lags and the high p-value suggests that the residuals are free from serial correlation. Second, we report two tests for heteroscedasticity, the Breusch-Pagan-Godfrey test and White test, with conflicting results. The Breusch-Pagan-Godfrey test fail to reject homoscedasticity, whereas the significance of White test statistic indicates signs of heteroscedasticity. Moreover, the insignificance of the ARCH test for ARCH effects indicate the residuals are free from conditional heteroscedasticity. Given some evidence favoring heteroscedasticity we report HAC (Newey-West) standard errors. Furthermore, the insignificance of the Jarque-Bera test for normality suggest that the errors are normally distributed, and the insignificance of the Ramsey RESET test is consistent with the absence of model misspecification. Overall, these diagnostic tests suggest the model is correctly specified.

Finally, to check for parameter stability we follow Pesaran and Pesaran (1997) and report the cumulative sum (CUSUM) and the cumulative sum of square (CUSUMSQ) tests of the recursive residuals developed by Brown et al. (1975). The CUSUM test is useful for detecting systematic changes in parameter stability, whereas, the CUSUMSQ test is useful when the changes are abrupt. Figures 2 and 3 report the results for the CUSUM and CUSUMSQ test, respectively. The CUSUM clearly falls within the critical lines consistent with parameter stability, however, the CUSUMSQ test shows some evidence of parameter instability from abrupt changes.

4. Results

Table 4 shows that among economic factors, GDP increased the U.S. shadow economy, while openness to trade and government size decreased it, with the effect of inflation being statistically insignificant. In terms of elasticity (evaluated at mean values - see Table 1), a 1% increase in *GDP* increases the shadow economy by 1% whereas a similar 1% increase in *OPEN* and *GOVSIZE* decrease the size of the shadow economy by 1.5% and 1.4%, respectively. Greater economic prosperity likely increased the shadow economy by providing greater outsourcing opportunities for the informal sector, while a higher tax burden acted as a check against these influences.[4] Greater openness to trade made foreign firms ready competitors and these firms likely took away some of the work from domestic informal operators.

Among political influences, both variables (*VETOES* and *PARTY*) have a negative sign; however, they are statistically insignificant. The lack of significance may be partly due to the inability of

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[4] Using data from transition countries, Eilat and Zinnes (2002) find a similar negative relation between tax burden and the shadow economy, and no significant effect of tax rates.

these variables to capture some underlying qualitative aspects (e.g., the possibility of filibuster by minority parties in the senate).

Table 5 presents the short-run dynamics represented by the lagged first differences of each variable and the error correction term. Consistent with a dynamically stable cointegrating relationship, the coefficient on the error correction term is negative and significant. The speed of the adjustment back to long-run equilibrium takes approximately six years.[5] Interestingly, this coincides with the approximate length of business cycles from 1945-2009 calculated by NBER.[6]

Different from the long-run effect, increases in GDP in the short run decrease the shadow economy shown by the negative and significant coefficients on lags two and five. This effect is consistent with the counter-cyclical nature of the shadow economy. Whereas inflation has an insignificant effect on shadow in the long-run, the short-run coefficients (period t, t-2, and t-3) show a negative and statistically significant effect on the shadow economy. For instance, monetary illusion created by higher inflation increases nominal earnings and raises the real tax burden, known as fiscal drag (see Dell'Anno and Dollery (2014)). Interestingly, both *OPEN* and *GOVSIZE* have opposite effects in the short run compared to the long run. In the short run, greater openness to trade increases competition, encouraging firms to migrate underground to lower costs to better compete with foreign firms. The lagged effect of the government size is positive and significant at lags one, three and four - consistent with a larger government (high taxes and regulations) being a driver of shadow activity.

Finally, the external shocks of both world wars increased the shadow sector, while the Great Depression reduced the shadow economy. The effects of the two world wars are consistent with the urgency of producing during war times, especially with foreign supplies being cut off that opened opportunities for underground operators.[7] Interestingly, the magnitude of WWII dummy is greater than that of WWI consistent with Figure 1.[8] On the other hand, the reduced economic activity during the great depression lowered opportunities for both the formal and the informal sectors.

Overall, the determinants of the shadow economy have strikingly different effects in the short-run relative to the long run. Table 6 includes a summary of the hypotheses and corresponding empirical findings.

5. Conclusions

This paper examines the determinants of the shadow economy in the United States. Key contributions include a look at the shadow economy over nearly a century and a half, consideration of political factors and the influences of the world wars and the Great Depression. Furthermore, the flexibility in the ARDL estimation model enables us to observe the influence of

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[5] Speed of adjustment is calculated as the reciprocal of the coefficient on the error correction term.
[6] See http://www.nber.org/cycles.html
[7] Wars also likely resulted in lax enforcement of underground activities.
[8] Of course, appropriate caution needs to be exercised with regarding to interpreting coefficients on dummy variables.

shadow determinants in both the long run as well as the short-run dynamics including adjustment to long-run equilibrium.

After performing a battery of diagnostic time series tests, results show that interesting economic, political and external influences on the long term spread of the U.S. shadow economy (Table 4). Specifically, among economic factors, greater GDP raised the underground sector while greater openness to foreign trade and a larger government lowered it. The rate of inflation did not have a significant influence. Among political factors, a strong presidency, as captured by the annual presidential vetoes, and party homogeneity were both statistically insignificant in their effects on the size of the shadow economy. In terms of relative magnitudes of effects, increases in GDP have a smaller positive effect on the shadow economy, than the negative effects of trade openness and government size, respectively. Finally, the influences of three external shocks considered were all significant, with the two world wars increasing the underground sector and the Great Depression reducing it.

Turning to the short-run influence of these variables (Table 5), the results suggest some remarkable differences. That is, greater openness to foreign trade and a large government worked to increase the size of the shadow economy in the short run, while higher inflation reduced it. Moreover, the size of the shadow economy revealed counter-cyclical behavior following changes in GDP.

While some of the factors, especially economic factors, have been found to significant affect shadow economies for the United States and elsewhere in the past (Goel and Nelson (2016), Goel and Saunoris (2016), Schneider (2012), Schneider and Enste (2000)), other contributions noted in this work are new. These findings are instructive for formulation of long term policies in tackling the underground sector as well as short term contingencies necessitated by occasional shocks.

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Table 1: Variable definitions, summary statistics and data sources

Variable	Definition	Mean	S.D.	Min	Max
Shadow	The size of the shadow economy (% of GDP), using the currency demand method. Source: Geidigh et al. (2016)	15.3625	6.7725	5.4000	36.9000
GDP	The log of real GPD per capita (constant 2009 $). Source: Williamson et al. (2017)	9.4297	0.8459	8.0196	10.8057
INFL	Inflation rate measured as the percent change in the GDP deflator. Source: Williamson et al. (2017)	2.0405	4.5652	-14.7377	23.3240
OPEN	Trade openness measured as the sum of imports and exports divided by nominal GDP. Source: Jordà et al. (2017) & authors' calculations	0.1163	0.0448	0.0499	0.2414
GOVSIZE	Government expenditures as a percent of GDP. Source: Jordà et al. (2017) & authors' calculations	0.1191	0.0897	0.0142	0.4065
VETOES	Total congressional bills vetoed per 100,000 population. Source: http://www.senate.gov/	114.1841	166.0997	0	734.6884
PARTY	Dummy variable =1 if the majority party in the House of Representatives and the Senate is the same and zero otherwise. Source: http://clerk.house.gov	0.793103	0.406485	0	1
Depression	Dummy variable equal to one for the years covering the Great Depression (1929-1939), and zero otherwise.				
WWI	Dummy variable equal to one for the years covering World War I (1914-1918), and zero otherwise.				
WWII	Dummy variable equal to one for the years covering World War II (1939-1945), and zero otherwise.				

Note: The data include annual observations for the United States from 1870 to 2014, unless otherwise specified.

Table 3: Drivers of the underground economy -Unit Root Tests: Augmented Dickey-Fuller

Variable	ADF[a]	ADF-break point test[b]
Shadow	-1.78 [0.389]	-2.44 [0.917] Break Date: 1943
ΔShadow	-11.62*** [0.000]	-12.24*** [<0.01]
GDP	-0.55 [0.878]	-3.37 [0.463] Break Date: 1933
ΔGDP	-8.92*** [0.000]	-9.63*** [<0.01]
INFL	-6.31*** [0.000]	-7.57*** [<0.01] Break Date: 1917
OPEN	0.52 [0.987]	-2.38 [0.932] Break Date: 1986
ΔOPEN	-11.33*** [0.000]	-12.37*** [<0.01]
GOVSIZE	-3.02** [0.035]	-7.63*** [<0.01] Break Date: 1941
VETOES	-2.54 [0.109]	-3.24 [0.545] Break Date: 1944
ΔVETOES	-9.55*** [0.000]	-14.23*** [<0.01]

Notes: Schwartz Information Criterion (SIC) used to determine optimal lag length with a max lag length of 13.
a. MacKinnon (1996) one-sided p-values are in brackets.
b. Vogelsang (1993) asymptotic one-sided p-values in brackets.
*Asterisks denote the following significance levels: *** p<0.01*

Table 4: Drivers of the underground economy - Cointegration test: Bounds testing procedure

Panel A: Cointegration estimates				
	Coefficient	Standard Error	Probability Values	
GDP	15.9660***	4.1292	0.0002	
INFL	0.1563	0.2480	0.5299	
OPEN	-200.6768***	32.0604	0.0000	
GOVSIZE	-186.8600***	43.9842	0.0000	
VETOES	-0.0066	0.0056	0.2432	
PARTY	-2.3520	1.5766	0.1388	
C	-85.3403***	30.1740	0.0056	
Panel B: Bounds tests for cointegration				
H$_0$: No cointegration				
F(*Shadow | GDP, INFL, OPEN, GOVSIZE, VETOES, PARTY*) (k=6) 5.93***				

Notes: Asterisks denote the following significance levels: *** p<0.01, ** p<0.05, and * p<0.1. C is constant term and the other variables are defined in Table 1. Critical value bounds for the Bounds testing with intercept and no trend and k=6 are:

Significance	I(0) Bound	I(1) Bound
10%	1.99	2.94
5%	2.27	3.28
1%	2.88	3.99

Table 5: Drivers of the underground economy - ARDL Error-Correction Model

	Coefficient	Standard Error	P-value	
ΔGDP_t	-3.2716	3.5008	0.3522	
ΔGDP_{t-1}	-1.6444	3.6145	0.6501	
ΔGDP_{t-2}	-10.1108***	3.6327	0.0064	
ΔGDP_{t-3}	-7.0382	3.6839	0.0588	
ΔGDP_{t-4}	-4.3641	3.8040	0.2539	
ΔGDP_{t-5}	-9.7485*	3.7510	0.0107	
$\Delta INFL_t$	-0.0943*	0.0562	0.0965	
$\Delta INFL_{t-1}$	-0.0589	0.0594	0.3242	
$\Delta INFL_{t-2}$	-0.1144*	0.0598	0.0584	
$\Delta INFL_{t-3}$	-0.1514***	0.0573	0.0095	
$\Delta INFL_{t-4}$	0.0454	0.0561	0.4204	
$\Delta INFL_{t-5}$	-0.0812	0.0510	0.1142	
$\Delta OPEN_t$	8.1438	15.2868	0.5954	
$\Delta OPEN_{t-1}$	55.1570***	16.6505	0.0013	
$\Delta OPEN_{t-2}$	27.7700*	16.5719	0.0968	
$\Delta OPEN_{t-3}$	47.4811***	16.5603	0.0050	
$\Delta GOVSIZE_t$	-5.8595	8.4355	0.4889	
$\Delta GOVSIZE_{t-1}$	16.1793*	9.2002	0.0816	
$\Delta GOVSIZE_{t-2}$	10.7125	8.8311	0.2279	
$\Delta GOVSIZE_{t-3}$	32.7600***	8.8987	0.0004	
$\Delta GOVSIZE_{t-4}$	16.8694*	8.6002	0.0525	
$\Delta GOVSIZE_{t-5}$	4.4851	8.1693	0.5842	
$\Delta GOVSIZE_{t-6}$	10.0916	6.9308	0.1484	
WWI	2.3597**	0.9547	0.0151	
$WWII$	3.3713***	1.0847	0.0024	
$Depression$	-1.6685***	0.6109	0.0074	
ECT_{t-1}	-0.1611***	0.0226	0.0000	
Diagnostic tests				
Q-Stat (36)	32.202	[0.650]		
Jarque-Bera test	0.072	[0.965]		
Breusch-Pagan-Godfrey test	1.266	[0.185]		
White test	1.474*	[0.072]		
ARCH test (3 lags)	1.78	[0.154]		
Ramsey RESET test	0.0004	[0.985]		

Note: Asterisks denote the following significance levels: *** p<0.01, ** p<0.05, and * p<0.1. ECT_{t-1} is the error correction term, which captures deviations from the long-run equilibrium; The other variables are defined in Table 1.

| Hypothesis	Description	Findings (sign of effect)
H1	*No clear-cut hypothesis about the effect of the size of government on the shadow economy.*	Long run: (-) Short run: (+)
H2	*The higher the inflation rate, the higher is the shadow economy, ceteris paribus.*	Long run: Not significant Short run: (-)
H3	*The higher the official GDP, the lower is the shadow economy, ceteris paribus.*	Long run: (+) Short run: (-) (Confirmed)
H4	*No clear-cut hypothesis about the effect of trade-openness on the shadow economy.*	Long run: (-) Short run: (+)
H5	*No clear-cut hypothesis about the effect of bills vetoed and same political party on the shadow economy.*	Not Significant
H6	*The more intense exogenous shocks like wars, the higher is the shadow economy, ceteris paribus.*	(+) (Confirmed)

Figure 2: CUSUM test for parameter stability
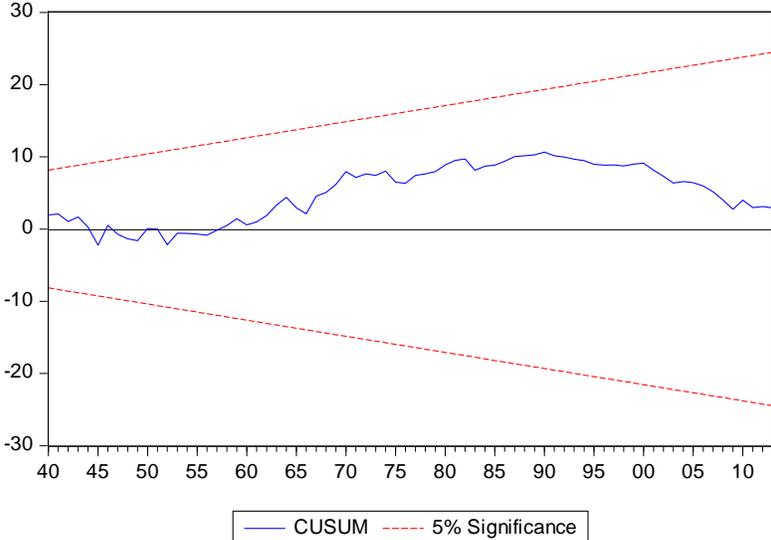
Figure 3: CUSUMSQ test for parameter stability