The Shadow Economy and Implications for Money Demand in Germany

by

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Abstract

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JEL-Classification: O17, K42, F14

Keywords: Shadow Economy, Money Demand, Germany

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Abstract

Taking into account the fact that recorded output understates actual output might be important to improve econometric models and for better policy advice. Using the shadow economy data presented in Buehn et al. (2009) we provide some new results on modeling the demand for money in Germany. We find that the elasticity for money is much smaller with respect to the shadow economy than for official GDP. Estimating an error correction model for money demand in Germany in the second step, we demonstrate that the inclusion of shadow economy output measures can improve the estimation of a money demand function.

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1 Introduction

While most authors dealing with the shadow economy estimate its size or try to understand individuals' motives for working underground, the implications for econometric modeling have often been neglected. In this paper we use recent information about the size and development of the German shadow (underground) economy to explore the link between informal output and money demand. As the shadow economy has – as in most countries – reached a considerable size in Germany, taking account of unrecorded (shadow) GDP in the empirical money demand function may improve the modeling of money demand which is usually based on the transaction demand motive using the GDP is an appropriate scale variable.

Although the European Central Bank (ECB) is in charge of the (monetary) development in the euro area as a whole, individual country analysis can lead to important additional insight for the money demand relationship for one of the following reasons: firstly, for the optimal design of monetary policy if national monetary transmission mechanisms are asymmetric (Carstensen et al. 2008).[1] Secondly, it has been shown that country-specific inflation forecasts outperform forecasts that use aggregate euro data only (Marcellino et al., 2003). Finally, the design of the monetary and banking system, household preferences, and, in turn, money demand functions are not equal across countries. Consequently, monetary growth will exhibit different patterns in the single countries than in the European Monetary Union (EMU) aggregate.

Generally, detailed information about the shadow economy output is unavailable. Even where careful measures of the shadow economy are constructed, these data are often available only periodically. Important exceptions are the classic results of Tanzi (1983) for the United

[1] This argument is reinforced by Golinelli and Pastorello (2002), Dedola et al. (2001), and Wesche (1997) who show that coefficient estimates of aggregate and national money demand specifications do not conform to each other.

States, and Bhattacharyya's (1990) series for the United Kingdom. In the case of the New Zealand economy, a time-series of data on the shadow economy has been generated by Giles (1997). Also, Friedrich Schneider and Roberto Dell' Anno make enormous efforts to estimate size and development of the shadow economy in various – typically OECD – countries. In a recent paper, Buehn et al. (2009) present multiple indicators multiple causes (MIMIC) model estimates for the German shadow economy from 1970 thru 2005. These estimates provide the rare opportunity to take account of informal economic activities in econometric modeling, in particular for modeling money demand in Germany.

But why is it important to explore this link? First of all, following Friedman's proposition that inflation is a monetary phenomenon, the derivation of actual money supply from money demand equilibrium can indicate future pressure to inflation. A stable relationship between real money, the (nominal) interest rate and a measure of economic activity is however necessary for monetary policy that is consistent with price stability. Secondly, the substantial size of the shadow economy in Germany and the permanent and stable demand for cash by people who work underground are likely to influence the concrete empirical money demand function. Finally, money demand relates the real and he monetary side of an economy and thus plays a central role in resource allocation.

Although, empirical applications to the shadow economy could vary enormously in terms of the methodology employed and the magnitudes that have been estimated, consensus exists regarding certain aspects of this phenomenon. Firstly, it seems clear that the size of the shadow economy has been growing over the past two or three decades, in almost all of the countries for which comparative data are available. Secondly, there is evidence that this growth in the shadow economy is associated with increases in the actual or perceived tax burden. Third, there is also evidence that there is a similar association between shadow economic activity and the degree of economic regulation. Rather than going into a detailed

documentation of these aspects here, the reader is referred to the excellent discussion and references in Schneider and Enste (2000, 2002).

The rest of the paper is organized as follows: Section 2 defines the shadow economy and presents an overview about shadow economy estimates for Germany. Section 3 briefly describes the economic theory of money demand. Section 4 explains the empirical model and presents the estimation results. Section 5 concludes.

2 The Shadow Economy

2.1 Definition

The unofficial economy itself can be separated into the shadow and the do-it-yourself economy. Do-it-yourself activities include all market-based goods and services which are produced do-it-yourself in order to avoid gross wage payments, including taxes and social security contributions, in the official economy or to avoid any net wage payments in the shadow economy. It is important to note, that the main difference between do-it-yourself and shadow economic activities is that the former are entirely legal.

The shadow economy is often defined as “market-based production of goods and services, whether legal or illegal that escapes detection in the official estimates of GDP” (Smith 1994, p. 18). One of the broadest definitions interprets the shadow economy as those economic activities and the income derived from them that circumvent government regulation, taxation or observation. The shadow economy estimates used in this paper rely on a more narrow definition, i.e. the shadow economy includes all market-based, lawful trade in goods and services that are deliberately concealed from public authorities for one of the following reasons:

(1) to avoid payment of income, value added or other taxes;

(2) to avoid payment of social security contributions;

(3) to avoid certain legal labour market standards, such as minimum wages, maximum working hours, safety standards, etc.; or,

(4) to avoid compliance with administrative procedures, such as filling in tatistical questionnaires or other administrative forms.

As the definitions of the shadow economy are less precise and still leave some wiggle room, Table 1 might be helpful to develop a reasonable consensus of the shadow economy.

[Insert Table 1 about here]

From Table 1 it is clear, that typical shadow economy figures do not cover underground criminal activities, such as burglary, robbery, or drug dealing, which are all illegal. They rather reveal the size of neglected shadow economic activities.

2.2 The Shadow Economy in Germany

The oldest estimate of the German shadow economy uses the survey method of the Institute for Demoscopy (IFD) in Allensbach, Germany and shows that the shadow economy was 3.6% of official GDP in 1974 (IFD 1975). In a much later study, Feld and Larsen (2005) undertook an extensive research project using the survey method to estimate shadow economic activities in the years 2001 and 2004. Using the officially paid wage rate, they concluded that these activities reached 4.1% in 2001 and 3.1% in 2004. Using the (much lower) shadow economy wage rate, however, these estimates shrink to 1.3% and 1.0%, respectively. If one looks at the discrepancy method the German shadow economy is much larger: using the discrepancy between expenditure and income it amounts to approximately 11% for the 1970s, and using the discrepancy between official and actual employment, to roughly 30%.

The physical input methods deliver values of around 15% for the second half of the 1980s. The (monetary) transaction approach developed by Feige (1996) places the shadow

economy at 30% between 1980 and 1985. Yet another monetary approach – the currency demand approach firstly undertaken by Kirchgässner (1983) for Germany – provides values of 3.1% (1970) and 10.3% (1980). His estimates are quite similar to the ones obtained by Schneider and Enste (2000), who also used a currency demand approach to value the size of the shadow economy at 4.5% in 1970 and 14.7% in 2000. Finally, if we look at latent multiple indicators multiple causes (MIMIC) estimation procedures, the first ones being conducted by Frey and Weck-Hannemann (1984), the estimations for the 1970s are quite similar. Later on, Schneider (2005) and others (e.g. Pickhardt and Pones 2006) followed estimating figures which are close to those of the currency demand approach. Surely, figures placing the size of the shadow economy at almost one-third of official GDP in the mid-1980s are most likely overestimates.

In a recent paper Buehn et al. (2009) present consistent structural equation (SEM) estimates of the size and development of the shadow economy and of do-it-yourself (DIY) activities in Germany from 1970 to 2005. They find, employing a MIMIC approach, that the shadow economy reached a level of about 17% of official GDP by 2005. Table 2 presents a comprehensive summary of shadow economy estimates for Germany.

[Insert Table 2 about here]

3 The Demand for Money, Revisited

According to the standard theory of money demand, money is demanded for two reasons: as a mean to smooth flows of income and expenditure, and as one among several assets in a portfolio. The two reasons lead to the following, common long-run specification of money demand:

$$M^d / P = f(\mathbf{I}, \mathbf{R}) \ , \qquad (1)$$

where M^d is nominal demand for money, P is the price level, $\mathbf{I}$ is a vector of scale

variables, and $\mathbf{R}$ is a vector of returns on assets.

The function $f(\mathbf{I},\mathbf{R})$ is typically increasing in the elements contained in $\mathbf{I}$. Regarding the choice of scale variables, the portfolio approach to asset demand supports to use financial wealth while transaction motives suggest including also a measure of income, such as the GDP. Omitting financial wealth from money demand would lead to an estimate of the money elasticity to income being greater than one which is likely to be an overestimation according to the quantity theory (see e.g. Laidler, 1993). If financial wealth is included, the corresponding estimate should be less than (or equal to) one. With respect to $\mathbf{R}$ the function $f(\mathbf{I},\mathbf{R})$ is increasing as long as those elements in $\mathbf{R}$ which are associated with assets included in M are considered. It is decreasing in $\mathbf{R}$ for those assets excluded from M.[2]

Equation (1) commonly appears in the literature in its log-linear form, with return rates entering in either logs or levels:

$$m = \alpha + \beta y + \gamma w + \delta_1 r^{own} + \delta_2 r^{out} \ , \qquad (2)$$

where the parameters β and γ represent the elasticity and δ_1, δ_2, and λ the semi-elasticity of real money with respect to the explanatory variables. The variable m is the logarithm of the chosen measure of money balances, typically the monetary aggregate M3, while y and w are the logarithms of the two scale variables in real terms, i.e. of GDP and wealth, respectively. The return rates r^{out} and r^{own} are a long-term interest rate and the own rate of money, respectively, and Δp is the inflation rate.[3]

According to economic theory the predicted sign and magnitude is $\beta = 1$ in the quantity theory or $\beta = 0.5$ in the Baumol-Tobin framework. For γ one would anticipate $\gamma > 0$. For r^{own} and r^{out} the expected coefficients are of equal magnitude but opposite sign implying

[2] For extensive summaries of the money demand literature see Goldfeld and Sichel (1990) and Laidler (1993).

[3] If equation (2) is specified in nominal terms, Δp would vanish.

$\delta_1\left(r^{out} - r^{own}\right)$. The spread $\left(r^{out} - r^{own}\right)$ can be interpreted as a measure of the opportunity cost of holding money rather than long-term bonds. Finally, the expected coefficient of λ is negative as the inflation rate measures the return of holding goods, i.e. goods are an alternative to money.

4 The Empirical Model

The specification of our empirical model for the long-run money demand is inspired by Deutsche Bundesbank (1995) where holdings of nominal balances M3 are determined by a measure of transactions using nominal GDP as scale variable. As argued in subsection 4.1 we also include total net financial wealth, in particular the monetary assets of domestic households and domestic enterprises, to account for the portfolio theory of asset demand and also for the trend of a declining velocity of money as argued in Deutsche Bundesbank (1995). To measure the opportunity costs of holding money rather than financial assets are captured by a long-term interest rate, in particular by using the yield on public debt securities outstanding.[4]

Taking further into account that recorded output understates actual output German shadow economy data has to be included in the long-run money demand specification. Thus, our empirical model is given by:

$$m = \alpha + \beta_1 y^{off} + \beta_2 y^{unoff} + \gamma w + \delta_1 r^{out} \ , \tag{3}$$

where y^{off} and y^{unoff} indicate official and unofficial GDP while the coefficients β_1 and β_2 represent the elasticity of real money to official and unofficial GDP, respectively. All variables are used in logs and the data span the period Q1 1975 to Q4 1994 on a quarterly

[4] Brand and Cassola (2000, p. 12) and Bruggeman (2000) argue that, due to the strong resemblance between the dynamics of the long-term interest rate and the spread $\left(r^{out} - r^{own}\right)$, the long-term interest rate is the prefered measure of opportunity costs.

basis. Table A.1 in the Appendix summarizes the variable definitions and data sources.

Unfortunately, the shadow economy estimates for Germany presented in Buehn et al. (2009) are on a yearly basis only. To obtain quarterly figures for the size and development of the German shadow economy, we interpolate their time series using the proportional Denton technique. This benchmarking technique is well suitable for combining a series of high-frequency data (e.g. quarterly data) with a less frequent (e.g. annual data) time series. It generates a series of quarterly estimates which is as proportional as possible to a selected indicator series, subject to the restrictions provided by the annual data.

The derived quarterly data are consistent with the annual estimates, if the selected indicator series shows a similar behaviour as the benchmark.[5] For this reason, we use the seasonally adjusted quarterly time series of construction orders received as indicator for the quarterly time series of the German shadow economy. The motivation behind the assumption that the intra year dynamics of the German shadow economy is mainly driven by the construction sector is given in Schneider (2003). He analyzes the sectoral structure of the shadow economy in Germany and finds that the construction sector accounts for almost 40%. Thus, it is reasonable to assume that the dynamics of the whole German shadow economy is driven by the construction sector.

The interpolated quarterly time series of the German shadow economy is shown in Figure 2. It can be clearly seen that the German shadow economy experienced a remarkable increase over the past 25 years. The German reunification in 1990 triggered a further steep rise in the shadow economy during the reconstruction period that followed. After East Germany caught up to West Germany's behavioral patterns, growth in the shadow economy slowed down considerably to the current level of around 17% of official GDP in 2005. This

[5] The details of the "relatively simple and robust" proportional Denton technique are described in Bloem et al. (2001).

significant size of unrecorded GDP is likely to influence the estimation of long-run money demand in Germany.

[Insert Figure 1 about here]

We start our empirical analysis with pre-testing the data for the sample period Q1 1975 to Q4 1994. In the first step, we tested for the presence of a unit root including the following deterministic terms: a constant, a shift dummy which has the value 1 from Q1 1991 onwards, and a time trend. The lag order was chosen using the Akaike information criterion. The test shows, that the null hypothesis of a unit root cannot be rejected for the variables in levels but unambiguously for their first differences. Proceeding with the analysis of cointegration, we find one unambiguous cointegration relationship in most cases which allows us to specify an error correction model. The results of the unit root and cointegration analysis are, respectively, shown in Table 3 and 4.

[Insert Table 3 and 4 about here]

In the next step, we estimate simple money demand equations. These results are presented in Table 5 with model (1) being the baseline specification according to Deutsche Bundesbank (1995). Models (2) and (3) extended model (1) by including the size of the shadow economy. In model (2) we use both the official and the shadow GDP as separate explanatory variables. Although the estimators are still unbiased, we find high collinearity between the variables for the official and the shadow economy. Therefore we estimate model (3) where we use the total GDP – defined as the sum of official and shadow GDP – instead of the two separate GDP variables. The most interesting finding is the much smaller elasticity for money with respect

to the shadow economy in comparison to the one for official GDP. This confirms the well known fact that transactions in the shadow economy are typically carried out using cash.

[Insert Table 5 about here]

Finally, we estimate error correction models for money demand in Germany which results are shown in Table 6. While model (1) again refers to the specification of Deutsche Bundesbank (1995), model (2) and model (3) are extended by the size of the shadow economy. In addition to the explanatory variables of official GDP, unofficial GDP, and the total net financial wealth we also employ the following dummy variables. While D86(1) captures the rise in M3 during December 1985 and January 1986 (see Deutsche Bundesbank (1986) for details), D91(l) grasps a shift in M3 in the first quarter of 1991 as a result of German reunification.[6] Imposing D94(4) is motivated by institutional changes and captures the decrease of M3 in the last quarter of 1994 due to flows into newly introduced money market funds.

[Insert Table 6 about here]

The results in Table 6 show that the error correction term (EC) is significant and has correct sign. As the left hand variable is the first difference of the log of M3 we can interpret the error correction in percentage. Thus, the first model indicates that a given “mistake” is corrected by 18.9 percent per quarter and the error is *ceteris paribus* corrected in about 5.3 quarters. Although model (1) shows a stable money demand, the inclusion of the shadow economy measures amplifies this relationship clearly. For model (2) and (3) the error correction takes 4.4 and 4.6 quarters, respectively.

[6] Unit the fourth quarter of 1990 M3 was recorded for West Germany only.

5 Conclusions

The nature of the shadow economy makes it difficult to measure its magnitude and to use such measures in econometric models designed to guide policy-makers. However, progress has been made during the past two decades and the widespread international evidence now indicates that the shadow economy is large and often growing. We argue that careful attempts to use measures of the shadow economy should be given higher priority. Even basic evidence on the causal relationships between the shadow economy and other macroeconomic variables, such as money demand, is important for policy-making. Moreover, it has serious implications if the policy conclusions are sensitive to whether or not we take into account the shadow economy.

In this paper we have used shadow economy estimates for Germany to re-estimate money demand in that country. Not surprisingly, we can confirm that transactions in the shadow economy are typically carried out using cash, i.e. the elasticity for money regarding the shadow economy is much smaller than for official GDP. We also find that the error correction to money demand equilibrium is faster. Thus, taking into account output in the shadow economy improves the estimation of the German money demand function.

References

Bhattacharyya, D. K. (1990), An econometric metbod of estimating the hidden economy, United Kingdom (1960-1984): estimates and tests. *Economic Journal*, 100, pp. 703-17.

Bloem, Adriaan M., Robert J. Dippelsman, and Nils O. Maehle (2001): Quarterly National Accounts Manual: Concepts, Data Sources, and Compilation, Chapter 6, International Monetary Fund.

Brand, C. and N. Cassola (2000): A money demand system for Euro area M3. ECB Working Papers, 39, November.

Bruggeman, A. (2000): The stability of EMU-wide money demand functions and the monetary policy strategy of the European Central Bank, The Manchester School, 68(2), 184–202.

Buehn, Andreas, Alexander Karmann, and Friedrich Schneider (2009): Shadow Economy and Do-it-yourself Activities: The German Case, *Journal of Institutional and Theoretical Economics*, forthcoming.

Carstensen, Kai, Jan Hagen, Oliver Hossfeld, and Abelardo Salazar Neaves (2008): Money Demand Stability and Inflation Prediction in the Four Largest EMU Countries, Kiel Working Paper No. 1443, January 2008.

Dedola, L., E. Gaiotti, L. Sillipo (2001): Money Demand in the Euro Area: Do National Differences Matter?. Banca d'Italia Working Paper No. 405.

Deutsche Bundesbank (1986), „Monetary Developments". Monthly Report of the Deutsche Bundesbank, March 1986. Frankfurt am Main.

Deutsche Bundesbank (1995). "Empirical study of the stability of money demand in Germany'. Monthly Report of the Deutsche Bundesbank, July 1995, Frankfurt am Main.

Feige, Edgar L. (1996): Overseas holdings of U.S. currency and the underground economy, in: Pozo, Susan (ed.): Exploring the Underground Economy, pp. 5-62, Michigan: W.E. Upjohn Institute for Employment Research.

Feld, Lars P. and Larsen, Claus (2005): Black activities in Germany in 2001 and 2004: A comparison based on survey data, The Rockwool Foundation Research Unit, Study No. 12, Copenhagen.

Frey, Bruno S. and Hannelore Weck (1983): Estimating the Shadow Economy: A 'Naive' Approach, Oxford Economic Papers, 35, pp. 23-44.

Frey, Bruno S. and Weck-Hannemann, Hannelore (1984): The hidden economy as an "unobserved" variable, European Economic Review, 26/1, pp.33-53.

Giles, David, E.A. (1997): The hidden economy and the tax-gap in New Zealand: a latent variable analysis. Discussion Paper 97-8, Depanmenc of Economics, University of Victoria.

Goldfeld S.M. and D.E. Sichel (1990): The demand for money. Chapter 8 in Friedman, B.M. and F.H. Hahn (eds.) Handbook of monetary economics, Volume 1, North-Holland, Amsterdam, pp. 299-356.

Golinelli, R., and S. Pastorello (2002): Modelling the demand for M3 in the euro area. European Journal of Finance 8, 371-401.

IFD (1975): Freizeitarbeit 1974 – Eine Stichtagsuntersuchung, Studie im Auftrag der Kommission für wirtschaftlichen und sozialen Wandel, Allensbach.

Kirchgässner, Gebhard (1983): Size and development of West-German shadow economy 1955-1980, Zeitschrift für die gesamte Staatswissenschaft, 139/2, pp.197-214.

Laidler, D.E.W. (1993): The demand for money: Theories, evidence, and problems, Fourth Edition, HarperCollins College Publishers, New York.

Langfeldt, Enno (1983): Ursachen der Schattenwirtschaft und ihre Konsequenzen für die Wirtschaft, Finanz- und Gesellschaftspolitik, Universität Kiel, Kiel.

Langfeldt, Enno (1984): The unobserved economy in the Federal Republic of Germany, in: Feige, Edgar L. (ed.): The unobserved economy, Cambridge University Press., pp. 236-260.

Lippert, Owen and Michael Walker (eds.) (1997): The Underground Economy: Global Evidences of its Size and Impact, Vancouver: The Frazer Institute.

Marcellino, M., J. H. Stock and M.W.Watson (2003): Macroeconomic forecasting in the euro area: country specific versus area-wide information. European Economic Review 47, 1-18.

MacKinnon, James G., Alfred Haug, and Leo Michelis (1999): Numerical Distribution Functions of Likelihood Ratio Tests for Cointegration, Journal of Applied Econometrics, 14(5), pp. 563-577.

Pickardt, M. and Pons, Jordi S. (2006): Size and Scope of the Underground Economy in Germany, Applied Economies, 38/4, pp. 1707-1713.

Schneider, Friedrich (2003): Zunehmende Schattenwirtschaft in Deutschland: eine wirtschafts- und staatspolitische Herausforderung. In: Vierteljahreshefte zur Wirtschaftsforschung, Bd. 72 (2003), S. 148-159.

Schneider, Friedrich (2005): Shadow economies around the world: what do we really know?, European Journal of Political Economy 21/3, September 2005, pp. 598-642.

Schneider, Friedrich (2007): Shadow economy and corruption all over the world: what do we know?, Discussion Paper, Department of Economics, University of Linz, Linz, Austria.

Schneider, Friedrich and Dominik Enste (2000): Shadow economies: Size, causes, and consequences, The Journal of Economic Literature, 38/1, pp. 77-114.

Schneider, F., Enste D. (2002). The Shadow Economy: Theoretical Approaches, Empirical Studies, and Political Implications, Cambridge (UK): Cambridge University Press.

Smith, P. (1994): Assessing the size of the underground economy: the Canadian statistical perspectives, Canadian Economic Observer, Cat. No. 11-010, 3.16-33, at 3.18.

Tanzi, Vito (1983): The underground economy in the United States: annual estimates, 1930-1980, IMF Staff Papers, Vol. 30, pp. 283-305.

Weck-Hannemann, Hannelore (1983): Schattenwirtschaft: Eine Möglichkeit zur Einschränkung der öffentlichen Verwaltung? Eine ökonomische Analyse, Frankfurt/Main: Lang.

Wesche, K. (1997): The stability of European money demand: an investigation of M3H. Open Economies Review 8, 371-391.

Tables

Table 1. *A Taxonomy of Types of Shadow Economic Activities*

Type of activity	**Monetary transactions**		**Non-monetary transactions**	
Illegal activities	Trade in stolen goods, drug dealing and manufacturing, prostitution, gambling, smuggling, fraud, etc.		Barter of drugs, stolen goods, smuggling, etc., production or growing of 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 from unreported work related to official/ lawful goods and services.	Employee discounts, fringe benefits.	Barter of official/lawfulg oods and services.	All do-it-yourself work and neighbourly help.

Note: The Structure of the table is taken from Lippert and Walker (1997, p. 5) with additional remarks.

Table 2. *The Size of the Shadow Economy in Germany According to Different Methods (in Percentage of Official GDP)*

Method	Shadow economy (in percentage of official GDP) in:							Source
	1975	1980	1985	1990	1995	2000	2005	
Survey	3.6 [1)]	-	-	-	-	-	-	IfD Allensbach (1975)
	-	-	-	-	-	4.1 [2)]	3.1 [2)]	Feld and Larsen (2005)
	-	-	-	-	-	1.3 [3)]	1.0 [3)]	
Discrepancy between expenditure and income	10.2	13.4	-	-	-	-	-	Lippert and Walker (1997)
Discrepancy between official and actual employment	38.5	34.0	-	-	-	-	-	Langfeldt (1983)
Physical input method	-	-	14.5	14.6	-	-	-	Feld and Larsen (2005)
Transactions approach	22.3	29.3	31.4	-	-	-	-	
Currency demand approach	6.0	10.3	-	-	-	-	-	Kirchgässner (1983)
	11.8	12.6	-	-	-	-	-	Langfeldt (1983, 1984)
	7.8	9.2	11.3	11.8	12.5	14.7	-	Schneider and Enste (2000)
Latent ((DY)MIMIC) approach	6.1	8.2	-	-	-	-	-	Frey and Weck (1983)

	-	9.4	10.1	11.4	15.1	16.3	-	Pickardt and Pons (2006)
	5.8	10.8	11.2	12.2	13.9	16.0	15.4	Schneider (2005, 2007)
	4.1	7.9	9.8	12.9	16.3	17.6	17.4	Buehn et al. (2009)
Soft modelling	8.3 [4)]	-	-	-	-	-	-	Weck-Hannemann (1983)

1) 1974.

2) 2001 and 2004; calculated using wages in the official economy.

3) 2001 and 2004; calculated using actual “black” hourly wages paid.

4) Average of 1974 and 1975.

Table 3. *Unit Root Tests*

Unit root test (ADF) for the sample period Q1 1975 – Q4 1994			
Variable	Deterministic terms	Lag order	Test statistic
M3	c, D91Q1	N(AIC) = 0	-2.02
Official GDP	c, D91Q1,t	N(AIC) = 0	-1.21
Unofficial GDP	c, D91Q1,t	N(AIC) = 2	-3.19**
Total GDP (official plus unofficial GDP)	c, D91Q1,t	N(AIC) = 0	-1.07
Total net financial wealth (Wealth)	c, D91Q1, t	N(AIC) = 1	-3.47**
Yield on public debt (Yield)	c	N(AIC) = 3	-3.064**
Δ M3	c, I91Q1	N(AIC) = 1	-5.89***
Δ Official GDP	c, I91Q1	N(AIC) = 0	-11.70***
Δ Unofficial GDP	c, I91Q1	N(AIC) = 1	-12.56***
Δ Total GDP	c, I91Q1	N(AIC) = 1	-11.51***
Δ Wealth	c, I91Q1	N(AIC) = 1	-4.68***

*** p<0.01, ** p<0.05, * p<0.1

Notes: c = constant, t = linear time trend, D91Q1 = shift dummy which is 1 from Q1 1991 onwards. I91Q1 is an impulse dummy obtained by the first difference of D91Q1. N(AIC) are the lag orders recommended by the Akaike information criterion (AIC). All variables are in logs and in nominal seasonally adjusted terms, except interest rates.

Table 4. *Cointegration Analysis*

Cointegration tests for sample period Q1 1975 – Q4 1994		
Variables	Null hypothesis	Johansen trace test
M3, Official GDP	0	16.79**
	1	2.14
M3, Total GDP	0	17.50**
	1	1.37
M3, Official GDP, Unofficial GDP	0	43.71***
	1	11.15
	2	1.80
M3, Official GDP, Yield	0	32.19**
	1	8.20
	2	1.75
M3, Total GDP, Yield	0	34.93**
	1	7.80
	2	1.27
M3, Official GDP, Unofficial GDP, Yield	0	62.68**
	1	28.13
	2	6.94
	3	1.02
M3, Official GDP, Wealth, Yield	0	48.34**
	1	14.92
	2	4.39

	3	0.006
M3, Official GDP, Wealth, Yield, Unofficial GDP	0	88.68***
	1	49.68**
	2	22.05
	3	5.10
	4	0.17
M3, Wealth, Yield, Total GDP	0	48.11**
	1	15.89
	2	5.25
	3	0.1

*** p<0.01, ** p<0.05, * p<0.1.

Note: All models are estimated with unrestricted constant and an impulse dummy for Q1 1991. Critical values are from MacKinnon et al. (1999). Lag order of 1 in underlying VAR models (level specification) according to Schwarz criterion.

Table 5. *Estimation of Money Demand in Germany*

	Model specification		
	(1)	(2)	(3)
Dependent variable	*m*	*m*	*m*
Official GDP	1.054***	0.981***	
	(0.0163)	(0.0384)	
Unofficial GDP		0.0485**	
		(0.0231)	
Wealth	0.223***	0.161***	0.208***
	(0.0281)	(0.0405)	(0.0264)
Yield	-0.537***	-0.655***	-0.495***
	(0.178)	(0.183)	(0.166)
Total GDP			1.013***
			(0.0146)
Constant	0.202***	0.569***	0.421***
	(0.0741)	(0.190)	(0.0661)
Observations	80	80	80
Adjusted R-squared	0.998	0.998	0.998

Note: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 6. *Error Correction Model for German Money Demand*

	Model specification		
	(1)	(2)	(3)
Dependent variable	Δ M3	Δ M3	Δ M3
$\Delta M3_{t-1}$	0.0348	0.0365	0.0425
	(0.0585)	(0.0557)	(0.0566)
Δ Official GDP	0.643***	0.576***	
	(0.0748)	(0.0827)	
Δ Total GDP			0.614***
			(0.0678)
Δ Unofficial GDP		0.0326*	
		(0.0171)	
Δ Wealth	0.508***	0.496***	0.498***
	(0.0578)	(0.0550)	(0.0556)
D86_1	0.0231***	0.0238***	0.0241***
	(0.00869)	(0.00836)	(0.00837)
D91_1	0.105***	0.110***	0.110***
	(0.0116)	(0.0118)	(0.0108)
D94_4	-0.0234***	-0.0246***	-0.0271***
	(0.00856)	(0.00841)	(0.00839)
Error Correction (1)	-0.189***		
	(0.0577)		
Error Correction (2)		-0.225***	
		(0.0578)	
Error Correction (3)			-0.218***

			(0.0605)
Observations	78	78	78
Adjusted R-squared	0.886	0.897	0.895
Durbin-Watson d-statistic	1.603749	1.641796	1.646038
Breusch-Godfrey LM test	6.407	6.205	5.863
	(0.1707)	(0.1844)	(0.2096)

Note: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. As the DW-statistics does not show a clear sign of no correlation we additionally employ the Breusch-Godfrey LM test for autocorrelation which indicates no autocorrelation until lag length 4.

Figures

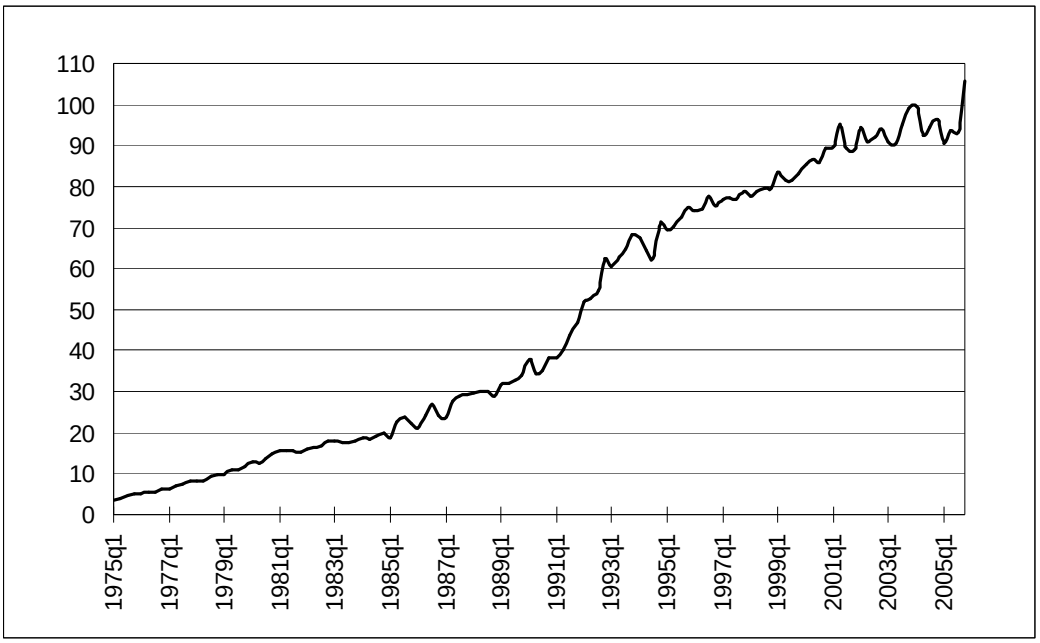

Figure 1

German Shadow Economy Index (1975q1:2005q4)

Appendix

Table A.1. *Data Definitions and Sources*

Variable	Definition	Source
m	Nominal M3; seasonally adjusted; until 1990(4) for West Germany only	Deutsche Bundesbank
y^{off}	Nominal GDP (Official GDP); seasonally adjusted; until 1990(4) for West Germany only	Federal Statistical Office, Germany
y^{unoff}	Shadow economy GDP (Unofficial GDP); seasonally adjusted	Buehn et al. (2009)
w	Net financial wealth of domestic households; until 1990(4) for West Germany only	Deutsche Bundesbank
r^{out}	Yield on public debt securities outstanding (Umlaufrendite)	Deutsche Bundesbank