Chapter 3
The Complex Dynamics of Social Interactions

3.1 Introduction

How large the non-observed economy (NOE) is and what determines its size in different countries and regions of the world is a much studied question (Schneider and Enste, 2000, 2002).[1] The size of this sector in an economy has important ramifications. It negatively affects a nation's ability to collect taxes to support its public sector, which can lead more economic agents to move into the non-observed sector (Johnson et al. 1997). When this sector is associated with criminal or corrupt activities it may undermine social capital and broader social cohesion (Putnam et al. 1993), which may damage economic growth (Knack and Keefer, 1997; Zak and Knack, 2001). Furthermore, as international aid programs are tied to official measures of the size of economies, these can be distorted by wide variations in the relative sizes of the NOE across different countries, especially among the developing economies.

Early studies (Guttman, 1977; Feige, 1979; Tanzi, 1980, Frey and Pommerehne, 1984) emphasized the roles of high taxation and large welfare state systems in pushing businesses and their workers into the non-observed sector. Although some more recent studies have found the opposite, that higher taxes and larger governments may actually be negatively related to the size of this sector (Friedman et al. 2000), others continue to find the more traditional relationship (Schneider, 2002; Schneider and Klinglmair, 2004).[2] Various other factors have been found to be

[1]Many terms have been used for the non-observed economy, including informal, unofficial, shadow, irregular, underground, subterranean, black, hidden, occult, illegal, and others, with much of this terminology originating in studies in Italy (Pettinati, 1979).. Generally these terms have been used interchangeably. However, here note distinctions between some of these and thus will use the more neutral descriptor, non-observed economy, adopted for formal use by the UN System of National Accounts (SNA) (see Calzaroni and Rononi, 1999; Blades and Roberts, 2002).

[2]However, in Schneider and Neck (1993) it is argued that the complexity of a tax code is more important than its level of tax rates. Also, in Schneider and Enste (2002, pp 97–101) it is argued that

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related to the NOE at the global level, including degrees of corruption, degrees of over-regulation, the lack of a credible legal system (Friedman et al. 2000), the size of the rural sector, and the degree of ethnic fragmentation (Lassen, 2007).

One factor often ignored in this mix is income inequality. The first published papers dealing empirically with such a possible relationship focused on this relationship within transition economies (Rosser Jr. et al. 2000, 2003b).[3] For a major set of the transition economies they found a strong and robust positive relationship between income inequality and the size of the non-observed economy. The first of these also found a positive relationship between changes in these two variables during the early transition period while the second only found the levels relationship still holding significantly after taking account of several other variables. The most important other significant variable was a measure of macroeconomic instability, specifically the maximum annual rate of inflation a country had experienced during the transition.

Here the hypothesis of a relationship between the degree of income inequality and the size of the non-observed economy is extended to the global data set studied by Friedman et al. (2000). Macroeconomic variables are considered that they did not include and also an index of trust as a measure of social capital. A main conclusion is that the finding of earlier studies carries over to the global data set: income inequality and the size of the non-observed economy possess a strong, significant, and robust positive correlation. No other variable shows up as consistently similarly related, although a corruption index does for some specifications. However, inflation is not significantly correlated for the global data set, in contrast to findings for the transition countries, and neither is per capita GDP. In contrast with Friedman et al, measures of regulatory burden and lack of property rights enforcement are weakly negatively correlated with the size of the non-observed economy but not significantly so. However, lack of property rights enforcement is strongly negatively correlated with corruption, and regulatory burden is also under some specifications. The finding of Friedman et al. (2000) that taxation rates are negatively correlated with the size of the non-observed economy holds only insignificantly in multiple regressions.

In addition, which variables are correlated in multiple regressions with income inequality, levels of corruption, and trust are considered. In a general formulation the two variables that are significantly correlated with income inequality are a positive relation with the size of the non-observed economy and the regulatory burden, with a

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for low income countries higher tax rates might reduce the share of the shadow economy as some government is needed to establish official markets.

[3]Lewis Davis (2007) notes the theoretical model of Rauch (1993) that hypothesizes such a relationship in development in conjunction with the Kuznets curve. During the middle stage of development inequality increases as many poor move to the city and participate in the "underemployed informal economy," a concept that follows the discussion of de Soto (1989), although this resembles more the "underground" economy as defined later here. Rauch does not provide empirical data and his theoretical model differs from the one presented here and involves a different mechanism as well. Rosser Jr. et al. (2007) initially extended this beyond the transition economies to a broader global data ser.

negative relation with taxation rates significant at the ten per cent level. Regarding the corruption index, the variables significantly correlated with it are negative relations with property rights enforcement and trust. Trust is significantly negatively related to corruption but counterintuitively is positively related to the size of the non-observed economy, although their bivariate relation is negative.

Beyond these more specific empirical findings (and related policy implications), there is a more general methodological issue to consider. It contributes to the emerging paradigm that emphasizes the role of social interactions of heterogeneous agents in complex economic systems as being important to consider in addition to the more conventional analysis that focuses solely upon individual incentives. That such a clear implication of the conventional approach as that higher taxes should be associated with greater involvement in the non-observed economy may be nullified by the effect of such social interactions is strong evidence of this conclusion.

3.2 Labor Returns in the Non-Observed Economy

Whereas Friedman et al. (2000) focus upon decisions made by business leaders, let us consider decisions made by workers regarding which sector of the economy they wish to supply labor to. This allows us to see clearly the issue of social interactions involved in the formation of the non-observed economy that tend to be left out in such discussions. Focusing on business leaders' decisions does not explain why income distribution might enter into the matter, and it may be that the use of such an approach in much previous literature explains why researchers have avoided the hypothesis we find to be so compelling. However, factors such as social capital and social cohesion seem related to the degree of income inequality and thus need to be recognized.

We need to clarify the use of terminology. As noted in footnote 1 above, most of the literature in this field has not distinguished between such terms as "informal, underground, illegal, shadow," and so forth in referring to economic activities not reported to governmental authorities (and thus not generally appearing in official national and income product accounts, although some governments make efforts to estimate some of these activities and include them). In Rosser Jr. et al. (2000, 2003b) the terms "informal" and "unofficial" were respectively used, with it argued that all of these labels meant the same thing. However, it must be recognized there that there were different kinds of such activities and that they had different social, economic, and policy implications, with some clearly undesirable and others potentially desirable from certain perspectives, e.g. businesses only able to operate in such a manner due to excessive regulation of the economy (Asea, 1996).[4]

[4]Another positive aspect of non-observed economic activity of any sort arises from multiplier effects on the rest of the economy that it can generate (Bhattacharya, 1999).

Rosser Jr. et al. (2007) used the term "Non-Observed Economy" (NOE), which will be will be used here and which was introduced into the United Nations System of National Acccounts (SNA) in 1993 (Calzaroni and Rononi, 1999), and which has become accepted in policy discussions within the OECD (Blades and Roberts, 2002) and other international institutions. The SNA further subdivides the NOE into three broad categories: *illegal*, *underground*, and *informal* (Calzaroni and Rononi, 1999). There are further subdivisions of these regarding whether their status is due to statistical errors, underreporting, or non-registration, which we shall not discuss further.

The illegal sector consists of activities that would be in and of themselves illegal if officially reported, e.g. murder, theft, bribery, and so forth. Some of corruption fits into this category, but not all. By and large these activities are viewed as unequivocally undesirable on social, economic, and policy grounds. Underground activities are those that are not illegal per se, but which are not reported to the government in order to avoid taxes or regulations. Thus they become illegal, but only because of this non-reporting of them. Many of these may be desirable to some extent socially and economically, even if the non-reporting of them reduces tax revenues and may contribute to a more corrupt economic environment. Finally, informal activities are those that take place within households and do not involve market exchanges for money. Hence they would not enter into national income and product accounts by definition, even if they were to be reported. They are generally thought to occur more frequently in rural parts of less developed countries and to be largely beneficial socially and economically. Although the broader implications of these different types of non-observed economic activity vary considerably, they all result in no taxes being paid to the government on them.

Although not necessary for positive relations between our main variables, income inequality, corruption, and the size of the NOE, conditions under which multiple equilibria arise as discussed in Rosser Jr. et al. (2003b) are of interest. This idea draws on a considerable literature, much of it in sociology and political science, which emphasizes positive feedbacks and critical thresholds in systems involving social interactions. Schelling (1978) in economics and Granovetter (1978) in sociology noted such phenomena, with Crane (1993) discussing cases involving negative social conduct spreading rapidly after critical thresholds are crossed. Putnam et al. (1993) suggested possible multiple equilibria in discussing the contrast between northern and southern Italy in terms of social capital and economic performance. Although Putnam emphasizes participation in civic activities as key in measuring social capital, others focus more on measures of generalized trust, found to be strongly correlated with economic growth at the national level (Knack and Keefer, 1997; Zak and Knack, 2001; Svendsen, 2002). Given that Coleman (1990) defines social capital as the strength of linkages between people in a society, it can be related to social cohesion and potentially lower transactions costs in economic activity.

The concept of social capital is controversial. Early advocates of the idea included Bourdieu (1977) and Loury (1977). Major overviews can be found in Woolcock (1998), Dasgupta (2000), Svendsen and Svendsen (2004), with Durlauf and

Fafchamps (2005) providing a more critical perspective. The latter note that different observers provide conflicting definitions of the concept with confused measures and econometric estimates. They note especially the problem of "negative social capital," that strong links within certain sub-groups, such as the mafia, may be inimical to economic growth. Putnam (2000) distinguishes between "bridging" social capital and "bonding" social capital. The former consists of links throughout society generally, the kind that presumably reduce transactions costs of economic activity. The latter are between individuals within a sub-group of society, the sort that could be inimical to general economic growth, although not necessarily to the incomes of the members of the group and might correspond more to the negative social capital of Durlauf and Fafchamps.[5] We shall assume that measures of generalized trust serve as proxies for the more economically productive, bridging social capital.

Dasgupta (2000, pp. 395-396) provides three alternative conceptualizations at the aggregate level for the operation of social capital, which he identifies with trust. The first has it operating through total factor productivity

$$Y = Af(K, N), \tag{3.1}$$

where Y is total output, A is total factor productivity, K is aggregate physical capital, and N is labor force. A is a positive function of bridging social capital, seen as lowering transactions costs through generalized trust. Dasgupta finds the evidence for this weak, at least for East Asia. The second approach distinguishes human capital, H, and sees it being influenced along with physical capital by the lowering of transactions costs through social capital

$$Y = Af(B(K, H), N), \tag{3.2}$$

where B now captures the social network externalities of social capital. Dasgupta reports for this as well that evidence is weak for B contributing substantially to economic growth in newly industrializing countries. Finally Dasgupta postulates that social capital works through both human capital and labor via C,

$$Y = Af(K, CN(H, N)). \tag{3.3}$$

Dasgupta then argues that it is not possible to clearly distinguish between these hypotheses. However, here I shall consider (3.3) to be the more appropriate representation and further consideration will assume that the social externality element will operate through its impact on labor directly (we shall not worry about physical capital directly).

[5]Lassen (2007) argues that ethnic divisions break down social capital and can open the door to a larger informal economy. Bjørnskov (2006) provides a fuller set of elements involved in social capital.

Rosser Jr. et al. (2000, 2003b) argue that the link between income inequality and the size of the NOE is a two-way causal relationship, running principally through breakdowns of social cohesion and social capital. Income inequality leads to a lack of these, which in turn leads to a greater tendency to drop out of the observed economy due to social alienation. Zak and Feng (2003) find transitions to democracy easier with greater equality. Going the other way, the weaker government associated with a large NOE reduces redistributive mechanisms and tends to aggravate income inequality.[6] Bringing corruption into this relation simply reinforces it in both directions. Although no one prior to Rosser Jr. et al. (2000) directly linked income inequality and the NOE, some did so indirectly. Thus, Knack and Keefer (1997) noted that both income equality and social capital were linked to economic growth and hence presumably to each other. Putnam (2000) shows among the states in the United States that social capital is positively linked with income equality but is negatively linked with crime rates.

The formal argument in Rosser Jr. et al. (2003b) drew on a model of participation in mafia activity due to Minniti (1995). That model was in turn based on ideas of positive feedback in Polya urn models due to Arthur et al. (1987; see also Arthur, 1994). The basic idea is that the returns to labor of participating in NOE activity are increasing for a while as the relative size of the NOE increases and then decrease beyond some point. This can generate a critical threshold that can generate two distinct stable equilibrium states, one with a small NOE sector and one with a large NOE sector. In the model of criminal activity the argument is that law and order begins to break down and then substantially breaks down at a certain point, which coincides with a substantially greater social acceptability of criminal activity. However, eventually a saturation effect occurs and the criminals simply compete with each other leading to decreasing returns. Given that two of the major forms of NOE activity are illegal for one reason or another, similar kinds of dynamics can be envisioned.

Let N be the labor force; N_{noe} be the proportion of the labor force in the NOE sector; r_j be the expected return to labor activity in the NOE sector minus that of working in the observed sector for individual j, and a_j be the difference due solely to personal characteristics for individual j of the returns to working in the NOE minus those of working in the observed economy, with this capturing both the human capital and social capital effects on the individual. Let us assume that this variable is uniformly distributed on the unit interval, $j \in [0, 1]$, with a_j increasing as j increases, ranging from a minimum at a_{o} and a maximum at a_1. Furthermore, this difference in

[6]This effect is seen further from studies showing that tax paying is tied to general trust and social capital. Scholz and Lubell, 1998; Slemrod, 1998). Anderson et al. (2004) provide experimental evidence of links between equality and the willingness to provide for public goods. Although not explicitly mentioning income distribution, Schneider and Enste (2002) emphasize "tax morality" as a factor in paying taxes, and they recognize that the perceived fairness of a tax system influences this. If general trust and income equality increase tax morality, then they could increase the paying of taxes.

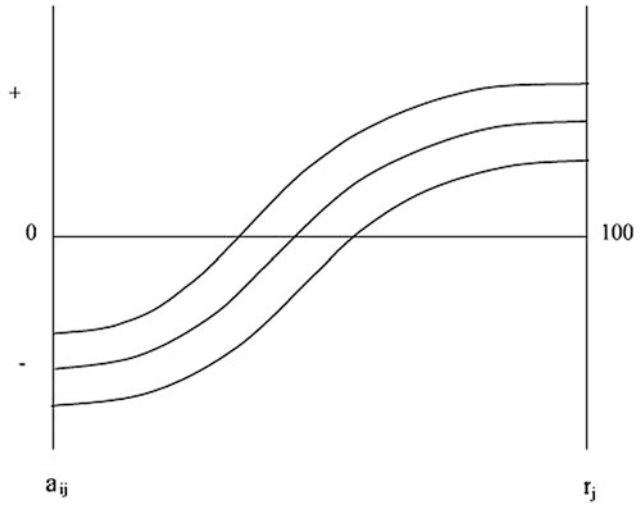

Fig. 3.1 Relative returns to working in non-observed sector for three separate individuals (vertical axis) as a function of percent of economy in non-observed sector (horizontal axis)

returns between the sectors follows a cubic function. With all parameters assumed positive this gives the return to working in the NOE sector for individual j as

$$r_j = a_j + \left(-\alpha {N_{\text{noe}}}^3 + \beta {N_{\text{noe}}}^2 + \gamma N_{\text{noe}}\right), \tag{3.4}$$

with the term in parenthesis on the right hand side equaling $f(N_\mu)$. Figure 3.1 shows this for three individuals, each with a different personal propensity to work in the NOE sector.

Broader labor market equilibrium is obtained by considering stochastic dynamics of the decisionmaking of potential new labor entrants. Let $N' = N + 1$; $q(noe)$ = probability a new potential entrant will work in the NOE sector, $1 - q(\text{noe})$ = probability new potential entrant will work in observed sector, with $\lambda_{\text{noe}} = 1$ with probability q (noe) and $\lambda_{\text{noe}} = 0$ with probability $1 - q(\text{noe})$. This implies that

$$q(\text{noe}) = [a_1 - f(N_{\text{noe}})]/(a_1 - a_0). \tag{3.5}$$

Thus after the change in the labor force the NOE share of it will be

$$N'_{\text{noe}} = N_{\text{noe}} + (1/N)[q(\text{noe}) - N_{\text{noe}}] + (1/N)[\lambda_{\text{noe}} - q(\text{noe})]. \tag{3.6}$$

The third term on the right is the stochastic element and has an expected value of zero (Minniti, 1995, p. 40). If $q(\text{noe}) > N_{\text{noe}}$, then the expected value of $N'_{\text{noe}} > N_{\text{noe}}$. This implies the possibility of three equilibria, with the two outer ones stable and the intermediate one unstable. This situation is depicted in Figure 3.2.

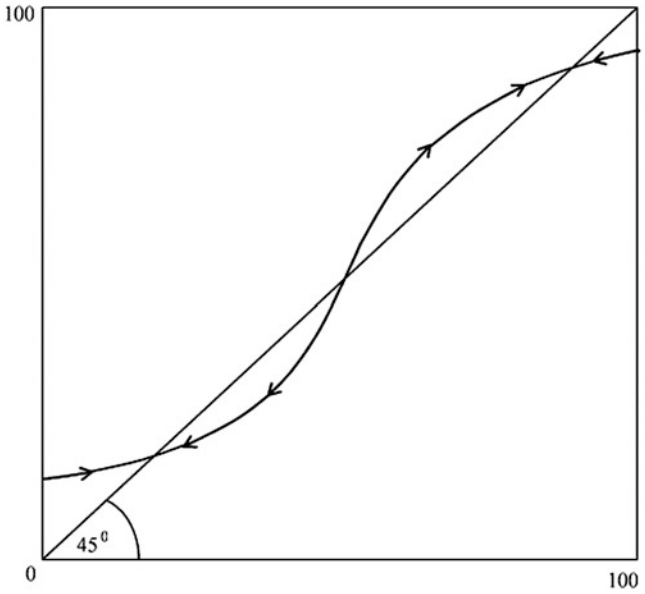

Fig. 3.2 Probability a new labor market entrant will work in the non-observed sector, $q(u)$, (vertical axis) as a function of the percent of labor in the non-observed sector (horizontal axis)

The argument can be summarized by positing that the location of the interval [a_0, a_1] rises with an increase in either the degree of income inequality, in the level of corruption in the society, or in an increase in the gap between bridging and bonding social capital. Such an effect will tend to increase the probability that that an economy will be at the upper equilibrium rather than at the lower equilibrium and if it does not move from the lower to the higher it will move to a higher equilibrium value. In other words, we would expect that either more income inequality or more corruption will result in a larger share of the economy being in the non-observed portion. However, in using trust as the main indicator of social capital, the relationship is ambiguous as it will depend on what kind of social capital it reflects. If it reflects bridging social capital, then we would expect more trust to lead to less activity in the NOE, whereas if it reflects bonding social capital it may well do the opposite.

Furthermore, one can expect there to be mutual interactions among several of these. The non-observed economy can be expected to increase inequality through reducing tax revenues available for redistribution. We also expect a strong feedback from it to corruption, with all of these potentially affecting social capital in various ways.

Finally, other variables that may interact with these and each other, including broader institutional, policy, or macroeconomic factors described below, must be considered.

3.3 Variables and Data Sources

Here I shall review part of the empirical analysis by Rosser Jr. et al. (2007), in which eight variables are considered: a measure of the share of the NOE sector in each economy, a Gini index measure of the degree of income inequality in each economy, an index of the degree of corruption in each economy, real per capita income in each economy, inflation rates in each economy, a measure of the tax burden in each economy, a measure of the enforcement of property rights, a measure of the degree of regulation in each economy, and a degree of generalized trust.[7] This set of variables produced equations for all the dependent variables with high degrees of statistical significance based on the F-test. Results for the 1992–93 and for 2000 were estimated using OLS estimates. There are problems with measuring each of these variables.

Without question the hardest of these to measure is the relative share of an economy that is not observed. The essence of the problem is that one is trying to observe that which by and large people do not wish to have observed. Thus there is inherently substantial uncertainty regarding any method or estimate, and there is much variation across different methods of estimating. Schneider and Enste (2000) provide a discussion of the various methods that have been used. However, they argue that for developed market capitalistic economies the most reliable method is one based on using currency demand estimates. An estimate is made of the relationship between GDP and currency demand in a base period, then deviations from this model's forecasts are measured. This method, due to Tanzi (1980), is widely used within many high income countries for measuring criminal activity in general. Given that most of the currency demand models assume that tax rates measure the underground economy effect, this complicates their use for testing that variable.[8]

Schneider and Enste recommend the use of electricity consumption models for economies in transition, a method originated by Lizzera (1979) because of the instability of financial relationships during economic transition. Kaufmann and Kaliberda (1996) and also Lackó (2000) have made such estimates for transition economies, with these providing the basis for the earlier work by Rosser Jr. et al. (2003b). Kaufmann and Kaliberda's estimates are similar in method to the currency

[7]Other variables have been included in other tests, including unemployment rates, aggregate GDP, a fiscal burden measure, and a general economic freedom index.. However, neither of the first two was significant and they were not in other studies as well. Real per capita GDP presumably is a better measure than aggregate anyway. Regarding fiscal burden, this is the same as the tax burden measure except that it includes the level of government spending. Most literature supports the idea that the tax aspect is the more important part of this and our results would support this. Finally the overall economic freedom index contains five sub-indexes, three of which are already being used individually. Also one index going into it is a measure of "black market activity," which looks like another measure directly of non-observed economic activity, or at least an important portion of it. So this variable has too many direct correlations with other variables to be of use.

[8]In the current economy looking at cash demand may not work so well given the rise of cryptocurrencies and their use for criminal activities (Norgaard, 2020).

demand one except that a relationship is estimated between GDP and electricity use in a base period, with deviations later providing the estimated share of the NOE. Lackó's approach differs in that she model's household electricity consumption relations rather than electricity usage at the aggregate level. Of course many forms of underground economic activity do not involve the use of electricity, and electricity production technology can change over time in ways complicating such estimates.

Another approach is MIMIC, or multiple indicator multiple cause, first used in this context by Frey and Pommerehne (1984) and used by Loayza (1996) to make estimates for various Latin American economies. This method involves deriving the measure from a set of links between presumed underlying variables and presumed indicators. This method has the problem that it in effect already presumes to know what the relationships are, so that one will get biased results for testing it on any of the presumed underlying variables.[9]

One more method is to look at discrepancies in national income and product accounts data between GDP estimates and national income estimates. Schneider and Enste list several other methods that have been used. However these four are the ones underlying the numbers we use in our estimates.

While some alternatives to some of their other variables are used, the measures of the NOE that Friedman et al. (2000) use are used for the 1992–93 estimates that are most directly comparable with their study. These in turn are taken from tables appearing in an early version of Schneider and Enste (2000). They have 69 countries listed and for many countries provide two different estimates. By and large for OECD countries they use currency demand estimates, mostly due to Schneider (1997) or Williams and Windbeck (1995) or Bartlett (1990), with averages of the estimates provided when more than one is available. For transition economies electricity consumption models are used, mostly from Kaufmann and Kaliberda, with a few from Lackó. Electricity consumption models are also used for the more scattered estimates for Africa and Asia, with most of these estimates drawn on work of Lackó as reported in Scheider and Enste. For Latin America most of the estimates come from Loayza (1996) who used the MIMIC method. However for some countries electricity consumption model numbers are available, due to Lackó and reported by Schneider and Enste. Finally the national income and product accounts discrepancy approach was the source for one country, Croatia, also as reported in Schneider and Enste. Here the estimate is selected from those available based on the prior arguments regarding which would be expected to be most accurate. Most of these numbers are for the early to mid-1990s.

For 2000 numbers provided by Schneider and Klinglmair (2004) are used. A substantial portion of these numbers are based on the DYMIMIC extension of the

[9]The originators of the MIMIC approach were Zellner (1970) and Goldberger (1972). Breusch (2005) shows that the use of it for some underground economy estimates leads to very fragile results, an outcome that may be more general than just for the MIMIC method. MIMIC stands for "multiple indicators, multiple causes" and DYMIMIC simply adds "dynamic" to the front of that.

MIMIC method. This makes for difficulties in comparing our results for the two different data points and for any studies of dynamic relations between them, which generally showed mostly non-significant results.[10] Unfortunately there were fewer country numbers available for this year, with the set consisting mostly of ones from the OECD and the transition economies. This variable became the main limiting one for 2000 data set, which had only 21 countries for all variables.

Although not as difficult to measure as the NOE, income inequality is a variable that is somewhat difficult to measure, with various competing approaches. The Gini coefficient is the most widely available number across different countries, although it is not available for all years for most countries. Furthermore there are different data sources underlying estimates of it, with the surveys in higher income countries generally reflecting income whereas in poorer countries they often reflect just consumption patterns. For most of the transition countries for 1992–93 estimates constructed by Rosser Jr. et al. (2000) are used, however for the other countries numbers provided by the *UN Human Development Report* for 2002 or 2003 are used, which are also for various years in the 1990s. Of the 69 countries studied in Friedman et al. (2000) there are three for which no Gini coefficient data are available, Argentina, Cyprus, and Hong Kong. Hence they are not included in these estimates.

The measure of corruption is an index used by Friedman et al. (2000) that comes from Transparency International (1998). It should be noted that the scale used for this index is higher in value for less corrupt nations and ranges from one to ten. This is in contrast to our NOE and Gini coefficient numbers, which rise with more NOE and more inequality. Thus, a positive relation between corruption and either of those other two variables will show up as a negative relationship for our variables. For 2000 numbers updated from the same source are used.

Real per capita GDP numbers come from *UN Human Development Report* for 2001 and are for the year 2000. The inflation rate estimate is from the same source but is an average for the 1990–2000 period. The measure of tax burden comes from Heritage Foundation's *2001 Index of Economic Freedom* (O'Driscoll Jr. et al. 2001). This combines an estimate based on the top marginal income tax rate, the marginal tax rate faced by the average citizen and the top corporate tax rate and ranges from one (low tax burden) to 5 (high tax burden). This number increases as the taxation burden increases. The measure of property rights enforcement comes from O'Driscoll Jr. et al. (2001) and ranges from one (high property rights enforcement) to five (low property rights enforcement). The measure of regulatory burden is also from O'Driscoll Jr. et al. (2001) and ranges from one (low regulatory burden) to five (high regulatory burden). Obviously there is a considerable amount of subjectivity involved in many of these estimates. After taking account of these variables so far, the usable data set is reduced from 69 to only 52.

[10]In a personal communication (2005), Dominick Enste notes that while the DYMIMIC method may have advantages as an estimate of the NOE, the way that other variables enter into its measurement may make it less well suited for use in checking on the independent significance of those variables in explaining the determinants of the NOE.

Finally, the measure of trust for 1992–93 is the index used in the World Values Survey (Inglehart et al. 1998), which varies from zero to 100, with higher meaning more trust. Although they study 43 "societies," many of these are sub-sections of the nations observed here, such as the city of Moscow and Northern Ireland. In the end, when the numbers from this sort are combined with those listed above one is left with only 32 of the original 69 countries, with the set heavily dominated by OECD and transition countries. Thus, in order to capture a broader view, regressions both with and without the trust variable are considered For 2000 numbers for this index used were provided personally by Ronald Inglehart, for which year estimates for many more countries were available.[11]

3.4 Empirical Findings

Prior to OLS multiple regressions for the 1992–93 data, the correlation matrix for these nine variables generally foreshadows the regression results, with a few exceptions. Using the larger 52 nation set without trust, for each of the three other main dependent variable the independent variables that prove to be statistically significant in the OLS regressions also have a high absolute value in the correlation matrix with the dependent variable. The two exceptions are that lack of property rights enforcement and regulatory burden appear strongly correlated with the NOE, but not so in the multiple regression. But their relations with corruption are the highest bivariate correlations in the matrix, foreshadowing that corruption may carry their effect in some multiple regressions. The main outlier comes when we bring in trust and the data set is reduced to 32 nations. Trust is negatively correlated with the NOE in the correlation matrix but seems to be positively related with it in the multiple regression at the ten per cent level.

In the OLS regression without the trust variable in which the measure of the non-observed economy is the dependent variable and the other seven variables are the independent ones. Most statistically significant is the corruption index, so at the 5 percent level, with it the most strongly correlated in the correlation matrix. The expected positive relationship between these two (shown by a negative sign) holds. The other significant variable at the 5 percent level is the Gini coefficient. The qualitative results seen here show up consistently in other regressions with these and other variables in various combinations.

Another shows the same regression but with the trust variable included as an independent variable and with the number of observations reduced by 20 because of the unavailability of the trust index for those countries. The Gini index continues to be significant, even more strongly so than in the previous regression. Corruption is no longer significant, although is nearly so at the ten per cent level. However, a

[11]Discussion with several interlocutors suggest that these estimates have many problems. Nevertheless, they were probably the best such numbers available for such a wide set of countries.

peculiar result is that trust is positively related to NOE and significantly so at the ten per cent level. This could be that the trust number is picking up "bonding" as well as "bridging" social capital, possibly consistent with this result.

Following the arguments of McCloskey and Ziliak (1996) the size of the coefficients for these two statistically significant variables are large enough to be economically significant as well. In the larger regression, the presumed ceteris paribus relations would be that a 10 percent increase in the Gini coefficient would be associated with a 6 percent increase in the share of GDP in the non-observed economy, while a 10 percent increase in the rate of corruption (change in index value of one point) would be associated with 4 percent increase in the share of GDP in the non-observed economy. These are noticeable relationships economically, although one must be careful about making such, extrapolations as these.[12]

However, one finding for the transition nations does not carry over to the global data set. This is the statistically significant relationship between inflation and the size of the NOE, which even carried over to the growth of the NOE as well. A possible explanation of this is that during the period of observation the transition economies experienced much higher inflation than most of the rest of the world, with Ukraine reaching a maximum annual rate of more than 10,000 percent. This high inflation was strongly related to the general process of institutional collapse and breakdown that happened in those countries then.

One finding of Friedman et al. (2000) is not confirmed, their finding that taxation burden is negatively correlated with the size of the NOE significantly. The correlation matrix shows a negative bivariate correlation of −0.45, but in the larger regression this becomes a weakly positive and statistically insignificant relation, while in the Table in a further regression it is weakly negative but insignificant relation. The likely explanation for the contrast between this finding and that of Friedman et al. (2000) is that there is a strong negative relation between taxation burden and income inequality, at least in the larger data set as seen in the largest regression. .In the multiple regression this dominates. The more important factor here is income inequality, and when it appears in an equation the statistical significance (and even the sign found) disappears. Thus, that Friedman et al. (2000) left out income distribution in their various estimates appears to have profoundly distorted their findings. The relation is not statistically significant in either direction in a more fully specified model.

Then there is the OLS regression results for the smaller set of variables but with the Gini coefficient as the dependent variable. The size of the NOE is statistically significant at the 5 percent level, although not at the 1 percent level. Even more statistiarelly significant, holding strongly at the 1 percent level, is tax burden, which is negatively correlated. It would appear that these tax burdens result in noticeable income redistribution, or if they do not, then nations with more equal income

[12]There have been some spectacular examples of nations having dramatic increases in both inequality and the size of their non-observed economy, with what happened in Russia between 1989 and 1993 especially notable.

distributions are more willing to tolerate higher tax rates. As in earlier regressions, the inflation measure also does not show up as statistically significant as holds for the other variables.

Regarding economic significance the relation from the NOE to income inequality appears to be somewhat weaker than going the other way. Thus, a 10 percent increase in the share of the non-observed economy in GDP would only be associated with about a 2 percent increase in the Gini coefficient. The taxation burden appears to be economically significant, with a 20 percent increase in tax burden leading to a 40 percent decline in Gini coefficient.

Another regression brings in trust to this estimate for the smaller 32 countries data set. While the NOE continues to be a significant variable, taxation is now only significant at the ten percent level, with regulatory burden now becoming significant at the 5 percent level, with it negatively correlated with inequality. Also, our macroeconomic variables come back into play somewhat, with the deflator being significant at the 10 percent level and positively correlated with inequality.

Then consider results for trust as the dependent variable, which is only available for the 32 observations data set. The most significant variable is corruption at the 1 percent level, which has the expected sign. An anomalous result is that NOE is significant at the 10 percent level, but with an unexpected positive sign, overturning the bivariate relation between these two variables in the correlation matrix. A surprising result is that the hypothesis that equality would drive trust does not hold up fully. The sign is as expected, but just missing being significant at the 10 percent level. Thus, curiously, inequality seems to more directly related to NOE than the hypothesized intermediary, social capital as measured by trust, although this may be due to the smaller data set available with the trust variable.

Then consider the correlation matrix for the variable set for 2000, with generally similar results compared to the earlier period. There are OLS regressions on the full variable set for each of the main dependent variables, with only one each shown given that the limiting variable for this period is the NOE variable. Unfortunately there are only 21 countries in this data set, confined to OECD and transition economies.

The one probably of greatest interest has NOE as the dependent variable. The results are reasonably consistent with the 1992–93 estimates earlier, but with some additional variables significant. Thus, inequality is significant again at the 5 percent level with our expected positive sign, and trust is again significant with a positive sign and at the 1 percent level. As before, this latter undoes the sign observed in the correlation matrix. The two additional variables that are significant are corruption, which is positively related as expected and at the 10 percent level of significance, along with inflation, which is counterintuitively negatively related with NOE and significant at the 5 percent level, strongly contrasting with findings just for the transition economies.

For one with the Gini coefficient as the dependent variable, the basic story of the two-way relationship between the NOE and inequality continues to hold up, with the NOE positive and significant at the 5 percent level. Also, the influence of inflation is even stronger, and is positively related at the 1 percent level. Unlike the earlier data

set, trust is now a significant variable, negatively related to inequality and significant at the 1 percent level. Also different from the earlier estimate are that the taxation and regulation variables are no longer significant, although taxation continues to have a negative sign.

A serious problem for these estimates is potential endogeneity of various variables with each other, with many possibilities available. An effort to deal with this involved several possible simultaneous equations formulations using two-stage least squares.[13] Unfortunately the results from these estimates were generally weak, raising questions about the robustness of the findings.

3.5 Conclusions

The finding of Rosser Jr. et al. (2000, 2003b, 2007) that there appears to be a significant two-way relationship between the size of the non-observed economy (or informal or unofficial economy) and income inequality is tentatively confirmed when the data set is expanded to include nations representing a more fully global sample based on OLS regressions, but does not retain significance in simultaneous equations formulations or in estimates of changes in variables between the two time periods. The finding of Friedman et al. (2000) that there is a strong relationship between the size of the non-observed economy and the level of corruption in an economy is more weakly confirmed, and may be a significant two-way relationship, although somewhat stronger in going from corruption to the non-observed economy than the other way. This weakens in the runs with trust that cover only 32 countries for 1992–93, but is stronger for 2000. That the maximum annual rate of inflation to be important in the size of the non-observed economy holds for the transition economies it does not hold for larger national data sets..

The finding not confirmed from the Friedman, Johnson, Kaufmann, and Zoido-Lobatón study is that of a negative relationship between higher taxes and the size of the non-observed economy. These results find no statistically significant relationship, in between this view and the alternative more traditional view that argues that higher taxes drive people into the non-observed economy. The failure of the Friedman et al. (2000) to include any measures of income inequality may explain this contrast and shows the importance of social interactions.

Their findings that the non-observed economy increases with lack of property rights enforcement and regulatory burdens is not directly found for either time period. However, there are strong relations between these and corruption for the broader data set without the trust variable in 1992–93 and for property rights enforcement with the trust variable, with corruption strongly linked with the non-observed economy, suggesting perhaps that this is the pathway through which these variables have their effect. However, these relationships did not hold up at all

[13] See Rosser Jr. et al. (2007) for further discussion of this issue.

in 2000, although these variations may reflect the varying sets of countries used, with the 21 country 2000 set being limited to OECD and transition economies, whereas the larger of the 1992–93 sets at 52 countries, without the trust variable, includes many less developed countries.

Using trust a our measure of social capital led to somewhat confusing results that may reflect conflicts between bonding social capital between sub-groups versus bridging social capital across groups, although presumably generalized trust should represent the latter. In any case it had an unexpected positive and significant relation with the non-observed economy for both time periods, more consistent with it as measure of bonding social capital. While insignificant with inequality in 1992–93 it was significantly and negatively related to inequality in 2000, consistent with most literature. Regarding corruption it was significant in both time periods with the expected negative sign. The NOE and corruption were the significant variables determining trust in 1992–93, retaining their signs, while in 2000 inequality was significantly negative and inflation was curiously significantly positive.

Efforts to test the robustness of these results using two-stage least squares on each of the data sets and OLS do not hold up well, warning of a fragility found by both Durlauf and Fafchamps (2005) and Breusch (2005) regarding studies of both social capital and the non-observed economy. Problems and uncertainties regarding much of the data, especially for the estimates of the size of the non-observed economy, are probably substantial contributors to this lack of robustness.

While these results should be used cautiously in making policy recommendations, they do reinforce the warning delivered in Rosser Jr. and Rosser (2001): international organizations concerned about the negative impacts on revenue collection in various countries of having large non-observed sectors should be cautious about recommending policies that will lead to substantial increases in income inequality. Fiscal austerity programs to reduce budget deficits that focus on reducing egalitarian transfer programs may backfire into a situation of reduced revenues. Sharply increasing inequality may well have the counterproductive outcome of increasing the size of the non-observed economy and corruption, thus reducing tax revenues and more broadly engendering a decline of social capital and general social cohesion, a deep finding showing how a conventionally expected result can be found not to hold when dynamically complex social interactions are accounted for.