Size and causes of the underground economy in Spain: A correction of the record and new evidence from the MCDR approach

by

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Abstract: We review existing estimates of the size of the Spanish underground economy, apply the Ahumada et al. (2007, *RIW*) correction procedure to some of them and calculate the size of the underground economy in Spain for the period 1960 through 2009 by using the modified-cash-deposits-ratio (MCDR) approach recently developed by Pickhardt and Sardà (2011, *EJLE*). We then extend the MCDR approach with respect to an analysis of the causes of the Spanish underground economy. Contrary to most other studies, we show that the latter is not predominantly caused by tax pressure, but by labor market aspects, macroeconomic influences and criminal activities. Based on these findings we derive some unprecedented policy recommendations.

JEL: O17, H26, C22, **Keywords**: underground economy, shadow economy, hidden economy, black economy, cash-deposit-ratio, currency demand approach, MIMIC approach,

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1 Introduction

The size, scope and impact of the underground economy[1] are among the top issues of the political and economic policy debates in Spain. Although these debates are fuelled by the current economic situation of Spain, the day to day presence of underground economy activities in most people's social environment also contributes to an increasing awareness.

From a scientific point of view, however, any analysis of the size, scope and impact of the underground economy is faced with severe data problems because underground activities are not recorded and anyone engaged in such activities has a strong incentive to hide them. Therefore, economists have developed a variety of methods to estimate the size of the underground economy and some of them are discussed in Schneider and Enste (2000), Kazemier (2006), Pickhardt and Shinnick (2008) or Adair (2011).

Yet, the most frequently applied approaches, the Multiple-Indicators-Multiple-Causes (MIMIC) method and the currency demand method (the latter is often used as an input for the MIMIC approach, see Giles 1999), have been heavily criticized on econometric grounds by Breusch (2005a,b,c,d). In addition, Ahumada et al. (2007) have shown that the currency demand method produces coherent estimates only if the long run income elasticity of the demand for currency is equal to unity. A condition that is not fulfilled for various published estimates. Moreover, Ahumada et al. (2008) have shown that if the lagged dependent variable is used in currency demand estimations, calculating cardinal values of the size of the underground economy requires a known initial value of the size of the underground economy. Again, in a number of relevant published estimates no such initial value was used. To this

[1] We use the term 'underground economy' interchangeably with terms such as shadow economy, hidden economy, black economy, etc. (see Kazemier 2006, Pickhardt and Sardà 2011).

extent, many estimates of the size of the underground economy have produced faulty figures and, therefore, have provided misleading information to the public, to politicians and law makers.

The purpose of this paper is to address this issue in three ways. First, we review existing estimates of the size of the Spanish underground economy. Second, we apply the Ahumada et al. (2007) correction to relevant estimates. Third, we apply a rather simple calculation method, the modified-cash-deposits-ratio (MCDR) approach, which was recently developed by Pickhardt and Sardà (2011) and which is not subject to the critique of Breusch (2005a,b,c,d) and Ahumada et al. (2008, 2007). Moreover, we extend the MCDR approach by incorporating an analysis of possible causes of underground economy activities. Among other things, we show that the MCDR approach allows for reproducing various existing estimates of the Spanish underground economy, that some previously published estimates are untenable with respect to the size of the latter and/or its evolution over time, and that the Spanish underground economy is predominantly caused by labor market aspects, macroeconomic issues and illicit activities, rather than just by tax pressure. These findings allow us to draw some comprehensive and unprecedented policy conclusions for combating the Spanish underground economy.

The paper is structured as follows. In the next section we deal with the size of the Spanish underground economy. First, we briefly review previous estimations. We then employ the Ahumada et al. (2007) correction procedure to some of these estimates. Eventually, we use the MCDR approach for calculating the size of the Spanish underground economy. In section three we compare and contrast our findings with previous estimates, provide an analysis of possible causes of the Spanish underground economy and offer some policy recommendations. The final section concludes.

2 Size and Evolution of the Spanish Underground Economy

Estimates of the size of the underground economy in Spain have been conducted since the 1980s by various researchers. However, almost all of them have used the monetary approach in one way or another. The latter is an indirect macro-based method that rests on the quantity theory of money and was pioneered by Cagan (1958). Two decades later, Gutmann (1977) developed a simple non-econometric calculation procedure based on the monetary approach and applied it to U.S. data. In contrast, Feige (1979), Klovland (1980, 1984), Tanzi (1980, 1982, 1983), Bhattacharyya (1990), and Escobedo and Mauleón (1991) have developed variants of the monetary approach that are all based on an econometrically estimated money demand equation. Therefore, these variants of the monetary method are also known as variants of the currency or money demand method.

Moreover, as noted, results derived from a monetary method are often used as a calibration input for MIMIC estimations. This is because the MIMIC method, which was first applied to underground economy estimations by Frey and Weck (1983), just generates relative estimates, so that the MIMIC index must be calibrated with a benchmark value taken from another source in order to get cardinal values of the size of the underground economy (e.g. see Giles 1999, F373; Schneider and Enste 2000). Apart from the monetary approach and the MIMIC approach, there are a number of alternative methods for estimating the size of the underground economy, which are reviewed, among others, by Schneider and Enste (2000), Kazemier (2006) or Adair (2011).

2.1 Previous Estimates

The first estimates of the Spanish underground economy were conducted by Lafuente Félez (1980), using the Tanzi method and by Moltó Calvo (1980), using the Gutmann method. However, both authors derive a percentage value of its size for just one year, 22.9 percent

(1978) and one percent (1976), respectively. Several other authors have also contributed some evidence for selected years (see Table 1, column Var.).

A time series of the size of the Spanish underground economy is provided by several authors who use different variants of the monetary method. For example, Escobedo and Mauleón (1991), Mauleón and Sardà (1997), Gómez-Antonio and Alañón-Pardo (2004), and Arrazola et al. (2011) all apply the Escobedo and Mauleón (1991) method. The MIMIC approach is used by Alañón-Pardo and Gómez-Antonio (2005), who calibrate their MIMIC model with the 1980 value and the 1980-1981 growth rate of the underground economy according to Gómez-Antonio and Alañón-Pardo (2004). Dell'Anno et al. (2007), essentially do the same because they also calibrate their MIMIC model with a 1980 value taken from Alañón-Pardo and Gómez-Antonio (2005) or Gómez-Antonio and Alañón-Pardo (2004). Moreover, Weck-Hannemann et al. (1984), Schneider (1997a,b, 2010) and Feld and Schneider (2010) also provide results for selected years based on a MIMIC model, which is calibrated with values taken from a currency demand method. In contrast, Prado-Domínguez (2004) offers a time series derived from using the Tanzi method and Gadea and Serrano-Sanz (2002) and Serrano-Sanz et al. (1998) provide several time series that are based on the Klovland (1980, 1984) method. Finally, Arrazola et al. (2011) not only use the currency demand method of Escobedo and Mauleón (1991), but also the MIMIC method and an electricity approach that is related to the method of Escobedo and Mauleón (1991).

Hence, almost all available estimates of the size of the Spanish underground economy are based on a variant of the monetary approach. In Table 1, columns three to 14 (counted from left to right) give an overview concerning these results, where the size of the underground economy is measured in percent of the official GDP. Inspection of Table 1 shows that most of the estimates in columns three to 14 provide fairly close values in several years, but not in all of them. For example, during the period 1980-1989, where most of the series overlap, the size of the Spanish underground economy seems to have ranged basically from about five percent

of official GDP in 1980 to about 20 percent in the late 1989, although in some years there are marked differences between the series. Also, during this period all estimates peak in 1989, except those of Mauleón and Sardà (1997) and Dell'Anno et al. (2007).

To explain these and other differences in the results, we proceed with examining the estimations in some detail. First, we consider the results in columns three to seven (EM, MS, GA, A+1, (A+2)), which are all obtained from a direct application of the Escobedo and Mauleón (1991) variant of the currency demand method, except the A+2 profile, which is obtained from an electricity demand method that is otherwise based on the Escobedo and Mauleón (1991) method. The main advantage of the latter is that it does not require the assumption of equal velocities of money circulation in both the legal and underground economy, an assumption that is central to all other versions of the monetary approach mentioned above and, in fact, one of the most heavily criticized assumptions regarding this approach (e.g. see Thomas 1999). The major disadvantage of this method is that it necessarily mimics the evolution of the tax pressure variable over time. Essentially, this means that any underground economy profile obtained from applying the Escobedo and Mauleón (1991) method cannot represent the evolution of the underground economy over time, unless it accidentally coincides exactly with the development of the tax pressure variable over time.[2] In fact, this may be clarified by the equation from which an absolute value of the underground economy is obtained (see Escobedo and Mauleón 1991, 109),

$$Y_{U,t} = (a_2 / b_1)\, T_t, \tag{1}$$

where Y_U denotes the size of the underground economy in absolute terms, T is the tax pressure variable, a_2 is the coefficient of the tax pressure variable, b_1 is the coefficient of the

[2] Obviously the same is true if several pressure variables are used as this would just lead to an underground economy profile that represents a combination of the profiles of these pressure variables.

legal size of the economy Y_L and t is the time index. However, equation (1) applies only in cases where cash in circulation and legal money are estimated separately. If just a single estimation is used, equation (1) amounts to,

$$\frac{Y_{U,t}}{Y_{L,t}} = exp(\alpha_3 \cdot P_{F,t} / \alpha_1) - 1 \cong \frac{\alpha_3}{\alpha_1} P_{F,t}, \qquad (2)$$

where $P_{F,t}$ corresponds to the tax pressure variable T, α_3 is the coefficient of the tax pressure variable and α_1 is the coefficient of the legal size of the economy Y_L (see Mauleón and Sardà 1997, 126; Gómez-Antonio and Alañón-Pardo 2004, 14; Alañón-Pardo and Gómez-Antonio 2005, 1016). Hence, equations (1) and (2) make it clear that differences in the results shown in columns three to six of Table 1 must *ceteris paribus* come either from different values of the coefficient ratio and, thus, from running the estimation with different variables, but with the same tax pressure variable and/or from choosing a different tax pressure variable. Put differently, if the tax pressure variable is the same, but other variables in the estimated equation differ, *ceteris paribus* this would result in a different size of the underground economy (i.e. a different ratio α_3/α_1), but not in a different profile over time. We will come back to this issue in section three.

Next, we consider results shown in columns eight and nine of Table 1 (AG and DGA). These results indirectly rest on the Escobedo and Mauleón (1991) variant because they are both obtained from calibrating a mimic index with the 1980 value of column GA.[3] This notwithstanding, the results in columns AG and DGA show a rather different profile and differ in most years, with up to 15 percentage points (see Table 1, 1997). Differences in the calibration procedure, underlying mimic indices and, therefore, alternative specifications of the MIMIC models explain these results. In this context, it seems worth noting that combining

[3] As noted, Alañón-Pardo and Gómez de Antonio (2005, 1019) have used, in addition, the growth rate of the underground economy during the period 1980-1981.

the Escobedo and Mauleón (1991) variant with a MIMIC index essentially solves the major problem of the former with respect to its incapacity of providing a profile that is independent from the profile of the tax pressure variable (see also Pickhardt and Sardà 2006).

We now turn to columns 10 to 13 of Table 1 (P, GS1, GS2, SE+). These results all differ with respect to the profile and they differ substantially with respect to the size of the underground economy, if results from the Tanzi method (column P) are compared to those obtained from the Klovland method (columns GS1, GS2, SE+). However, these estimates are subject to a recently proposed correction procedure and, therefore, we refrain from any closer inspection but turn to the Ahumada et al. (2007) correction procedure.

2.2 Ahumada et al. Correction Procedure

According to Ahumada et al. (2007), the currency demand method may produce coherent estimates provided that the long run income elasticity of the demand for currency, say β, equals one, $\beta = 1$.[4] This condition is an implication of the assumption of equal velocities of cash circulation in both the legal and underground economy. As noted, it is one of the crucial assumptions on which the currency demand method rests (e.g. see Breusch 2005b, 396), except the version developed by Escobedo and Mauleón (1991).

In addition, Ahumada et al. (2007) provide a correction procedure, which can be applied if the long run income elasticity of the demand for currency differs from unity, $\beta \neq 1$. In general, the Ahumada et al. (2007, 368) correction is:

$$\left(\frac{\overline{Y}_U}{\overline{Y}_L}\right)^{\frac{1}{\beta}} = \frac{Y_U}{Y_L}, \tag{3}$$

[4] The condition $\beta = 1$ is generally required, except in the rather unlikely case where the size of the underground economy is exactly equal to the size of the legal economy (see Ahumada et al. 2007, 367).

where Y_U denotes the size of the underground economy in national currency, Y_L denotes the size of the legal economy in national currency, the ratio $\overline{Y}_U / \overline{Y}_L$ denotes the faulty size of the underground economy, the ratio Y_U / Y_L denotes the correct size of the underground economy and β is the long run income elasticity, which is different from unity.

Following Ahumada et al. (2007), we choose to correct the Klovland based estimates of Gadea and Serrano-Sanz (2002) and Serrano-Sanz et al. (1998), which are shown in columns GS1, GS2 and SE+ of Table 1, respectively. The three models essentially differ with respect to the model specifications. The long run income elasticity's of the demand for currency regarding these three models are, β_1 = 1.68 (GS1), β_2 = 0.52 (GS2) and β_3 = 0.8 (SE+). Then, if we consider the faulty size of the underground economy in a specific year, say 1980 (see Table 1), which is $(\overline{Y}_U / \overline{Y}_L)_1$ = 0.0634 in the case of (GS1), application of (3) yields: $0.0634^{(1/1.68)}$ = 0.19362, which gives a corrected size of 19.36 percent of GDP for the Spanish underground economy in 1980 (see Table 1, column A-GS1). Likewise, for the second model we get $(\overline{Y}_U / \overline{Y}_L)_2$ = 0.0728, which yields: $0.0728^{(1/0.52)}$ = 0.006483, so that the corrected size is 0.65 percent of GDP (see Table 1, column A-GS2) and for the third model we get $(\overline{Y}_U / \overline{Y}_L)_3$ = 0.0585, which yields: $0.0585^{(1/0.8)}$ = 0.02877, so that the corrected size is 2.88 percent of GDP (see Table 1, column A-SE+). Corrected values for the entire period are obtained in the same way and displayed in Table 1, columns A-GS1, A-GS2 and A-SE+, respectively.

Inspection of Table 1 shows that the corrected sizes of the Spanish underground economy are substantially different from the initially published sizes.[5] Moreover, because all three corrected estimations are also subject to the critique of Ahumada et al. (2008), even the corrected values may not give a good approximation of the Spanish underground economy. In

[5] Ahumada et al. (2007, 370) correct the estimate of Isachsen and Strom (1985, 24) for Norway, which is also based on the Klovland method and find that the corrected size of the underground economy is 1.51 percent of GDP in 1978, rather than 6.3 percent.

this context it is worth noting again that the Ahumada et al. (2008, 2007) critique also applies to the results of Prado-Dominguez (2004), column P of Table 1, which are obtained by using the Tanzi version of currency demand method.

To summarize, inspection of Table 1 shows that applying the Ahumada et al. (2007) correction procedure leads to a substantial increase in the variability of the results. Given that these estimates are otherwise correct, the model specification seems to have a much larger impact than initially though. Yet, even the corrected values may still be faulty according to Ahumada et al. (2008) and Breusch (2005b,c). In any case, our brief review of existing estimates demonstrates that there is some faulty and mixed evidence concerning the size and evolution of the underground economy in Spain. Possible ways of addressing this issue include developing and applying alternative methods as well as conducting plausibility tests. Therefore, we proceed with applying the MCDR approach.

2.3 The MCDR Approach

The modified-cash-deposits-ratio (MCDR) approach was recently developed by Pickhardt and Sardà (2011) with a view to address various issues. First, to circumvent econometrical and mathematical criticism put forward by Breusch (2005,a,b,c,d) and Ahumada et al. (2007, 2008). Second, to include cash used in illicit economic activities, such as drug dealing, human trafficking, etc., that are not caused by tax pressure. Third, to simplify plausibility testing with respect to results obtained from other methods. Fourth, to raise the level of transparency regarding the estimation procedure.

Essentially, the MCDR approach is a modified version of the original Gutmann approach. Formal representations and critical reviews of Gutmann's original approach are provided by Thomas (1999, F382–F383), Feige (1989, 36–44), and Blades (1982, 43), among others. According to a central assumption of the original Gutmann approach, agents in the legal economy wish to maintain a constant proportion λ of cash holdings C and sight deposits D

over time. However, despite some country specific differences, agents in industrialized countries apparently seem to have changed their preferences over time toward a substantially higher share of deposits. Thus, application of the original Gutmann approach would now generate negative values of the underground economy in many countries.

Therefore, Pickhardt and Sardà (2011, 149–150) assume instead that "all currency in circulation in the base year, C_0, represents the entire cash agents wish to hold in any year after the base year for the set of legal transactions they prefer to carry out in cash". In addition, the authors assume that all additional transactions in the legal economy are carried out via sight deposits by using cheques, debit and credit cards, etc., but continue to apply the remaining assumptions of the original cash-deposit-ratio approach. Thus, by definition, any cash holdings in excess of those in the base year can be fully attributed to the underground economy. Subject to these assumptions, Pickhardt and Sardà (2011, 150) show that using Irving Fisher's (1911) quantity theory of money leads to:

$$\frac{C_t - C_0}{C_0 + D_t} \cdot Y_{Lt} = Y_{Ut}, \tag{4}$$

with $C_0 = C_{Lt}$, and $C_t - C_0 = C_{Ut}$, $t = 1, \ldots, Z$, and where C_t denotes currency in circulation outside banks at the end of the year, C_0 denotes currency in circulation outside banks at the end of the base year or base period, here 1960, C_L denotes currency used for legal transactions, C_U denotes currency used for underground economy transactions and D_t denotes sight deposits held by domestic non-banks (non-MFIs) at the end of the year.

Although this modification solves the major problem of the original cash-deposit-ratio approach (i.e., negative results), Pickhardt and Sardà (2011, 150–156) emphasize that all criticism put forward with respect to the original Gutmann approach applies to the modified

version as well. This notwithstanding, they suggest and apply further auxiliary modifications that may to some extent address this criticism.

In particular, these auxiliary modifications are (Pickhardt and Sardà 2011, 153): "1) that inflation may require increasing C_0 over time to allow agents to carry out their preferred set of cash transactions, 2) that changes in the size of the population may require to adjust C_0 over time, 3) that a certain fraction of C_t may be held abroad, 4) likewise, that a certain fraction of C_t may be hoarded by national agents, 5) that the number and set of transactions, which agents wish to carry out in cash, may change over time, for example, due to the evolution of new non-cash payment methods and facilities, 6) that some proceeds from underground activities may in fact be held as sight deposits, for example, because of money laundering or because the illegal transactions did not involve any cash payments at all, so that D_t may have to be reduced accordingly to D_{Lt} in the denominator of (4) and D_{Ut} may have to be added to C_{Ut} in the nominator, with $D_t = D_{Lt} + D_{Ut}$, 7) that the size of the underground economy may not have been close to zero in the base year or base period".

In the present paper we have addressed the first two modifications (inflation and population) and have forecasted C_t for the relevant period to bridge the gap caused by the Euro introduction (see appendix). Yet, we refrain from applying the third auxiliary modification because we have no evidence that substantial amounts of Pesetas were held outside Spain during the period under consideration and we could not apply the remaining modifications due to a lack of data. Given these auxiliary modifications, (4) changes to (5),

$$\frac{FC_t - PIC_{0t}}{PIC_{0t} + D_t} \cdot Y_{Lt} = Y_{Ut}, \tag{5}$$

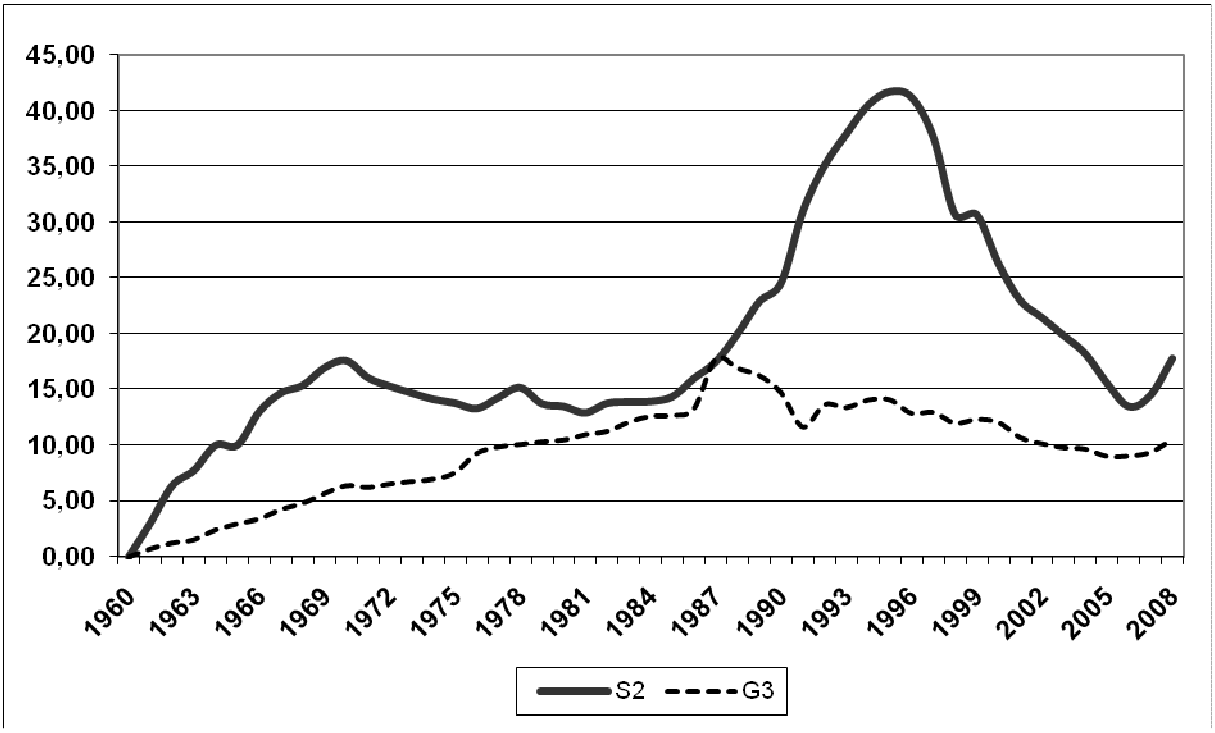
Table 1: Size of the Spanish Underground Economy in Percent of GDP

S2	Year	EM	MS	GA	A+1	A+2	AG	DGA	P	GS1	GS2	SE+	Var.	A-GS1	A-GS2	A-SE+
0.00	**1960**												2.6[W]			
3.06	**1961**															
6.39	**1962**															
7.75	**1963**															
10.01	**1964**								18.21	3.60	5.86	6.46		13.82	0.43	3.26
10.02	**1965**								17.91	*3.7*	*5.6*	6.14		*14.05*	*0.39*	3.06
13.00	**1966**								17.56	*3.8*	*6.0*	6.18		*14.28*	*0.45*	3.08
14.68	**1967**								16.65	*3.8*	*5.6*	5.90		*14.28*	*0.39*	2.91
15.35	**1968**							*1.7*	16.03	*3.0*	*4.5*	5.05		*12.40*	*0.26*	2.39
16.93	**1969**							*1.6*	15.15	*3.0*	*4.1*	4.58		*12.40*	*0.21*	2.12
17.57	**1970**							*1.8*	15.58	3.03	4.57	4.40		12.48	0.26	2.02
16.04	**1971**							*2.6*	14.19	*2.6*	*3.6*	3.85		*11.39*	*0.17*	1.71
15.29	**1972**							*3.9*	12.99	*2.3*	*3.4*	3.59		*10.59*	*0.15*	1.56
14.68	**1973**		12.3					*4.5*	12.69	*2.3*	*3.5*	3.45		*10.59*	*0.16*	1.49
14.12	**1974**		12.6					*4.2*	13.16	*2.3*	*3.2*	3.34		*10.59*	*0.13*	1.43
13.78	**1975**		14.4					*5.3*	12.61	2.85	3.67	3.70		12.03	0.17	1.62
13.28	**1976**		15.3				8.8	*7.6*	12.37	*3.0*	*3.8*	3.73	1.0[M]	*12.40*	*0.19*	1.64
14.27	**1977**		16.5				10.3	*8.7*	13.06	*3.8*	*5.8*	3.92	6.5[W]	*14.28*	*0.42*	1.74
15.16	**1978**		17.6				11.7	*10.6*	13.31	*4.0*	*6.5*	4.32	22.9[L]	*14.72*	*0.52*	1.97
13.72	**1979**		18.5				13.0	*12.1*	13.82	*4.9*	*7.0*	5.80		*16.61*	*0.60*	2.85
13.48	**1980**	3.7	17.9	15.5	11.69	11.69	14.0	*15.1*	14.26	6.34	7.28	5.85		19.36	0.65	2.88
12.90	**1981**	5.2	17.9	16.7	12.25	12.50	15.4	*18.1*	14.33	*5.7*	*6.4*	5.89		*18.17*	*0.51*	2.90
13.76	**1982**	6.8	17.1	16.3	12.68	12.69	15.2	*20.4*	14.96	*5.3*	*5.6*	5.63		*17.40*	*0.39*	2.74
13.88	**1983**	9.1	17.1	16.5	13.40	13.94	16.1	*22.6*	15.50	*6.0*	*7.5*	6.80		*18.74*	*0.69*	3.47
13.92	**1984**	10.7	16.2	16.7	12.32	14.17	15.3	*24.2*	16.15	*8.3*	*8.3*	7.39		*22.73*	*0.83*	3.85
14.35	**1985**	13.0	15.7	17.2	11.67	14.93	14.9	*27.2*	16.91	8.94	9.50	8.45		23.76	1.08	4.56
15.99	**1986**	14.6	15.5	18.7	9.51	15.84	15.4	*28.7*	17.34	*9.6*	*8.5*	7.98		*24.79*	*0.87*	4.24
17.46	**1987**	16.9	15.7	18.5	13.96	17.02	15.9	*28.7*	17.59	*14.5*	*14.3*	10.41		*31.68*	*2.37*	5.91
19.97	**1988**	18.5	15.7	18.4	13.94	17.11	15.7	*26.4*	18.40	*15.8*	*16.7*	11.44		*33.34*	*3.20*	6.65
22.85	**1989**	20.8	15.9	18.9	17.85	18.27	16.5	*24.9*	19.86	*19.2*	*21.6*	13.69		*37.44*	*5.25*	8.33
24.52	**1990**		16.2	19.8	17.92	18.13	17.2	24.5	19.50	*16.1*	*16.5*	12.46	16.1[I]	*33.72*	*3.13*	7.40
30.90	**1991**		16.7	19.9	18.31	18.32	18.0	*24.2*	21.05	*15.6*	*16.5*	13.64		*33.09*	*3.13*	8.29
35.03	**1992**		18.0	19.4	19.62	18.99	19.0	*26.8*	24.75	20.02	18.88	15.42		38.39	4.05	9.66
37.84	**1993**		18.4	20.1	19.61	18.35	18.9	*28.7*	25.38	*21.6*	*20.1*	14.15		*40.16*	*4.57*	8.68
40.43	**1994**		17.8	20.2	18.49	18.38	17.8	*32.5*	25.58	*19.9*	*17.0*	13.97	22.3[R]	*38.25*	*3.31*	8.54
41.64	**1995**		16.4	20.1	17.31	17.91	16.8	31.2	26.92	18.92	17.36	14.13	22.4[I]	37.12	3.45	8.66
41.15	**1996**		16.8	20.0	16.69	17.76	16.1	*30.9*	26.33	*18.3*	*17.4*			*36.39*	*3.46*	
37.59	**1997**			20.1	18.05	18.40	15.9	*30.9*	24.29	*18.4*	*17.5*			*36.51*	*3.50*	
30.67	**1998**			21.2	17.92	18.62	15.3	*29.4*	21.79	18.91	16.79		23.1[I]	37.11	3.23	
30.64	**1999**			20.7	18.73	19.22	15.5	*28.7*	19.15							
26.26	**2000**			20.9	19.03	19.25	15.9	26.2	18.46				22.7[I]			
22.96	**2001**				19.22	18.97	16.4	*25.7*	17.75							
21.44	**2002**				20.16	19.22	18.2	*26.3*					22.5[I]			
19.82	**2003**				20.05	19.24		*26.4*					22.2			
18.17	**2004**				20.85	19.54							21.9			
15.55	**2005**				22.64	20.26							21.3			
13.46	**2006**				24.46	20.86							20.2			
14.48	**2007**				26.37	21.23							19.3			
17.76	**2008**				21.29	18.47							18.7			
21.07	**2009**												19.5			
	2010												19.8			

Note: All values show the size of the Spanish underground economy in percent of legal GDP according to the various authors, except in column year. S2 represents the size of the Spanish underground economy according to the MCDR approach, equation (5), own calculations. EM denotes values of Escobedo and Mauleón (1991, 119). MS denotes values of Mauleón and Sardà (1997, 128). GA denotes values of Gómez-Antonio and Alañón-Pardo (2004, 17). A+1 and A+2 denote values from Arrazola et al. (2011, 93), where A+1 refers to the currency demand model and A+2 to the electricity model. AG denotes values by Alañón-Pardo and Gómez-Antonio (2005, 1020). DGA denotes values of Dell'Anno et al. (2007, Table 6, 69, for years 1990, 1995, and 2000, with the remaining values read from Fig. 4, 68, which are, therefore, denoted in italics). P denotes values of Prado-Domínguez (2004, 440). GS1 and GS2 denote values of Gadea and Serrano-Sanz (2002, for years 1964, 1970, 1975,

1980, 1985, 1992, 1995 and 1998 from Table 4, 514, all other values are read from Figure 4, 515, with respect to DIR2 (GS1) and DIR2 with neither INNOV nor PDP variables (GS2). SE+ denotes values of Serrano-Sanz et al. (1998, 32). Var. denotes values by various authors: W denotes values of Weck-Hannemann et al. (1984), cf. Schneider (1997a, 43; 1997b, 140), where 6.5 actually refers to 1978, M denotes Moltó Calvo (1980, 51), L denotes Lafuente Félez (1980, 590), R denotes Schneider (1997b, 149), I denotes Feld and Schneider (2010, 134), where the values represent the average between the selected year and the previous one, and with respect to 2003 to 2010 values are taken from Schneider (2010, 3)). A-GS1, A-GS2 and A-SE+ denote the Ahumada et al. (2007) correction applied to the values of GS1, GS2 and SE+, respectively (own calculations).Underlined numbers indicate the peak of the series and numbers set in italics denote that these numbers were read from figures.

Figure 1: Size of the Underground Economy in Spain (S2) and Germany (G3) in Percent of GDP based on MCDR approach



Note: S2 profile, own calculations. G3 profile obtained from Pickhardt and Sardà (2011, 151-152).

where *FC* denotes forecasted currency in circulation outside banks and PIC_0 denotes population and inflation adjusted values of C_0. Hence, according to (5) it is assumed that on average agents wish to hold a constant real currency budget to carry out their preferred set of

legal transactions in cash. Of course, the qualifications made by Pickhardt and Sardà (2011, 155–156) with respect to this notion, the changes in the statistics of sight deposits due to the Euro introduction and regarding the base year apply here as well. Then, application of (5) to the Spanish data set yields the size of the Spanish underground economy according to the MCDR approach, which is displayed in column S2 of Table 1. In Figure 1 we display and contrast the Spanish underground economy profile S2 with the German underground economy profile G3, which Pickhardt and Sarda (2011) have calculated using the MCDR approach.[6] Although the same approach and the same period have been used the two profiles differ remarkably, with the German profile being always below the Spanish one.

To summarize, by applying the MCDR approach to Spain we obtained underground economy profile S2. Yet, despite the fact that additional modifications are considered necessary, relevant data is currently unavailable so that further quantitative adjustments are impossible. Moreover, because these additional adjustments may have different signs, the sign of the net effect is unpredictable. Therefore, the S2 profile may represent a lower or upper bound of the size of the cash using section of the Spanish underground economy, or may even represent a rough estimate of its true size in case possible other influences balance.

3 Causes of the Spanish Underground Economy

As noted elsewhere, an inconvenience of the MCDR approach is its inability to explain possible causes of the underground economy. To address this issue, we now extend the MCDR approach by exposing the S2 profile to an econometrical estimation procedure. However, we first use a simple correlations test to further examine the profiles of the Spanish underground economy, as summarized in Table 1.

[6] Given some Deutsch-Mark specific circumstances the German G3 profile, rather than the G2 profile, should be compared with the Spanish S2 profile. Also, in Table 1 we directly display the S2 profile, but not the corresponding auxiliary profiles S0, S0_2, S1, as in Pickhardt and Sardà (2011, 151, Table 2, l.h.s.). Moreover, as noted in Pickhardt and Sardà (2011), during the period 1987 to 1991 the G3 profile is not entirely attributable to the underground economy.

3.1 Simple Correlations

Inspection of Table 1 shows that the MCDR approach allows for obtaining the largest available times series regarding the size of the Spanish underground economy. Moreover, the peak of the S2 profile and various values of the S2 profile by and large coincide with those obtained by several other researchers using different methods. In fact, this observation is confirmed by the correlation coefficients shown in Table 2 with respect to S2 and some other profiles of the Spanish underground economy, in particular, the one obtained by Prado-Dominguez (2004) and the Ahumada et al. corrected values of Gadea and Serrano-Sanz (2002), Tables 1 and 2, columns P and A-GS1, respectively.

Yet, the prime purpose of the correlations test shown in Table 2 is to further investigate the assertion of section 2.1 that the Escobedo and Mauleón (1991) method necessarily mimics the evolution of the tax pressure variable over time. Inspection of Table 2, columns EM and A+2, reveal that these two profiles almost exactly match the profile of the TTOT variable (total taxes over GDP) , with R^2 = 0.99. Hence, we can safely rule out that these two profiles, EM and A+2, represent the evolution of the Spanish underground economy during the relevant period of time.

Essentially the same is true for the remaining three profiles that rest on the Escobedo and Mauleón (1991) method, which are profiles MS, GA, and A+1 of Table 1. However, in two of these cases, GA and A+1, Table 2 cannot give a clear cut result because the profiles are not obtained from a single fiscal pressure variable. In the case of GA it is a relative pressure variable composed of the marginal over the average total tax rate and in the case of A+1 it is a combination of two variables, total taxes over GDP (TTOT) plus a variable that captures the fiscal structure, i.e., the percentage of indirect taxes over total taxes. Regarding the case of MS, it is actually a single tax pressure variable, the average value of social security payments, but there are obviously differences in the data set with respect to the variable TCSS (social security contributions over GDP). Arrazola et al. (2011, 33) support this view because in their

own model specifications the variable TCSS is never statistically significant. Yet, with R^2 = 0.67, the variable TCSS is still more correlated with the MS profile than any other variable listed in Table 2.

Furthermore, in the case of EM the authors claim that they have used two tax pressure variables in their estimation procedure, indirect taxes over GDP (TIND) and direct taxes over GDP (TDIR). Yet, results of the correlations test in Table 2 suggest that either the variable direct taxes includes social security taxes (TCSS), so that TIND + (TDIR + TCSS) = TTOT holds, or that effectively the TTOT variable was used. To this extent the correlations test not only supports our claim that the Escobedo and Mauleón (1991) method is unsuitable for an analysis of the evolution of the underground economy, but it also reveals some irregularities with respect to the EM and MS profiles shown in Table 1. This notwithstanding, the Escobedo and Mauleón (1991) method may still be useful for obtaining a single value of the size of the underground economy in a specific year, which may then be used for calibrating a MIMIC index as in Alañón-Pardo and Gómez-Antonio (2005), for example.

Finally, it is worth noting that all profiles of the Spanish underground economy shown in Table 2 are highly correlated with just a single tax pressure variable, except profiles P and S2. In particular, the profiles MS and AG show the highest correlation with the TCSS variable, profiles A+1, GS1, GS2, and SE+ with the TDIR variable, none of the profiles with the TIND variable and the profiles EM, GA, A+2, and DGA with the TTOT variable. Therefore, it seems that these underground economy profiles mimic the profiles of a tax pressure variable to a large extent and, thus, may not provide reliable evidence with respect to the evolution of the Spanish underground economy. In this context it is also worth noting that the S2 profile is not even moderately correlated with any of the variables, FC (R^2 = 0.32), PIC (R^2 = 0.25) or D (R^2 = 0.05), which were used according to (5) for calculating the S2 profile.

Table 2: Correlation Coefficients

	S2	EM	MS	GA	A+1	A+2	AG	DGA	P	GS1	GS2	SE+	A-GS1	A-GS2	A-SE+
S2	1.0000	0.8964	0.3266	0.8188	0.2124	0.3657	0.5962	0.6548	0.9033	0.8726	0.8297	0.8380	0.8455	0.8374	0.8541
R^2	*1.00*	*0.80*	*0.11*	*0.67*	*0.05*	*0.13*	*0.36*	*0.43*	*0.82*	*0.76*	*0.69*	*0.70*	*0.71*	*0.70*	*0.73*
GDP_R	*0.4901*	0.9531	0.3923	0.9192	0.8959	0.8244	0.5630	0.7881	0.5949	0.8874	0.8530	0.7933	0.8908	0.8301	0.8001
R^2	*0.24*	*0.91*	*0.15*	*0.84*	*0.80*	*0.68*	*0.32*	*0.62*	*0.35*	*0.79*	*0.73*	*0.63*	*0.79*	*0.69*	*0.64*
CF	0.6731	0.9809	0.4770	0.9442	0.7442	0.9542	0.5997	0.8099	0.9079	0.8494	0.8126	0.7429	0.8662	0.7744	0.7432
R^2	*0.45*	*0.96*	*0.23*	*0.89*	*0.55*	*0.91*	*0.36*	*0.66*	*0.82*	*0.72*	*0.66*	*0.55*	*0.75*	*0.60*	*0.55*
TCSS	0.4513	-0.1204	0.8194	0.6041	0.7972	0.6968	0.8993	0.9051	0.4603	0.7022	0.6803	0.6223	0.7307	0.6302	0.6182
R^2	*0.20*	*0.01*	*0.67*	*0.36*	*0.64*	*0.49*	*0.81*	*0.82*	*0.21*	*0.49*	*0.46*	*0.39*	*0.53*	*0.40*	*0.38*
TDIR	0.5168	0.9383	0.4099	0.9110	0.9550	0.9670	0.8177	0.9218	0.7628	0.9617	0.9563	0.9390	0.9734	0.9252	0.9365
R^2	*0.27*	*0.88*	*0.17*	*0.83*	*0.91*	*0.94*	*0.67*	*0.85*	*0.58*	*0.92*	*0.91*	*0.88*	*0.95*	*0.86*	*0.88*
TIND	0.6013	0.9570	0.1424	0.8945	0.6096	0.9086	0.7290	0.8532	0.7940	0.9148	0.8996	0.9126	0.9208	0.8698	0.9063
R^2	*0.36*	*0.92*	*0.02*	*0.80*	*0.37*	*0.82*	*0.53*	*0.73*	*0.63*	*0.84*	*0.81*	*0.83*	*0.85*	*0.76*	*0.82*
TTOT	0.5559	0.9955	0.4389	0.9490	0.8855	0.9999	0.8383	0.9529	0.7257	0.9374	0.9217	0.9005	0.9546	0.8811	0.8960
R^2	*0.31*	*0.99*	*0.19*	*0.90*	*0.78*	*0.99*	*0.70*	*0.91*	*0.53*	*0.88*	*0.85*	*0.81*	*0.91*	*0.78*	*0.80*
ID	*0.6775*	0.5202	0.3950	0.8085	0.7882	0.8031	0.6213	0.7432	0.8171	0.8709	0.8196	0.8345	0.8535	0.8170	0.8463
R^2	*0.46*	*0.27*	*0.16*	*0.65*	*0.62*	*0.65*	*0.39*	*0.55*	*0.67*	*0.76*	*0.67*	*0.70*	*0.73*	*0.67*	*0.72*
ISE	*-0.569*	-0.154	-0.696	-0.809	0.055	-0.192	-0.814	-0.938	-0.516	-0.759	-0.725	-0.657	-0.788	-0.670	-0.664
R^2	*0.32*	*0.02*	*0.49*	*0.65*	*0.00*	*0.04*	*0.66*	*0.88*	*0.27*	*0.58*	*0.53*	*0.43*	*0.62*	*0.45*	*0.44*
IU	0.6946	0.8053	0.4323	0.6439	0.7589	0.9744	0.7510	-0.165	0.0985	0.8937	0.8524	0.8339	0.9159	0.8006	0.8256
R^2	*0.48*	*0.65*	*0.19*	*0.42*	*0.58*	*0.95*	*0.56*	*0.03*	*0.01*	*0.80*	*0.73*	*0.70*	*0.84*	*0.64*	*0.68*
UR	0.7127	0.6717	0.4465	0.3323	-0.534	-0.285	0.7025	0.9408	0.6845	0.8460	0.8063	0.7868	0.8754	0.7479	0.7761
R^2	*0.51*	*0.45*	*0.20*	*0.11*	*0.29*	*0.08*	*0.49*	*0.89*	*0.47*	*0.72*	*0.65*	*0.62*	*0.77*	*0.56*	*0.60*
CL	0.4605	0.9573	0.0717	0.6518	0.6455	0.9114	0.6654	0.2787	0.6646	*0.8290*	*0.8268*	*0.8047*	*0.8580*	*0.7718*	*0.7897*
R^2	*0.21*	*0.92*	*0.01*	*0.43*	*0.42*	*0.83*	*0.44*	*0.08*	*0.44*	*0.69*	*0.68*	*0.65*	*0.74*	*0.60*	*0.62*

Note: all values own calculations, columns S2 trough A-SE+ correspond to the underground economy profiles shown in Table 1. GDP_R denotes real GDP, *CF denotes overall factor competitiveness, TCSS denotes social security contributions over GDP, TDIR denotes direct taxes over GDP, TIND denotes indirect taxes over GDP, TTOT denotes total tax revenue over GDP, ID denotes the index of drug crime related prisoner, ISE denotes index of self employed people, IU denote the index of unemployment, UR denotes the unemployment rate, CL denotes labor force competitiveness and* R^2 *denotes the coefficient of determination. underlined* R^2 *values denote peak values in the relevant column.*

3.2 Econometric Estimations

To proceed, we now extend the MCDR approach by exposing the S2 profile to an OLS estimation procedure. In particular, we use the S2 profile as the dependent variable and choose the following explanatory variables.

The first class of variables which we select includes real gross domestic product (GDP_R) and overall factor competitiveness (CF), to capture the macroeconomic performance of the economy. The expected sign of the variable GDP_R is difficult to predict and might depend on both the structure and development stage of the legal and underground economy under consideration (e.g. see Schneider and Enste 2000; Serrano-Sanz and Gadea 2005, 146). However, in developed countries a negative sign of this variable is more likely. In contrast, an increase in overall factor competitiveness is expected to the lead *ceteris paribus* to less underground activities, so that a negative sign is expected here.

The second class of variables deals with tax pressure and we consider here just one variable, total tax revenue over GDP (TTOT). As noted, this is a frequently selected variable in underground economy estimation procedures and conventionally the expected sign is a positive one.

The third class of variables is devoted to criminal activities. We consider an index that measures the normalized number of drug crime related prisoners (ID), with a view to capture the most cash intensive crime activities. Unfortunately, however, we were unable to obtain other crime related data for a sufficiently long time series and, thus, the variable ID is the only crime related variable we can currently include.

The last class of variables we consider is related to the labor market. First, we include an index of self-employed people (ISE), to capture those who have more options with respect to underground economy engagements and tax evasion (positive sign expected). Next we use an index of unemployment (IU), which measures the absolute change in unemployment (positive sign expected). In addition, we include the unemployment rate (UR) with a view to address a

relative measure of unemployment. As argued by Alañón-Pardo and Gómez-Antonio (2005, 1014) and others the relationship between the unemployment rate and the underground economy is somewhat ambiguous and, therefore, the sign of the variable is hard to predict. Lastly, labor force competiveness (CL) is considered (negative sign expected) with a view to capture the international productivity of the national labor force.

Following Serrano-Sanz et al. (1998, 27–28) and Prado-Domínguez (2004, 450), we also use a dummy variable (F), which is designed to capture changes in the Spanish fiscal system. In particular, this dummy equals zero from 1970 to 1984, one from 1985 to 1987, two from 1988 to 1990 and three from 1991 onwards. Moreover, we use a deterministic time trend. Data is available for all variables just for the period 1970 to 2009 and, therefore, we can expose the S2 profile only during this limited period to some estimation procedures. Subject to the limitations mentioned so far, we use the Engle-Granger error correction procedure and obtain four different models, which are presented in Table 3. All estimations have been carried out with the EViews software package.

3.3 Discussion

Inspection of Table 3 shows that all four models pass the diagnostic statistics for normality $\chi^2_{Norm}(2)$, no residual serial correlation $\chi^2_{SC}(2)$, no autocorrelation in the error term $\chi^2_{ARCH}(1)$, no heteroscedasticity $\chi^2_{Hetero}(1)$ and no misspecification $\chi^2_{RESET}(1)$. To ensure that there is no misspecification due to parameter instability, we have carried out a CUSUM test (results not displayed) and a CUSUM of squares test (see appendix Fig. 3). Both tests indicate the absence of parameter instability because the test statistics are within the five percent critical bounds.

Moreover, according to the adjusted coefficient of determination (adj. R^2) the four models fit the data reasonable well, with Model 1 (2, 3, 4) explaining about 75 (70, 66, 76) percent of the variations in the S2 profile, respectively.

Table 3: Estimation Results for S2 Regressions (1970 to 2009)

	Model 1		Model 2		Model 3		Model 4	
Variable	LR	SR	LR	SR	LR	SR	LR	SR
C	--	-10.71 (-4.93)***	-98.24 (-2.43)**	--	--	--	--	-9.00 (-4.71)***
$\Delta S2_{t-1}$	--	0.62 (3.69)***	--	0.45 (3.15)***	--	0.39 (2.63)**	--	0.80 (4.70)***
$\Delta S2_{t-2}$	--	0.64 (2.94)***	--	0.59 (3.75)***	--	0.41 (2.68)**	--	0.47 (2.79)**
GDP	-1.07E-15 (-2.06)**	--	-1.99E-15 (-8.24)***	--	--	--	-1.75E-15 (-7.45)***	--
ΔGDP	--	--	--	3.33E-16 (2.01)*	--	--	--	--
ΔGDP_{t-1}	--	1.46E-15 (2.73)**	--	--	--	--	--	1.21E-15 (2.64)**
ΔGDP_{t-2}	--	1.64E-15 (4.19)***	--	--	--	--	--	9.39E-16 (2.87)***
CF	-2.16 (-4.95)***	--	--	--	-0.73 (-4.17)***	--	-1.89 (-3.60)***	--
ΔCF	--	--	--	--	--	--	--	-0.94 (-2.60)**
TTOT	2.02 (4.86)***	--	0.82 (1.87)*	--	2.26 (5.07)***	--	0.64 (1.81)*	--
$\Delta TTOT$	--	2.22 (4.74)***	--	--	--	--	--	0.79 (2.59)**
$\Delta TTOT_{t-1}$	--	--	--	--	--	-0.58 (-2.05)*	--	--
$\Delta TTOT_{t-2}$	--	--	--	0.89 (2.72)**	--	0.66 (2.24)**	--	0.76 (2.14)**
ID	0.05 (4.33)***	--	0.06 (5.52)***	--	0.07 (5.58)***	--	0.06 (4.98)***	--
ΔID	--	--	--	--	--	0.02 (2.36)**	--	0.01 (2.42)**
ΔID_{t-1}	--	-0.04 (-5.60)***	--	-0.03 (-4.29)***	--	-0.02 (-3.88)***	--	-0.04 (-4.76)***
ISE	98,72 (4.23)***	--	76.89 (2.61)**	--	--	--	117.89 (3.94)***	--
ΔISE_{t-1}	--	-70.87 (-3.67)***	--	-40.63 (-2.98)***	--	--	--	-90.34 (4.17)***
ΔISE_{t-2}	--	-30.23 (-2.17)**	--	--	--	--	--	-41.85 (-2.63)**
IU	4.78 (4.95)***	--	3.44 (3.07)***	--	5.53 (4.76)***	--	--	--
ΔIU	--	3.06 (4.34)***	--	0.83 (4.05)***	--	1.71 (2.58)**	--	--
ΔIU_{t-1}	--	-2.54 (-3.14)***	--	-0.55 (-2.25)**	--	-2.24 (-2.57)**	--	--
ΔIU_{t-2}	--	-3.67 (-2.97)***	--	--	--	--	--	--
UR	-4.69 (-5.35)***	--	-3.86 (-3.65)***	--	-4.75 (-4.50)***	--	-0.76 (-2.45)**	--
ΔUR	--	-2.09 (-3.30)***	--	--	--	-1.32 (-2.10)**	--	--
ΔUR_{t-1}	--	2.14 (2.87)***	--	--	--	1.65 (2.21)**	--	--
ΔUR_{t-2}	--	3.58 (3.24)***	--	--	--	--	--	--

Table 3: continued

	Model 1		Model 2		Model 3		Model 4	
Variable	LR	SR	LR	SR	LR	SR	LR	SR
CL	5.92 (6.49)***	--	3.54 (4.11)***	--	3.72 (5.05)***	--	4.60 (4.44)***	--
ΔCL	--	1.61 (2.59)**	--	--	--	--	--	2.65 (3.46)***
ΔCL_{t-2}	--	--	--	-1.33 (-3.37)***	--	--	--	--
F	.--	1.75 (4.70)***	--	--	--	--	--	1.31 (4.20)***
Trend	-3.29 (-2.43)**	--	--	--	-5.02 (-8.11)***	--	--	--
EC_{t-1}	--	-0.93 (-5.95)***	--	-0.24 (-2.69)**	--	-0.41 (-3.63)***	--	-0.87 (-4.67)***
Diagnostics								
adj. R^2	0.89	0.75	0.84	0.70	0.84	0.66	0.82	0.76
s.e.	3.00	1.26	3.64	1.38	3.68	1.45	3.90	1.24
AIC	--	3.60	--	3.69	--	3.81	--	3.54
SBC	--	4.37	--	4.12	--	4.28	--	4.18
$\chi^2_{NORM}(2)$	--	0.01 [0.99]	--	0.04 [0.98]	--	1.56 [0.46]	--	0.21 [0.90]
$\chi^2_{SC}(2)$	--	2.77 [0.25]	--	2.15 [0.34]	--	1.10 [0.58]	--	3.15 [0.21]
$\chi^2_{ARCH}(1)$	--	0.20 [0.66]	--	0.69 [0.40]	--	0.10 [0.76]	--	0.02 [0.90]
$\chi^2_{HETERO}(1)$	--	38.58 [0.27]	--	13.39 [0.86]	--	19.78 [0.60]	--	34.84 [0.17]
$\chi^2_{RESET}(1)$	--	0.24 [0.62]	--	2.44 [0.12]	--	0.09 [0.77]	--	0.03 [0.87]

*Note: Own calculations, t-statistics are given in parenthesis, * denotes significance at the 10% level, ** denotes significance at the 5% level, and *** indicates significance on the 1% level. LR denotes long run, SR denotes short run, C denotes constant, Δ denotes first differences, F denotes a dummy variable, Trend denotes a deterministic time trend, EC denotes error correction term, s.e. denotes standard error, AIC denotes Akaike Information Criterion, SBC denotes Schwarz Bayesian Criterion, values in square brackets denote probability. An Augmented Dickey-Fuller test and a Phillips-Perron test show that all variables are integrated of order one I(1), although evidence for the variable IU is rather weak. The residuals of the long-run etimations in all four models are I(0) at the one percent level of significance and, thus, we can reject the null that the variables are not cointegrated.*

Bearing in mind that the MCDR approach covers the entire cash using section of the underground economy and that due to missing data we were unable to include more than one crime related variable, the closeness of fit might be even better if more crime related variables could be included. The error corrections terms (EC_{t-1}) have the expected negative sign and are

statistically significant at the one percent level (Models 1, 3 and 4) or five percent level (Model 2), which confirms that the variables are cointegrated. However, the coefficients of the error correction terms indicate that the adjustment of the Spanish underground economy to shocks depends heavily on the model specification. In fact, results of Table 3 seem to suggest that the inclusion or not of labor market variables, macro variables and the dummy F account for these differences. Results for Model 1, where all variables are included, indicate that about 93 percent of a shock is absorbed already in the first year, whereas in Model 4 it is 88 percent, in Model 3 only 41 percent and just 24 percent in the case of Model 2.

Further inspection of Table 3 with respect to the four classes of variables and their long run results reveals the following. Regarding the first class, Table 3 shows that the macroeconomic variables, GDP and overall factor competitiveness (CF), have a statistically significant and negative influence on the Spanish underground economy in the long run in all four models. This result not only coincides with conventional expectations, but it also indicates that a growth and competitiveness orientated economy policy would automatically help to curb the underground economy in Spain. In this context is worth noting that neither this result nor the policy recommendation can be derived from the approaches listed in Table 1, r.h.s., except in the case of Dell'Anno et al. (2007, 73), who explicitly recommend a growth orientated policy.

Next, we consider the class of tax pressure variables, which contains only the TTOT variable. In the long run, this variable has a positive influence and is statistically significant at the one percent level, except in Models 2 and 4 where it is significant at the 10 percent level. This clearly indicates that in the long run higher tax pressure leads to more underground economy activities. In one way or another, this result is obtained by all studies on the Spanish underground economy mentioned in Table 1, r.h.s. Yet, it must be emphasized again that in all of these studies, except in the cases based on the MIMIC approach, tax pressure is the only explanatory variable, whereas in Models 1 to 4 tax pressure is only one of several explanatory

variables. This notwithstanding, according to our four models any economic policy approach leading to less tax pressure would help to curb the Spanish underground economy.

Regarding the class of criminal activities, which again contains just one variable, ID, all four models indicate that this variable has a positive sign and that it is highly significant in the long run. These findings support the view expressed by Pickhardt and Sardà (2011) that the MCDR approach covers all cash using sections of the underground economy and not just the share induced by excessive taxation. In fact, it is the first time that evidence on the influence of drug related criminal activity is obtained in a study on the Spanish underground economy. The policy implication of this finding clearly points to an intensified combat against drug related crime and the use of drugs in general.

As noted, the labor market class includes four variables, the index of self-employed (ISE), the index of unemployment (IU), the unemployment rate (UR), and the competitiveness of labor (CL). According to Table 3 all of them are statistically significant in the long run in all four models, except the variable ISE which is not included in Model 3 and the variable IU which is not included in Model 4. Moreover, the variables ISE and IU have the expected positive sign in all models. This indicates that increasing numbers of self-employed and unemployed people would lead to more underground economy activities. In fact, these findings are supported by several other studies on the Spanish underground economy, for example, by Ahn and de la Rica (1997) and Alba-Ramirez (1994), and by Bargain and Kwenda (2011) for other countries.

Yet, as mentioned above, with respect to UR there is no clear cut theoretical prediction of the sign and, in fact, some studies have found a negative sign (i.e. Alañon-Prado and Gómez-Antonio 2005, 1018; Arrazola et al. 2011, 79), while others have found a positive relation (i.e. Dell'Anno et al. 2007, 77; Feld and Schneider 2010, 130). For example, based on their finding of a negative sign, Alañon-Prado and Gómez-Antonio (2005, 1017) state that "in Spain higher unemployment rates do not necessarily go hand in hand with increases in the

shadow economy". In fact, mixed results with respect to the sign may point to a more complex interaction between the unemployment rate and the underground economy. But subject to the results obtained for the variable IU, we still think that there is evidence that more unemployment increases the demand for jobs in the underground economy, which may eventually lead to an increase in underground economy activities.

Regarding the variable CL we find an unexpected positive sign and we have been unable to trace any other study taking this variable into account. However, the work of Ahn and de la Rica (1997) indicates that the Spanish labor market is rather divided in the sense that a higher proportion of those with lower education and skills work underground, as compared to those with higher education levels and skills. Hence, *ceteris paribus* increased labor competitiveness might imply that those at the lower end of the legal market are pushed into the underground section. In any case, Table 3 indicates that labor market aspects might well be the main driving force of the underground economy in Spain. To this extent, the policy conclusion is that labor market reforms which lead to more employment in large or medium sized, internationally competitive firms would contribute to a substantial reduction in the size of the Spanish underground economy.

In summarizing, the overall policy conclusion that emerges from our findings is a growth and factor competiveness orientated macro policy that leads to more exports, combined with a fundamental labor market reform that aims at increasing the Spanish innovation and competitiveness capacities at the international level. For example, by allowing more young people to enter the labor market and by increasing relevant skills, such as advanced knowledge of languages, in the existing labor force. Moreover, the fight against criminal activities, especially drug related crime, should be intensified. Our findings also suggest that these policy reforms should be accompanied by less tax pressure, which might be achieved, for example, by tax cuts and by shifting some public labor force from less to more policy relevant departments. Yet, our results also indicate that even revenue neutral changes in the

Spanish tax structure, leading to a lower social security tax burden, may *ceteris paribus* help to curb the underground economy. Moreover, since tax pressure is clearly not the main driving force of the Spanish underground economy, moderate tax increases to finance the policy reforms mentioned above might be tolerable for a limited time.

4 Concluding Remarks

In this paper we present the most comprehensive review of available estimates of the Spanish underground economy ever conducted. It turns out, however, that most of these estimates are untenable with respect to either the evolution or the size of the latter or both. By applying the correction procedure suggested by Ahumada et al. (2007), we were able to correct some of these estimates. Yet, the large spread of the corrected values, together with the rather small differences in the underlying estimation equations and the critique of Breusch (2005c) and Ahumada et al. (2008), suggest that the currency demand method is very sensible to the model specification. Hence, results obtained from this method should be used with great care only, if at all.

Given these findings we applied the MCDR approach to the Spanish data set and obtained the largest available time series regarding the size and evolution of the Spanish underground economy. Although this approach is not subject to the aforementioned critique, a major disadvantage is its inability to explain possible causes of the underground economy. Therefore, we further developed the MCDR approach by exposing the S2 profile of the Spanish underground economy to an econometric estimation procedure. The estimation results clearly indicate that the S2 profile is not predominantly caused by tax pressure, but by labor market aspects. Moreover, macroeconomic influences and drug related criminal activities also play a role. Based on these findings we were able to propose some comprehensive economic policy measures to combat the underground economy in Spain.

Finally, the application of the MCDR approach to the Spanish case and the econometric estimation of the Spanish underground economy profile S2 show that the MCDR approach may in fact have some appealing features regarding the macro analysis of cash using underground economy activities. Yet, the MCDR approach is just a first attempt to deal with the criticism put forward against the traditional monetary methods.

Appendix

A) Data Sources

Data on *currency in circulation outside banks* (Efectivo en manos del público): end of year data listed in Anuario Estadístico de España, scanned printed matter, published for various years by Instituto Nacional de Estadística (INE). S*ight deposits*: end of year data for 1962 to 2010 obtained from Banco de España (series BE040504) and for years 1960 and 1961 from Anuario Estadístico de España (1965, 236), published by Instituto Nacional de Estadística. *Consumer price index* (2005 = 100), (series 18464ZF), was collected from International Financial Statistics (IFS) online. Data on *population* was collected from International Financial Statistics online (series 18499ZZF, 1960-2009) and Instituto Nacional de Estadística for 2000–2010, estimates by INE and official figures from the annual review of the municipal census, for January 1 of each year. Nominal GDP was collected from the IFS (series 18499BCZW) and the GDP Deflator (2005 = 100) from the IFS (series 18499BIRZF). *ID* is the index of population in prison for crimes against public health at the end of the year (1964 = 1), data collected from Anuario Estadístico del Ministerio de Interior. *IU* (1964 = 1) was obtained from OECD Statistical compendium (series ESP4050) and *UR* was obtained from OECD Statistical compendium (series ESP4051), except for years 1977, 2000 and 2001, which are taken from INE (EPA - Encuesta de Población Activa - of the corresponding year). *TTOT* was collected from OECD Statistical compendium (series 32A3TOTAT). *ISE* (1964 = 1) was obtained from OECD Statistical compendium (series ESP4042). *CF* (1995 = 100) was collected from the Banco de España (series SI_1_4_6 745874) and *CL* from Banco de España (series SI_1_4_5 745873).

B) Euro Introduction

To deal with the Euro introduction and the associated changes of currency in circulation and sight deposits, we have used an exponential interpolation in the following way. First, we have

chosen some years before and after the drop of the series, that is, 1995 through 1999 and 2006. Second, by inspection of the data we decided that an exponential function would produce the best fit, and, thus, we used $C = e^{(a + b\,t)}$, where C denotes currency in circulation outside banks and t denotes time, where 1995=1, 1996=2, ..., 2006=12. Third, by using an OLS estimation procedure, we obtained,

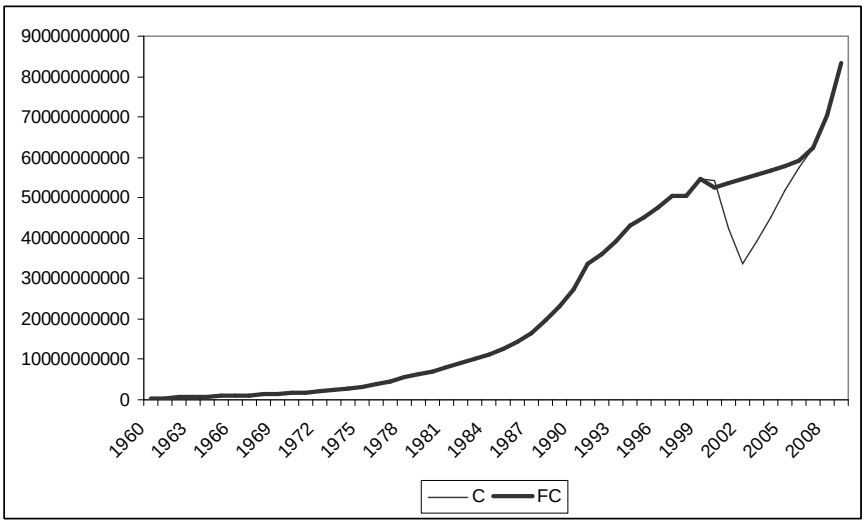
$$Ln\ C_t = 24.5618109 + 0.01999468^{*}\ t,$$
$$\qquad\qquad (896.6) \qquad\quad (4.2)$$

where relevant t-statistics are given in parenthesis below the coefficients and diagnostic statistics are: Adj. R^2 = 0.77, standard error = 0.0419. Taking natural logarithms, we calculated parameters a and b:

$$C_t = e^{24.5618 + 0.1999t}.$$

Third, if the expression above is given, interpolation between 2000 and 2006 yields the results shown in Figure 2, where FC denotes forecasted C, which we used in equation (5) of the main text.

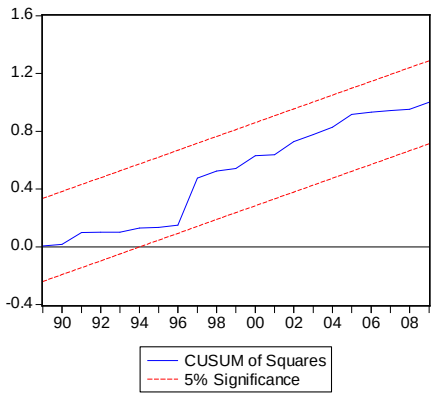
Figure 2: Actual and Forecasted Currency in Circulation (Spain 1960-2009)



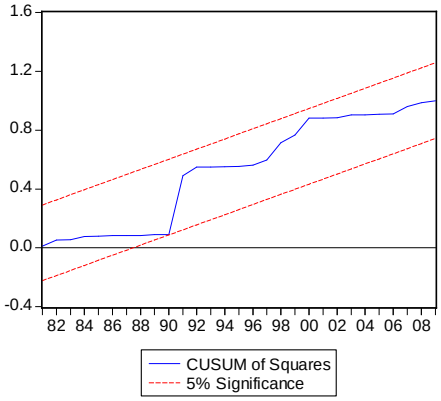
C) Test Statistics

Figure 3a,b,c,d: CUSUM Test of Squares

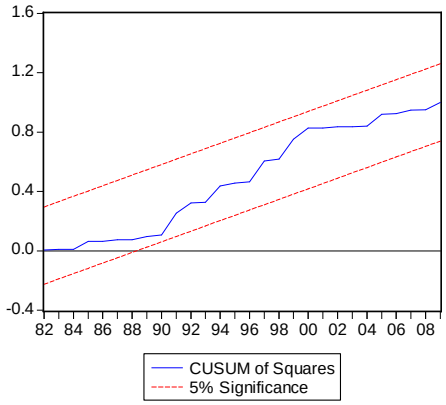
a) Model 1



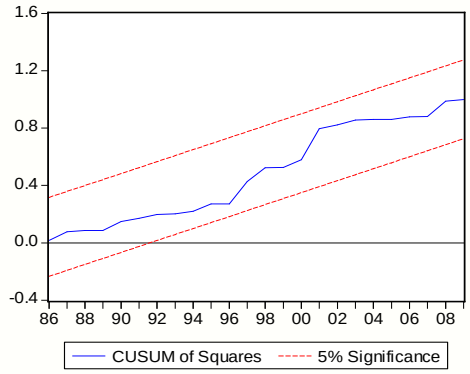
b) Model 2



c) Model 3



d) Model 4



References

Adair, P. (2011). Non-Observed Economy in the European Union countries (EU-15): A comparative analysis of estimates, in: M. Pickhardt and A. Prinz (eds.), *Tax Evasion and The Shadow Economy*, Cheltenham: Edward Elgar, forthcoming.

Ahn, N. and de la Rica, S. (1997). The underground economy in Spain: an alternative to unemployment?, *Applied Economics*, 29, pp. 733–743.

Ahumada, H., Alvaredo, F. and Canavese, A. (2007). The Monetary Method and the Size of the Shadow Economy: A Critical Assessment, *Review of Income and Wealth*, 53 (2), pp. 363–71.

Ahumada, H., Alvaredo, F. and Canavese, A. (2008). The monetary method to measure the shadow economy: The forgotten problem of the inital conditions, *Economics Letters*, 101, pp. 97–99.

Alañón-Pardo, A. and Gómez-Antonio, M. (2005). Estimating the size of the shadow economy in Spain: a structural model with latent variables, *Applied Economics*, 37(9), pp. 1011-1025.

Alba-Ramirez, A. (1994). Self-employment in the midst of unemployment: the case of Spain and the United States, *Applied Economics*, 26, pp. 189–204.

Arrazola, M., de Hevia, J., Mauleón, I., and Sánchez, R. (2011). *La Economía Sumergida Española*, Discussion Paper, Universidad Rey Juan Carlos, Madrid.

Bargain, O. and Kwenda, P. (2011). Earnings structures, informal employment, and self-employment: New evidence from Brazil, Mexico, and South Africa, *Review of Income and Wealth*, 57, pp. S100–S122.

Bhattacharyya, D. K. (1990). An econometric method of estimating the hidden economy, U.K. (1960–1984): estimates and tests, *Economic Journal*, 100, pp. 703–717.

Blades, D. (1982). The Hidden Economy and the National Accounts, *OECD Occasional Studies*, June, Paris: OECD, pp. 28–45, reprinted in: Schneider, F. (ed.) (2008), *The Economics of the Hidden Economy*, Vol. II, Edward Elgar: Cheltenham, pp. 79–96.

Breusch, T. (2005a). 'The Canadian Underground Economy: An Examination of Giles and Tedds', *Canadian Tax Journal*, 53 (2), pp. 367–91.

Breusch, T. (2005b). Australia's Cash Economy: Are the Estimates Credible? *The Economic Record*, 81, pp. 394–403.

Breusch, T. (2005c). *Fragility of Tanzi's method of estimating the underground economy*. Working Paper, The School of Economics, The Australian National University: Canberra.

Breusch, T. (2005d). *Estimating the Underground Economy using MIMIC Models*, Working Paper, The School of Economics, The Australian National University, Canberra.

Cagan, P. (1958). The Demand for Currency Relative to the Total Money Supply, *Journal of Political Economy*, 66, pp. 303–28.

Dell' Anno, R., Gómez-Antonio, M. and Alañón-Pardo, A. (2007). The shadow economy in three Mediterranean countries: France, Spain and Greece. A MIMIC approach, *Empirical Economics*, 33(1), pp. 51-84.

Escobedo, M. I. and Mauleón, I. (1991). Demanda de dinero y economía sumergida, *Hacienda Pública Española*, 119, pp. 105–25.

Feige, E. L. (1979). How Big is the Irregular Economy? *Challenge*, 22, November-December, pp. 5–13.

Feige, E. L. (1989). *The Underground Economies*, Cambridge: Cambridge University Press.

Feld, L. P. and Larsen, C. (2005). Black Activities in Germany in 2001 and in 2004 – A Comparison Based on Survey Data, The Rockwool Foundation Research Unit, Copenhagen.

Feld, L. P. and Schneider, F. (2010). Survey on the Shadow Economy and Undeclared Earnings in OECD Countries, *German Economic Review*, 11(2), 109–149.

Fisher, I. (1911). *The Purchasing Power of Money: Its Determination and Relation to Credit, Interest and Crisis*, New York: Macmillan.

Frey, B. S. and Weck, H. (1983). Estimating the shadow economy: A naive approach, *Oxford Economic Papers*, 35, pp. 23–44.

Gadea, M. D. and Serrano-Sanz , J. M. (2002). The hidden economy in Spain – A monetary estimation, 1964-1998, *Empirical Economics*, 27: pp. 499-527.

Giles, D. E. A. (1999). Measuring the Hidden Economy: Implications for Econometric Modelling, *Economic Journal*, 109, pp. F370–F80.

Gómez-Antonio, M. and Alañón-Pardo, A. (2004). Evaluación y análisis espacial del grado de incumplimiento fiscal para las provincias españolas (1980-2000), *Hacienda Pública Española / Revista de Economía Pública*, 71(4), pp. 9-32.

Gutmann, P. M. (1977). The Subterranean Economy, *Financial Analysts Journal*, 35, pp. 26–34.

Isachsen, A. and Strom, S. (1985). The size of the Hidden Economy in Norway, *Review of Income and Wealth*, 31(1), pp. 21–38.

Kazemier, B. (2006). Monitoring the Underground Economy – A Survey of Methods and Estimates, in: Enste, D. and Schneider, F. (eds.), *Jahrbuch Schattenwirtschaft 2006/2007*, Vienna: LIT, pp. 11–53.

Klovland, J. T. (1980). *In search of the hidden economy: Tax evasion and the demand for currency in Norway and Sweden*. Discussion Paper 18/80, Norwegian School of Economics and Business Administration, 1980.

Klovland, J. T. (1984). Tax Evasion and the Demand for Currency in Norway and Sweden. Is there a Hidden Relationship? *Scandinavian Journal of Economics*, 86 (4), pp. 423–439.

Lafuente Félez, A. (1980). Una medición de la Economía Oculta en España, *Información Comercial Española*, 111, pp. 581-593.

Mauleón, I. and Sardà, J. (1997). Estimación cuantitativa de la economía sumergida en España, *Ekonomiaz*, (39)3, pp. 125-134.

Moltó Calvo, M. A. (1980). La economía irregular. Una primera aproximación al caso español, *Revista Española de Economía*, 10, pp. 33-52.

Pickhardt, M. and Sardà Pons, J. (2006). Size and Scope of the Underground Economy in Germany, *Applied Economics*, 38(14), pp. 1707–13.

Pickhardt, M. and Sardà, J. (2011). The size of the underground economy in Germany: a correction of the record and new evidence from the modified-cash-deposit-ratio approach, *European Journal of Law and Economics*, 32(1), pp. 143–163.

Pickhardt, M. and Shinnick, E. (2008). Governance and Illicit Activities: A Survey of Recent Issues and Developments, in: Pickhardt, M. and Shinnick, E. (eds.), *The Shadow Economy, Corruption and Governance*, Edward Elgar: Cheltenham, pp. 3–17.

Prado-Domínguez, J. (2004). Una estimación de la economía informal en España, según un enfoque monetario, 1964-2001, *El Trimestre Económico*, 71(282), pp. 417-452.

Schneider, F. (1997a). The shadow economies of Western Europe, *Economic Affairs*, 17 (3), pp. 42–48.

Schneider, F. (1997b). El tamaño de la economía sumergida en los países de Europa Occidental, *Ekonomíaz*, 39(3), pp. 136-151.

Schneider, F. (2010). Size and Development of the Shadow Economy of 31 European Countries from 2003 to 2010 (Revised Version), Working Paper, University of Linz, Austria, http://www.econ.jku.at/Schneider

Schneider, F. and Enste, D. (2000). Shadow Economies: Size, Causes, Consequences, *Journal of Economic Literature*, 38, pp. 77–114.

Serrano-Sanz, J. M., Bandrés Moliné, E., Gadea Rivas, M. D., Sanau Villaroya, J., (1998). *Desigualdades Territoriales en la Economia Sumergida*, Confederación de Empresarios de Aragón (CREA), Zaragoza (Spain). (www.crea.es)

Serrano-Sanz, J. M. and Gadea, M. D. (2005). What causes the hidden economy in Spain?, *Applied Financial Economics Letters*, 1:3, pp. 143-150.

Tanzi, V. (1980). The underground economy in the United States: Estimates and Implications, Banca Nazionale del Lavoro, *Quarterly Review*, No. 135, (December 1980), pp. 427–53.

Tanzi, V. (1982). *The Underground Economy in the United States and Abroad*, Lexington (MA): Lexington Books.

Tanzi, V. (1983). The underground economy in the United States: Annual Estimates, 1930-80, *IMF Staff Papers*, 30 (2), June, pp. 283–305.

Thomas, J. (1999). Quantifying the Black Economy: 'Measurement without Theory' Yet Again? *Economic Journal*, 109, pp. F381–F389.

Weck-Hannemann, H., Pommerehne, W. and Frey, B. S. (1984). *Schattenwirtschaft*, Verlag Vahlen, München.