THE SHADOW ECONOMY DETERMINANTS - THE CASE OF PORTUGAL

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Abstract

Despite the existence of many studies regarding the meaning and measurement of the shadow economy, literature dedicated to the study of its determinants is almost inexistent. Thus, this study intends to explore the impact of several variables on the shadow economy in Portugal, using data from 1983 to 2015. The findings suggest that social security expenditure and the real Gross Domestic Product (GDP) growth rate exerted negative impacts on the size of the shadow economy.

JEL Classification Codes: E26, H55, K42, O17
Keywords: Shadow Economy, Social Security, Portugal

INTRODUCTION

The shadow economy is considered to be a phenomenon that is present in all economies, regardless of their level of development, and it remains a major problem in terms of fiscal, economic, and social consequences. Measuring the shadow economy proves to be an extremely challenging task, with a long list of studies using different methods to estimate its size and evolution. The absence of a common methodology for estimating its size makes any analysis of it difficult (Amendola & Dell'Anno, 2010; Feige, 2016; Medina & Schneider, 2018).

The relationship between the shadow economy and its determinants has not been given due attention. The debate has focussed on several factors, such as social security system expenditure, the unemployment rate, and indirect taxes. Indeed, the maturation of a public social security scheme seems to induce expenditures that follow a logistical curve, that is to say, a tilted s-shaped curve with a horizontal asymptote. On the other hand, as the shadow economy is not subject to labour regulations, it represents millions of contributions lost by the social security system every year (Cichon et al., 2004).

This paper focusses on the relationship between the shadow economy and its determinants in Portugal. It aims to make an important contribution to filling the existent gap in the literature regarding this issue.

The paper is organised as follows. Section 2 presents the literature review about the shadow economy and its possible determinant variables. Section 3 provides an overview of the Portuguese social security system. Section 4 presents the data and methodology, and Section 5 recounts the results. Section 6 concludes.

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SHADOW ECONOMY DETERMINANTS

The debate regarding the influence that the shadow economy has on the economy of a nation is not recent, with some authors mentioning its benefits and others its disadvantages. Different authors define the shadow economy in different ways (Dell'Anno, 2003; Feige, 2016; Schneider, 2014; Smith, 1994).

It is possible to observe a clear division between the shadow economy's components. It comprises two types of activities, legal and illegal, each of which include monetary and non-monetary transactions. It is also useful to differentiate these activities as leading to either tax evasion or tax avoidance, as summarised in Table 1. Sam (2010) divides the shadow economy into tax paying and non-tax paying activities, with the former being divided into legal and illegal ones. A number of authors make a distinction between tax evasion and tax fraud, considering that both represent some sort of tax avoidance. Therefore, while tax fraud is the adoption of an illegal procedure followed by an individual in ways that are reprehensible and punishable, tax avoidance includes all procedures followed by the taxpayer to minimise taxes, and the seizing of opportunities created by the existence of loopholes in the tax law without breaching those laws.

Table 1

	Monetary Transactions		**Non-Monetary Transactions**	
Illegal Activities	Trade in stolen goods, drugs; manufacture of drugs; prostitution, gambling, fraud		Barter, drugs, stolen goods, etc.	Produce or grow drugs for own use. Theft for own use.
	Tax Evasion	**Tax Avoidance**	**Tax Evasion**	**Tax Avoidance**
Legal Activities	Unreported income from self-employment, wages, salaries, and assets	Employee discounts, fringe benefits (cars, subsidised food, etc.)	Barter of legal services and goods.	Do-it-yourself work

Source: Professor H. G. Grubel, reproduced in Lippert & Walker (1997).

This study only considers the shadow economy as the legal production and provision of goods and services that are deliberately concealed from public authorities (Schneider, 2013). Consequently, illegal underground economic activities, criminal activities (such as drug dealing, robbery, etc.), and all household services and productions are excluded. These kinds of activities are often excluded from national accounts of the shadow economy due to estimation difficulties, which can limit international comparability (Dell'Anno, 2007; Feige, 2016).

The existence and growth of the shadow economy can be explained by distinct factors which can differ between countries and economies. The main ones are: increased tax burdens and social security contributions; increased regulation in the official economy; trust in the justice system and parliament; early retirement; unemployment and self-employment; the quality of state institutions; corruption; and *tax morale* (Petersen et al., 2010; Schneider & Enste, 2000; Williams & Schneider, 2016).

While this study focusses on the influence that economic factors have on the shadow economy, it is also important to mention that this can only partly explain the shadow economy's existence and growth. Social and political factors are also determinant considerations when measuring the shadow economy (Losby et al., 2002). Regardless of the type of forces driving the shadow economy, it is noteworthy that these variables, in empirical terms, can be subject to endogeneity issues. Therefore, they must be seen as indicative evidence (Bovi, 2003).

Taxes affect labour-leisure choices and also stimulate labour supply in the shadow economy. Therefore, the greater the difference between the total cost of labour in the official economy and after-tax earnings, the more incentive there is to avoid this difference and participate in the shadow economy (Schneider & Klinglmair, 2004). Tax burden can be defined as being the ratio of state tax revenues to personal income. Similarly, social security burden is defined as being the ratio of social security contributions to personal income. The burden of tax and social security contributions is often considered to be the key determinant for the existence of the shadow economy (Frey & Schneider, 2001; Schneider & Enste, 2000; Schneider, 2013). Schneider (1994) says that the direct tax burden (including social security payments) has the greatest influence of all factors, as it is the driving force for shadow economy activities, although he also concludes that a major reduction in the direct tax burden would not necessarily lead to a similar reduction in the shadow economy. Generally, if the tax burden increases in a country, economic units move from operating in the formal economy to the informal economy over time. This is reflected in the Laffer curve (Trabandt & Uhlig, 2011). After a certain point, which can vary from country to country, the optimal level is reached and tax revenue starts to decrease. In this context, social security expenditure is expected to negatively affect the shadow economy.

Unemployment is usually associated with a decrease in a country's Gross Domestic Product (GDP). This is denoted as Okun's Law. Unemployment imposes costs on society and contributes to instability and less employment in the formal economy, which drives people who have difficulty finding jobs to engage in the shadow economy (Ball et al., 2012). For a more in-depth study of the impact of unemployment on the shadow economy, see Bajada and Schneider (2009). Feld and Schneider (2010) and Schneider and Williams (2013) found that, *ceteris paribus*, the higher the unemployment and self-employment rates are, the more activities are performed in the shadow economy. The fact that one can observe such high and persistent unemployment levels in the European Union (EU) throughout the years may also be explained by the existence of a significant level of shadow labour market activity in these countries.

Corruption is defined by the Organisation for Economic Co-operation and Development (OECD) as the "abuse of public or private office for personal gain" (OECD, 2008, p. 22), while the International Chamber of Commerce, Transparency International, the United Nations Global Compact, & the World Economic Forum Partnering Against Corruption Initiative (2008) consider it to be "the single greatest obstacle to economic and social development" (p. 2). Efficient and discretionary application of the tax code and regulations by the government

plays a crucial role in the decision to work underground, whereas bureaucracy associated with highly corrupt government officials is usually linked to a larger shadow economy (Schneider & Buehn, 2012). This was demonstrated by Johnson et al. (1999), who found that a one point increase in the corruption index[3] was associated with a 5.1 percent decrease in the unofficial economy, *ceteris paribus*. Empirical studies by Dreher et al. (2005) showed that institutional quality can reduce the size of the shadow economy and corruption simultaneously. This positive correlation may reflect peoples' overall perceptions of a country's institutional environment, whereby when public institutions and government officials demonstrate low levels of corruption, the shadow economy tends to be lower and vice versa, suggesting that the quality of institutions and the size of the shadow economy go hand in hand (Friedman et al., 2000). This becomes especially true when one considers the endogenous linkage between institutional quality and taxation, as tested by Loayza (1997) and Friedman et al. (2000). Therefore, the greater the distance perceived by taxpayers between what they pay to the State and what they get from it, the more they are predisposed to engage in the shadow economy. Tanzi (1998) notes that countries such as Portugal have managed to reduce the incidence of corruption significantly[4], considering the existence of an inversely proportional relationship between the development level of a country and corruption-bribery, which could, therefore, affect the size of the shadow economy.

In summary, bureaucracy with highly corrupt government officials tends to be associated with more unofficial activity, while the proper application of laws through the securing of property rights and the enforceability of contracts increases the benefits of being engaged in the formal economy for citizens. Efficient policymaking is characterised by the imposition of a certain level of taxation, with most of the income received being spent on productive public services. Accordingly, production in the formal sector benefits from a higher provision of productive public services and is negatively affected by taxation, with the opposite applying in the shadow economy (Schneider & Buehn, 2012). Fraud (including corruption) usually precedes, follows, or succeeds the shadow economy, even though the shadow economy can exist without fraud and fraud can exist without the shadow economy.

Tax morale is defined by OECD (2013) as being the motivation of an individual to pay their taxes. Deterrence is the probability of being audited and the size of the penalty applied, which, according to Schneider (2011), can also impact the intrinsic motivation to pay taxes. In this way, the former is influenced by the latter and thus there is always a reciprocal link between the two, although this is also influenced by the quality of state institutions and the constitutional differences among states. Tax morale is particularly affected by the efficiency of the public sector, as it has an indirect effect on the size of the shadow economy (Schneider & Buehn, 2012). However, citizens are willing to honestly declare income, even if they do not receive a full public good that is equivalent to their tax payments. If the political process is perceived to be fair and legitimate, representing a fair interaction between taxpayers and the government, a reciprocal exchange that involves the giving and taking of both parties is accepted, with the government providing public services to citizens in exchange for their tax payments (Alm & Torgler, 2004; Feld & Frey, 2007).

The shadow economy allegedly mitigates government-induced distortions and, as a result, leads to enhanced economic activities in the official sector. In this sense, the unofficial sector acts as a complement to, rather than a substitute for, the official economy (Choi & Thum,

[3] This index ranks between 0 and 10 (10 means an absence of corruption).
[4] In 2016, Portugal ranked 29th out of 176 countries in Transparency International's Corruption Perception Index.

2005). Therefore, it is not possible to simply say that the elimination of the shadow economy would benefit the economy and society as whole. Nor is it possible to simply say that the shadow economy can have a positive side, although this might be the case under certain conditions. Schneider (2013) assumes that two-thirds of all activities that take place in the shadow economy complement those in the official sector as that amount returns to the official economy via consumption. He concludes that the development of the shadow economy can lead to higher value-added figures given the fact that total GDP is formed by the official GDP and part of the shadow economy GDP (Schneider, 2013). Considering these facts, if the shadow economy disappeared or suffered a huge decline, it would only improve a country's total welfare if almost all of it was transferred to the official economy.

On the negative side, an increase in the size of the shadow economy results in lower tax revenues and, consequently, in the availability of fewer public services and goods. The erosion of tax and social security bases not only results in significantly larger budget deficits, but also causes inefficiency in government policies, which are a consequence of unreliable indicators (Dreher et al., 2005). This erosion is partly explained by the existence of undeclared work which, according to the European Commission (2007), tends to obstruct growth-oriented economic, budgetary, and social policies. It is particularly harmful for the social security system when a person decides to enter the informal economy whilst also receiving social security benefits, as this creates a system of responsibility without creating a source for the system financing. Considering that public infrastructure plays a key role in economic growth (Loayza, 1997), the idea that a country may face a decrease in economic growth related to a growth of the shadow economy might become true. Loayza (1997) discovers some evidence of this by studying the correlation between the shadow economy and economic growth. He finds that the relative size of the informal sector is negatively correlated with the rate of economic growth. His findings also suggest that an increase in the size of the informal sector negatively affects growth by reducing the availability of public services and increasing the number of activities that either do not use the existing public services or use them less efficiently. In fact, the growth of the shadow economy represents a huge risk to the public sector which obviously depends on tax and social security contributions to keep the protective welfare state running smoothly. This growth represents less revenue and, consequently, an additional pressure on public finance, reducing the quality and quantity of publicly provided goods and services. This can lead to increased tax rates in the official sector, which are often combined with a deterioration in the quality of public goods and their administration, creating even stronger incentives for citizens to participate in the shadow economy (Schneider & Enste, 2000), resulting in a snowball effect.

The shadow economy is often considered to be a force that debilitates the official economy by attracting factors of production away from the official economy and creating unfair competition for legally established firms. As such, most countries attempt to control underground economic activities through various punitive measures rather than through reforms of the tax and social security systems. Cebula (1997) empirically concluded that the size of the shadow economy can be diminished by increased Internal Revenue Service (IRS) audits and penalties, although the evidence also suggests that an exclusive reliance on deterrence is not a reasonable strategy for increasing tax compliance (Feld & Frey, 2007). Research has shown that people's decisions to participate in the shadow economy are barely influenced by detection rates and depend far more on other factors, such as the acceptance of the tax system, perceived values, and the overall situation in the labour market (Feld & Schneider, 2010). However, if the population perceives the existence of tax evasion without penalties, this tends to increase the sense of injustice among those who pay their taxes, which eventually leads to an increase in size of the

shadow economy. A more pragmatic way of reducing the size of the shadow economy is to query who is participating in the shadow economy and how they are doing it. If companies and wealthier individuals are more frequent participants in the shadow economy, the authorities should turn their attention to bigger fiscal frauds and capital flights rather than smaller businesses, although they should not leave these out either.

To mitigate the movement of workers to the shadow economy, and as a way of increasing social protection coverage, some nations with significant shadow economies and environments in which most employment relations are informal have created systems of matching contributions, providing some incentives for greater participation in the formal labour market and therefore the pension system (Carranza et al., 2012), which is focussed on individuals who would otherwise have no coverage at all. However, in countries such as Colombia and Peru, the results were disappointing. Not only did coverage remain low, but it actually became even lower. It is still too early to develop more in-depth conclusions about these programmes, but Hinz et al. (2013) consider that matching is moderately effective for increasing programme participation, although it is generally not an effective measure for raising contributions and thus benefit levels.

In conclusion, the shadow economy cannot be counteracted by simply increasing the probability of detection and increasing the level of penalties, as these measures only deal with the effects, rather than causes, of the problem (Williams & Schneider, 2016). The strengthening of institutions and tax morale also plays a crucial role in the mitigation of the shadow economy. Berrittella (2015) emphasises the role that education plays in decreasing shadow economy size, suggesting that policies devoted to improving education levels contribute to a decrease in the shadow economy.

The shadow economy is a phenomenon which is present in all economies, regardless of their development, and it is considered to be of major concern for national authorities and institutions. In terms of its influence from a macroeconomic perspective, the shadow economy decreases tax revenues and undermines the financing of social security systems (European Commission, 2007). According to Schneider (2014), every activity in the shadow economy, by definition, involves a "shadow labour market" to some extent (p. 35). Therefore, this labour market includes all cases where employees or employers, or even both, are engaged in the shadow economy. It is important to note not just the effect that the shadow economy has on the sustainability of the social security system, but how the social security system affects the shadow economy. According to Bajada and Schneider (2009), substantial and prolonged participation in the shadow economy by the unemployed not only distorts the intended equitable distribution of the social security system, but can also engender what the authors call the "dependency trap", whereby shadow economy income (when supplemented by social security payments) discourages active participation in the formal economy. However, even though the social security burden is considered to be one of the main driving forces of the shadow economy, social contributions have never shown a positive correlation with the shadow economy (Bovi, 2003) and, therefore, the effect of this variable is not straightforward. In fact, associated costs are taken into account by economic agents at the time they plan to engage in shadow economy activity and these costs seem to prevent them from doing so. This applies to employees and employers. If social contributions are considered to be fair, and when faced with the prospect of earning a fair wage, employees may perceive that they will lose social benefits by engaging in the shadow economy. This incentivises them to make these contributions. Employers, meanwhile, may consider that social contributions lead to higher productivity and are an appreciated source of credit, and may not, therefore, feel tempted to go

underground. The costs of participating in the informal sector, which are also known as "costs of concealment", are usually modelled in terms of exclusion from certain public goods and services (e.g. social infrastructure, property rights, and the justice system) (Blackburn et al., 2012). The lack of social security entitlements is one of the major consequences of working in the shadow economy (European Commission, 2014).

Brown (2008) identifies three main priorities of a well-designed social security pension system: the mitigation and alleviation of poverty amongst the elderly; to help citizens maintain an acceptable standard of living post-retirement; and solidarity. Brown (2008) referred to solidarity as being the desire of workers and employers to contribute to and support the social security system. To achieve this, he assumes that there should not be a substantial proportion of workers who do not participate in and benefit from the system at the same time. The shadow economy plays a key role in this scenario. If people perceive that the total burden of taxes and social security contributions is too high[5], and that they do not benefit enough from the system, they will enter the shadow economy. As such, social security systems should not create what Brown (2008) defines as "perverse economic incentives" which can lead people to enter the shadow economy. However, the implementation of an effective social security system should always be subject to in-depth analysis by policymakers. If the level of generosity is too low, the social security system fails to maintain adequate support for those experiencing financial hardship, while a very generous system may encourage welfare dependency (Bajada & Schneider, 2009).

Góra (2014) enumerates several ways in which the pension system could be adjusted in order to become properly sustainable, ranging from an increase in the retirement age to an increase in the contribution/tax rate to finance pension expenditures. However, all of these measures would eventually lead to an increase in unemployment and a higher fiscal burden, which are the main driving forces of the shadow economy.

METHODOLOGY AND DATA

Hypothesis

Given the literature review, the following hypothesis is tested: the shadow economy is negatively influenced by social security expenditure and real GDP growth, and is positively determined by the unemployment rate, indirect taxes, and self-employment. Table 2 presents the variables and the expected impact of independent variables on shadow economy size.

[5] According to Brown (2008), "too high" varies from time to time and culture to culture, even though there is always a limit on the total of taxes and contributions applied.

Table 2: Description of the variables

Variables	Expected Impact	Unit	Source
Dependent			
Shadow economy size		Percentage of GDP	Dell'Anno (2007) (from 1983 to 2002) and Schneider (2015) (from 2003 to 2015).
Independent			
Social security expenditure	-	Percentage of GDP	PORDATA
Unemployment rate	+	Percentage	PORDATA
Indirect taxes	+	Percentage of total taxes	PORDATA
Real GDP growth	-	Percentage	PORDATA
Self-employment	+	Percentage of total employment	PORDATA

Models

Two models are estimated in order to study the relationship between shadow economy size and its determinants.

Considering the arguments of Schneider (2014), the first regression model only includes social security expenditure as an independent variable (simple regression model), as follows:

$$ShadowEconomySize_t = \beta_0 + \beta_1 Social\ Security\ Expenditure_t + \epsilon_t$$

where $\beta_1$represents the marginal impact of social security spending on the shadow economy.

On the other hand, considering that other factors might also explain shadow economy size, as previously reviewed in the literature, a multiple regression analysis is conducted which uses the unemployment rate, indirect taxes, real GDP growth, and self-employment as independent variables. All of these variables were chosen based on the most relevant determinants presented by Schneider and Buehn (2012). Therefore, the second model is depicted below:

$$ShadowEconomySize_t = \beta_0 + \beta_1 Social\ SecurityExpenditure_t +$$

$$\beta_2 UnemploymentRate_t + \beta_3\ IndirectTaxes_t +$$

$$\beta_4 RealGDPGrowth_t + \beta_5 SelfEmployment_t + \beta_6 Dummy + \beta_7 Year + \epsilon_t$$

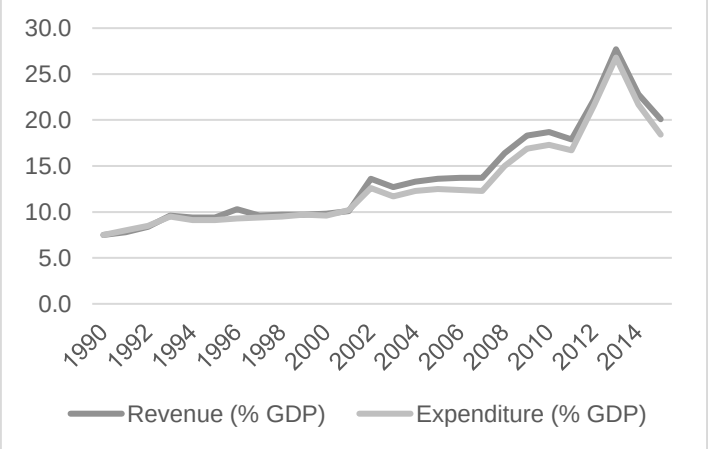
where Dummy = 1, from 2003 onwards, which allows for the correction of any systematic difference that the change of the source regarding shadow economy size data from 2002 to 2003 could cause, while the variable *Year* controls year effects.

All model estimations were implemented using the Stata statistical software package.

Data

The data used covers the period from 1983 to 2015, enabling a balanced time series sample. The Portuguese public pension system is financed through contributions from employers and employees (the earnings-related pension insurance provision or contributory pension system), and also through government or other public entities' transfers (the anti-poverty provision that is non-contributory and guarantees a minimum income in old age). In 1989, the government created the public pension reserve fund to cope with the maturation of the earnings-related pension insurance system. In 2015, this managed around €14,100M in assets, financed through its surpluses and a percentage of between 2% and 4% of obligatory contributions paid by employees to the social security system until the level of assets of the fund attains the equivalent value of two years' of pension benefits (Garcia, 2014). The assets value that year corresponded to 119.9% of the annual pension spending in Portugal and 7.9% of Portuguese GDP (Instituto de Gestão Financeira da Segurança Social, I.P., 2017). Moreover, in 2007, Law No. 4 introduced the sustainability factor (determined by life expectancy) in order to reduce the earnings-related old age pension benefit, and a legal age of retirement that started to be dependent on life expectancy. Therefore, in 2017, the legal age of retirement had already reached 66 years and 3 months.

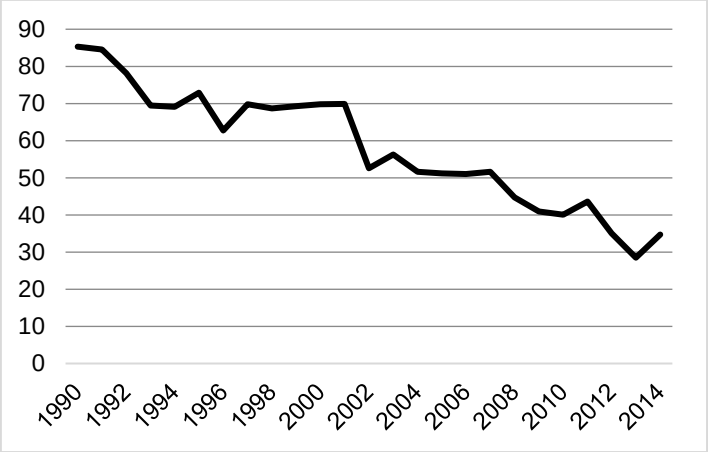
Figure 1. Social security revenue/expenditure (% of GDP)



Source: PORDATA.

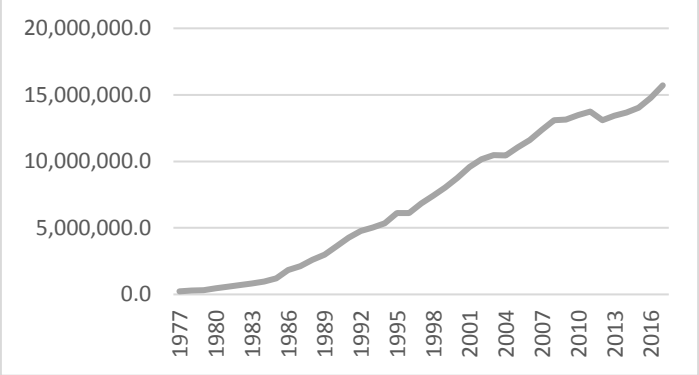
Figure 1 shows social security revenue and expenditures between 1990 and 2014, revealing some sustainability improvements. However, contributions represent a decreasing share of this revenue (Figure 2), which is possibly explained by the growth of unemployment and a labour force that had moved to the informal sector, although in absolute terms (Figure 3). In 2014, total pension expenditure accounted for 15.7% of GDP and almost 75% of all social security expenditure.

Figure 2. Mandatory social security contributions (% of revenue)



Source: PORDATA.

Figure 3. Mandatory social security contributions (thousands of euros)



Source: PORDATA.

Undoubtedly, demographic factors represent a huge challenge for the sustainability of the Portuguese social security system. Life expectancy has increased substantially, from 67 years in 1970 to 80 years in 2014, and the overall fertility rate fell from above 3 in 1970 to just 1.3 in 2015. The potential sustainability index, which measures how many people aged between 15 and 64 years exist per each older citizen, fell from 6.6 in 1970 to 3.2 in 2015. Projections estimate that the Portuguese population will decrease from 10.3 million to 7.5 million in 2080, with the ageing index[6] doubling from the current ratio of 147 older people per 100 children to 317 older people per 100 children in 2080 (INE, 2017). In addition, the dependency ratio[7], which is directly linked to the potential sustainability index, is projected to rise rapidly from the current 31.8% to an impressive 73% in 2080.

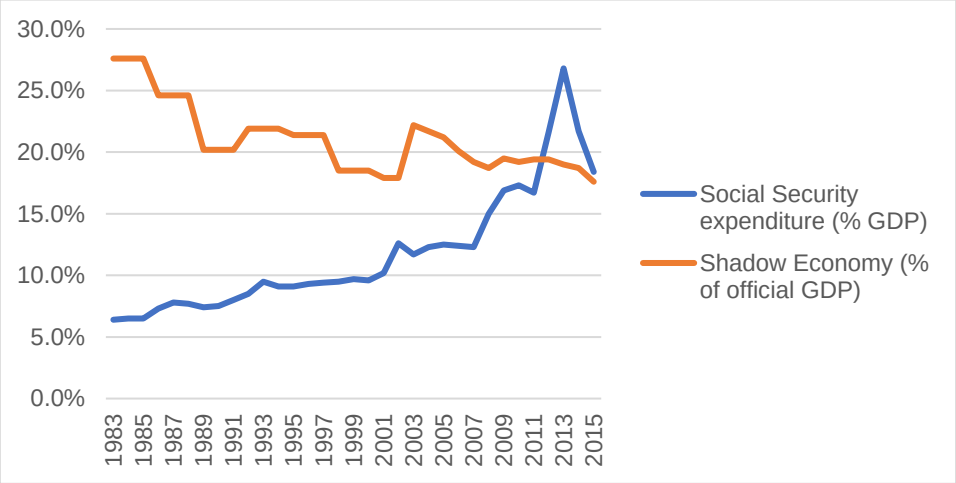
On the other hand, the shadow economy could also have a significant impact on the financial performance of the Portuguese social security system, as its size was estimated to be 17.6% of GDP in 2015 albeit with a decreasing trend (Figure 4) (Schneider, 2015). The corresponding

[6] The ageing index is the ratio of the number of people of an age when they are generally economically inactive (aged 65 and over) to the number of young people (aged from 0 to 14)

[7] The ratio of the number of people of an age when they are generally economically inactive (aged 65 and over) to the number of people of working age (from 15 to 64).

monetary amount would be sufficient, for instance, to pay the total contributory pension system expenditure for approximately two years, and represents thousands of people whose contributions are not making it into the social security system. Therefore, shadow economy activities have a considerable impact on the pension system's sustainability by reducing the basis for calculating pension contributions and leading to the decline of those contributions, as unreported employment results in lower bases for calculating the pension contributions during labour activity, which leads to a smaller initial pension size. If increased black market activities cause a lower demand for the workforce in the official economy, and thus lower pay rises and a higher unemployment rate, the rate of pension increase for all pensioners will be lower and the dynamics of expenditure will be relaxed (Gankova-Ivanova, 2015).

Figure 4. Social security expenditure and shadow economy (% of GDP) (1983-2015)

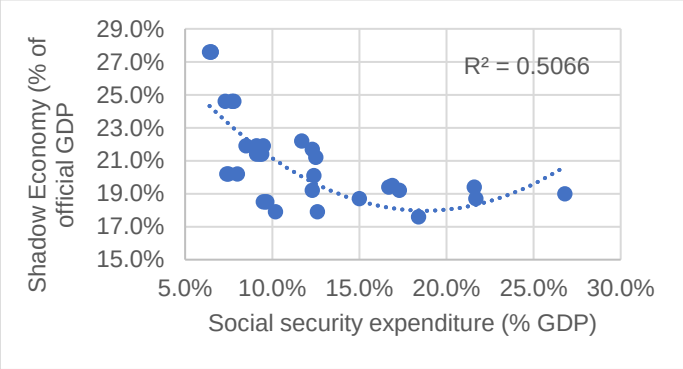


Sources: PORDATA, Dell'Anno (2007), and Schneider (2015).

Figure 4 presents the opposing trends displayed by social security expenditure (% of GDP) and shadow economy size (% of GDP) in Portugal from 1983 to 2015. While social security expenditure seems to increase throughout the years, the shadow economy seems to decrease, which corroborates William & Schneider's (2016) theory.

Figure 5 suggests that the marginal effect of a social security expenditure increase on the reduction of shadow economy has an effect until approximately the 17.5% threshold. After this, the result becomes negative and shadow economy size increases again, which seems to be in line with Schneider and Enste (2000), that is to say, more social transfers lead to stronger negative incentives for beneficiaries to work in the official economy.

Figure 5. Relationship between shadow economy size and social security expenditure (1983-2015)



Source: Author's calculations.

Indeed, Schneider and Enste (2000) mention the disincentives to search for work in the official economy that these systems provide for individuals receiving welfare payments, based on the fact that a person's overall income is higher if they receive these transfers while working in the underground economy. Therefore, the positive effect of an increase of social transfers to mitigate the shadow economy seems to disappear after a certain point. Thus, it seems that policymakers should be focussed not only on implementing economic measures to reduce the size of the shadow economy, but also, probably more importantly, on how the quality of public institutions and the application of certain measures are perceived by citizens, considering that the rationales for engagement in the shadow economy are only partly explained by fiscal and economic factors. This situation is reflected by the size of the shadow economy in different countries. Those with small public sectors and comparatively high tax morale (such as the U.S. and Switzerland) are also those with the smallest shadow economies (Schneider & Enste, 2000; Schneider, 2002), which might indicate a possible relationship between the two variables. Nevertheless, social transfers, allied with a proper level of investment in public services, seem to be truly effective at reducing the size of the shadow economy.

The available data resulted in a sample size from 1983 to 2015. With the exception of the shadow economy size (in % of GDP), all variables were obtained from PORDATA. The former was provided by Dell'Anno (2007) (from 1983 to 2002) and Schneider (2015) (from 2003 to 2015), which justified the introduction of a dummy variable in the second model. Table 3 shows the descriptive statistics.

Table 3: Summary statistics

Variable	Observations	Mean	Std Dev	Min	Max
Year	33	-	-	1983	2015
Dependent Variable					
The shadow economy (% of GDP)	33	0.210	0.028	0.176	0.276
Independent Variables					
Social security expenditure (% of GDP)	33	0.117	0.050	0.064	0.268
Unemployment rate	33	0.077	0.033	0.039	0.162
Indirect taxes (% of total taxes)	33	0.590	0.039	0.520	0.712
Real GDP growth rate	33	0.020	0.028	0.040	0.079
Self-employment (% of total employment)	33	0.242	0.022	0.179	0.271

RESULTS

Table 4 presents the models' estimations. Model 2, with the Newey-West (1987) correction, was also estimated.

Social security expenditure as a proportion of GDP is always statistically significant. Therefore, the results suggest that an increase in social security expenditure as a share of GDP of one percentage point is associated with a decrease in the size of the shadow economy as a share of GDP of 0.224 percentage points, *ceteris paribus*. This corroborates the computations carried out by Williams and Schneider (2016). Furthermore, the negative coefficient on the real GDP growth rate is always statistically significant, in line with previous studies.

On the other hand, the unemployment rate also seems to affect the shadow economy, as an increase of one percentage point in the unemployment rate is associated with an increase of 0.438 percentage points in the size of the shadow economy, *ceteris paribus*.

In addition, both indirect taxes and self-employment are not significant explanatory variables. Furthermore, the R-squared value shows that the explanatory variables explain about 91.2% of the variation in the dependent variable.

To evaluate the quality of the model, regression diagnostics and tests were conducted (Wooldridge, 2015). First, the overall significance test was carried out to see if the model has explanatory power. The value of the F-statistic was 36.80 and the associated p-value was less than 0.01. Therefore, the estimated model coefficients were jointly significant at the 1% level and at least one estimated coefficient is statistically different from zero. We conclude that the chosen explanatory variables can be statistically related to the size of shadow economy. Second, the Breusch-Pagan test was carried out to check whether the residuals are heteroskedastic. Gauss-Markov assumptions stipulate that if residuals are heteroskedastic, then Ordinary Least Squares standard errors will be biased, which would mean that the t-statistic will not have the standard distribution under the null hypothesis and therefore cannot be used for hypothesis tests. The Breusch-Pagan test statistic has a p-value of 0.1913, suggesting that the null hypothesis of homoskedasticity cannot be rejected in Model 2. Similar results are found

when a more general test of heteroskedasticity is used, such as the information matrix test (Cameron & Trivedi, 1990).

Table 4: Regression estimation results

	(1)	(2)	(3)
Variables	**Model 1**	**Model 2**	**Model 2 with Newey-West (1987) correction**
Social security expenditure (% GDP)	-0.319***	-0.224*	-0.224*
	(0.0832)	(0.130)	(0.113)
Unemployment rate		0.438***	0.438***
		(0.128)	(0.128)
Indirect taxes (% of total taxes)		0.0112	0.0112
		(0.0648)	(0.0723)
Real GDP growth rate		-0.221**	-0.221**
		(0.0868)	(0.0953)
Self-employment (% of total employment)		0.0432	0.0432
		(0.151)	(0.130)
Dummy		0.0311***	0.0311***
		(0.00814)	(0.00752)
Year		-0.00366***	-0.00366***
		(0.000637)	(0.000622)
Constant	0.248***	7.498***	7.498***
	(0.0106)	(1.285)	(1.257)
Observations	33	33	33
R-squared	0.322	0.912	0.912

Source: STATA 13
Note: Standard errors in parentheses. ***, **, * denote significance at the 1%, 5%, and 10% levels.

In conclusion, the joint statistical significance and diagnostic tests reveal that social security spending and real GDP growth rate do indeed have a statistically significant negative impact on the size of the shadow economy, whereas the unemployment rate has a positive impact on it.

CONCLUSION

Our empirical analysis suggests that there is a statistically significant negative relationship between social security expenditure and the shadow economy, and between real GDP growth rate and the shadow economy. Therefore, the role of those two variables should be enhanced in reducing the shadow economy. As expected, the unemployment rate has a significant positive relationship with shadow economy size. This suggests that increasing social security expenditure and economic growth, and reducing unemployment, can help to reduce the size of

the shadow economy. It is worth noting that a reverse causality is possible. Thus, when a larger proportion of the economy, including the labour force, moves to the official sector, it allows for the collection of more taxes and social security contributions. This would lead to higher social security expenditure and could enhance economic growth, for example, through public investment in infrastructure. A more advanced analysis would need to take this potential endogeneity of explanatory variables into account.

Finally, not only is the shadow economy a threat to the financial sustainability of the social security system, it also causes macroeconomic data distortions which, consequently, affect policymakers' decisions. Therefore, reforms to solve the alleged financial problems of the social security system should take its present role in mitigating the shadow economy into account.

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