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The Non-Observed Economy in Israel

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1. Introduction

Estimating the size of the non-observed economy (NOE), or as it is more commonly known the "black economy," is a daunting task. This is explained not just by the elusive nature of its components, but also by the efforts of those active in the NOE to hide their tracks, which makes it particularly challenging to obtain data.

Determining the size of the NOE is an important step in estimating the scope of tax evasion in an economy and in choosing the tools to combat it. Non-compliance with a country's laws and regulations has a major effect on the economy and reduces the efficiency of its systems. Furthermore, economic activity that goes unreported erodes the tax base, which is liable to enlarge the size of the public debt and reduce the size and quality of the public services provided to the country's citizens.

The need to estimate the size of a country's NOE and its trend over time also stems from its political relevance and its economic effect on our lives. Moreover, reliable measurement of total economic activity, including both the formal and informal production of goods and services, is essential in order to formulate economic policy that will respond optimally to economic fluctuations and developments over time.

Despite the ample body of literature on the NOE and the broad consensus regarding the importance of understanding it, there is no accepted definition of the term. The differences in classification have a direct impact on the optimal method for estimating the size of the NOE. Nonetheless, it is agreed that the NOE includes all of the economic activity that should have been reported to the tax authorities and required the payment of taxes by law.

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Therefore, we have chosen to use the most common definition, according to which the NOE is composed of "those economic activities and the income derived from them that circumvent or otherwise avoid government regulation, taxation or observation" (Dell'Anno & Schneider, 2003).

The current paper is structured as follows: Section 2 describes the most common methods used in the economic literature to estimate the size of the NOE. Section 3 reviews previous attempts to estimate the size of the NOE in Israel, with emphasis on the drawbacks of the estimation methods used. Section 4 presents an alternative estimation model that is modified for the Israeli economy. Section 5 presents the estimation results and Section 6 includes a short summary and possible ways to deal with the phenomenon.

2. Methods for estimating the size of the NOE

In general, there are three main approaches to measuring the size of the NOE: the direct approach, the indirect approach, and the model approach. Each one of these has advantages and disadvantages and each leads to different results, even for the same country. However, when estimating the size of the NOE in one particular country, and in view of the fact that each country has its own methods of data gathering and data recording, the indirect approach has a clear advantage over the others based on its ability to use explanatory variables that are modified to each country.[1]

This is a particularly important advantage when using the currency demand approach (CDA), which was first suggested by Cagan (1958). His approach was adapted to the US economy by Tanzi (1980, 1983) and has since served as the theoretical basis for many studies (Ferwerda, Deleanu & Unger, 2010). According to this approach, the size of the NOE is measured in two stages. In the first, the aggregate demand equation for money (cash) is estimated econometrically with the inclusion of a specific parameter related to the use of cash in NOE transactions; in the second stage, the value of the NOE transactions is calculated using the quantity theory of money.

In the first stage of the estimation, the main assumption is that all transactions in the NOE are carried out in cash in order to hide revenue and evade taxation. The aggregate demand for cash is estimated using variables that can be attributed to both the formal economy (such as the interest rate

1 See the discussion in the report of the OECD survey to estimate the size of the NOE in each of its member countries (Gyomai, Arriola, Gamba & Guidetti, 2012, pp. 11–12).

on deposits) and the NOE (such as the tax burden). The calculation of the demand for cash that results from NOE transactions relies on the gap between the estimated demand for cash in the full model (which includes all of the variables related to the demand for cash) and the estimated demand for cash on the assumption that the coefficients of the variables related to the NEO are equal to zero.[2]

In the version used by Tanzi (1980; 1983) in his study of the NOE in the US, the dependent variable in the estimation equation for the demand for cash is the ratio between cash and the supply of money in the economy. According to his method, the ratio is dependent on four variables that determine the demand for cash: the share of wages paid in cash within national revenues; the interest rate on savings and deposits; income per capita in the country; and average rate of taxation on labor income. According to his assumption, the average tax rate on labor income is the only factor that drives cash transactions in the NOE. This assumption relies on the understanding that a higher tax rate encourages tax evasion which leads to an increased demand for cash. The assumption is then that there is a positive relationship between the tax rate (the tax burden) and the size of the NOE.

In the second stage, the share of the NOE within GDP is calculated by choosing a base year in which, according to the assumption, the contribution of the NOE to total GDP is equal to zero and the velocity of money is calculated according to the Fisher equation.[3] On the assumption that the velocity of money is identical in the two economies — both formal and informal — the size of the NOE is calculated as the product of the velocity of money and the "surplus" demand for cash, as calculated in the first stage.

This approach has, unsurprisingly, received a fair amount of criticism, primarily due to the assumptions on which the econometric estimation is based. Schneider and Enste (2000) and Enste and Schneider (2002) described three of its major disadvantages: the assumption that the velocity of money is identical in the formal economy and in the NOE; the determination that the average tax rate (the tax burden) is the only explanation for the existence of the NOE; and the assumption that the contribution of the NOE to GDP is negligible in the base year.

2 For further details, see Section 5.

3 The Fisher equation poses parity between the demand for money and the supply of money: $M \cdot V = P \cdot T$ where M is the money supply, V is the velocity of money, P is the price level and T is total transactions (goods and services).

In order to overcome these disadvantages, we will make use of an updated version of the currency demand approach, which was formulated for the Italian economy (Ardizzi, Petraglia, Piacenza & Turati, 2014). The model has two innovative components:

1. The dependent variable in the demand for money (cash) equation is the ratio between total cash withdrawn by the public from bank checking accounts (including by way of ATMs) and total non-cash transactions. This method makes it unnecessary to use the Fisher equation and consequently also the assumption that the velocity of money is identical in both economies.
2. In addition to the tax burden, this version takes into account another important component in measuring the size of the NOE, namely the number of crimes that involve the use of cash (such as trading in drugs and prostitution). According to the OECD, these crimes rely to a large extent on cash and therefore they constitute an important component of the NOE (Gyomai et al., 2012).

3. Previous attempts to measure the NOE in Israel

According to estimates, the NOE constitutes about 12 percent of all economic activity in the Anglo-Saxon countries, between 20 and 30 percent in the Southern European countries (Schneider & Williams, 2013) and close to 40 percent in the developing countries (Schneider, 2008). Furthermore, in several countries, and even some OECD countries, the size of the NOE comes close to that of government consumption (Hassan & Schneider, 2016). It appears, therefore, that the existence of unreported economic activity is widespread, a fact that reduces government revenues and leads to distortions in important economic indicators, such as the measurement of GDP and the distribution of income in the economy.

In 2011, the OECD conducted a survey of its member countries to estimate the size of the NOE in each of them. Most of the member countries provided the information for 2008 or 2009. According to the OECD definitions, the NOE includes four main components (Gyomai et al., 2012):

a. Underground production: Although this type of productive activity is legal, it is concealed from the tax authorities in order to avoid the payment of taxes or the regulations applying to it.

b. Illegal production: Productive economic activity that generates or supplies illegal goods and services or goods produced by illegal means.
c. Informal sector production: Productive economic activity by unregistered agents that belong to households but which produce beyond their own needs.
d. Statistical underground: This component involves unreported economic activity that is not included in the calculation of GDP due to defects in the government's data collection.

According to the survey, the NOE in Israel in 2008 could be broken down as follows: 21.8 percent informal production; 32.8 percent underground production; and 45.6 percent unreported due to data collection defects (see Table 1). The data for Israel were gathered for various industries. In the construction industry, for example, estimates are based on surveys carried out by the Ministry of the Interior to evaluate the extent of illegal building and combined with data on the average cost of building a home during the relevant year. In the car repair industry, data are based on Central Bureau of Statistics estimates of expenditure on private and public consumption. In addition, the data included, among other things, taxi services, private tutoring, fruits and vegetables sold in open markets, the internal economic activity of the kibbutzim, gardening services, and tips in the food and lodging industry.

The survey indicates that the extent of the NOE in Israel in 2008 was only about 6.6 percent of GDP (close to NIS 70 billion in 2008 prices), a surprising result that gives Israel a favorable ranking relative to other countries. A possible explanation for this figure is that Israel did not include the component of illegal activity (such as the drug trade and prostitution) in its NOE.

Table 1. The composition of the non-observed economy in the OECD countries

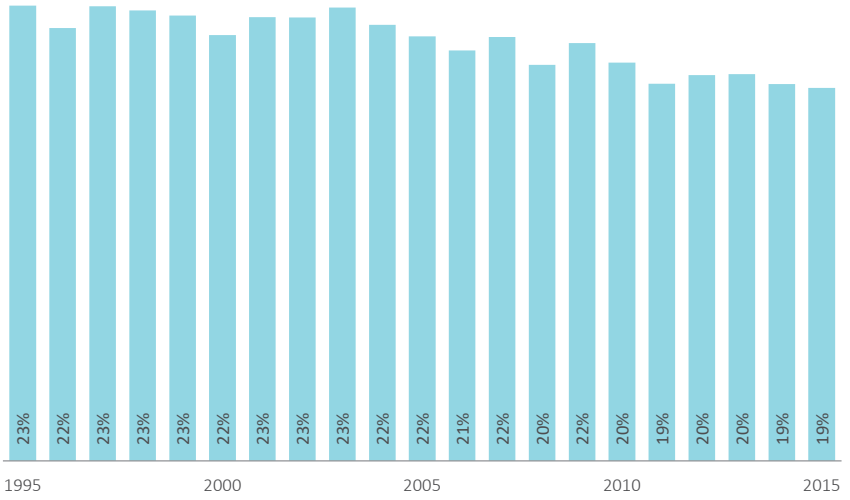
Share of GDP, in parentheses the share of the non-observed economy

Country	Underground production	Illegal production	Informal production	Statistical underground	Total
Austria	2.4% (31.7%)	0.2% (2.1%)	1.5% (19.4%)	3.5% (46.8%)	7.5% (100%)
Belgium	3.8% (83.8%)			0.7% (16.2%)	4.6% (100%)
Canada	1.9% (88.2%)	0.2% (8.2%)		0.1% (3.6%)	2.2% (100%)
Czechia	6.3% (77.6%)	0.4% (4.5%)	1.3% (15.6%)	0.2% (2.3%)	8.1% (100%)
France	3.7% (54.7%)		2.9% (42.7%)	0.2% (2.7%)	6.7% (100%)
Hungary	3.1% (27.9%)	0.8% (7.5%)	3.1% (28.6%)	3.9% (36.0%)	10.9% (100%)
ISRAEL	**2.2% (32.6%)**		**1.4% (21.8%)**	**3.0% (45.6%)**	**6.6% (100%)**
Italy	16.2% (92.8%)			1.2% (7.2%)	17.5% (100%)
Mexico	5.5% (34.7%)		10.4% (65.3%)		15.9% (100%)
Netherlands	0.8% (36.6%)	0.5% (20.1%)	0.5% (20.0%)	0.5% (23.2%)	2.3% (100%)
Norway	0.5% (51.5%)	0% (0.3%)	0.5% (43.8%)	0% (4.4%)	1.0% (100%)
Poland	12.7% (82.6%)	0.9% (6.0%)		1.8% (11.4%)	15.4% (100%)
Slovakia	12.1% (77.3%)	0.5% (3.0%)	2.9% (18.7%)	0.2% (1.0%)	15.6% (100%)
Slovenia	3.9% (38.2%)	0.3% (3.2%)	2.8% (27.7%)	3.1% (30.9%)	10.2% (100%)
Sweden	3.0% (100%)				3.0% (100%)
UK	1.5% (65.6%)		0.5% (22.9%)	0.3% (11.4%)	2.3% (100%)

Source: Labib Shami, Taub Center | Data: OECD

Medina and Schneider (2018) estimated the size of the NOE in 158 countries (including Israel) and arrived at markedly different estimates. According to them, Israel's "shadow economy," as they called it, ranged from 23 percent of GDP in 1995 to 19 percent in 2015 (Figure 1).[4] Figure 2 presents the share of the NOE in the OECD countries in 2015. The calculations were conducted by the researchers using the Multiple Indicators Multiple Causes (MIMIC) model.

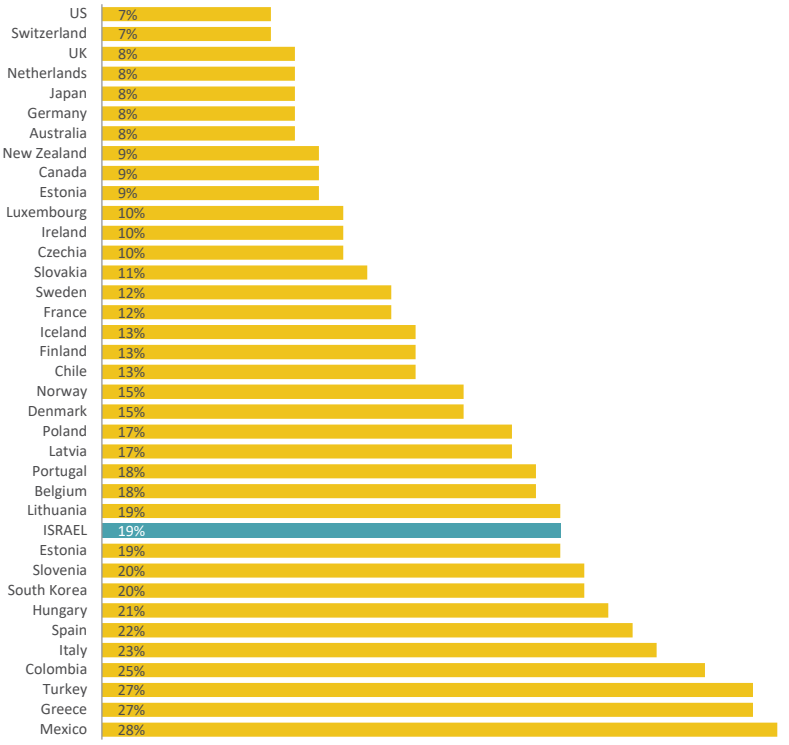
Figure 1. The share of the non-observed economy out of GDP in Israel
MIMIC model



Source: Labib Shami, Taub Center | Data: Medina and Schneider, 2018

4 It is worth mentioning that in most of the other OECD countries, similar differences were observed between the estimates generated by Medina and Schneider and the OECD estimates.

Figure 2. The share of the non-observed economy out of GDP in the OECD
MIMIC model



Source: Labib Shami, Taub Center | Data: Medina and Schneider, 2018

Criticism of the MIMIC model

The MIMIC model is based on the work of Frey and Weck (1983) who developed it in order to analyze psychometric factors in the measurement of intelligence. This approach is based on the idea that the correlation between observed variables is explained by unobserved (hidden) variables. The MIMIC approach assumes that the NOE is an unobservable (hidden) phenomenon that can be estimated using the measurable factors that generate it, such as the tax burden.

In contrast to this assumption, Breusch (2005a) points out that, unlike psychological variables, the NOE is not a hidden variable or a hypothetical phenomenon like intelligence and it should be estimated using the same methods employed to measure the formal economy, rather than using a model such as MIMIC. Breusch raises some additional technical issues to explain his opposition to the use of the MIMIC model to estimate the NOE, including, among others, the instability of the coefficients when the size of the sample or the specification changes and the difficulty in obtaining reliable data on variables that are unrelated to taxes. Another disadvantage of the MIMIC model is that it is not based on any microeconomic foundation. The MIMIC model is almost entirely a statistical model, with very little economic-logical basis (Breusch, 2005b). This may lead to uncertainty with respect to the estimated value and to overestimation of the dimensions of the NOE.

4. The currency demand approach modified for the Israeli economy

The current research estimates the size of the non-observed economy in Israel using the currency demand approach (CDA) modified to the Israeli economy. In the first and most basic version of the CDA model, we use the stock of liquid assets in the economy as the dependent variable in a demand for cash (stock variables).[5] This requires the use of the Fisher equation and the assumption that the velocity of money is identical in both economies, namely the formal economy and the NOE. In contrast, in the modified version of the model, the ratio between two flow variables is used: the dependent variable in the demand for cash equation is the ratio between total cash withdrawals from the public's checking accounts (CW — cash withdrawals) and total non-cash transactions (VOP — value of payments). This approach allows the measurement of the demand for anonymous payments against every shekel used for payment in a traceable transaction (such as transactions in which the payment is by bank transfer, check, or credit card).

5 A stock variable relates to a specific point in time, such as the amount of money in the economy as measured in NIS on a specific date. A flow variable, in contrast, relates to some period of time, such as in the case of GDP measured in NIS for a period of a year or a quarter.

The decision to use total cash withdrawals from checking accounts in order to estimate the size of the NOE is based on the assumption that in order to conceal income and to evade taxation, all transactions in the NOE are cash. This is the basic assumption used in all approaches that calculate the size of the NOE (Rogoff, 2015). Of course, the assumption is not that all cash withdrawals are used in NOE transactions since obviously some cash is used for transactions in the formal economy.[6] We believe that there are three main components in the demand for cash payments: structural variables, tax evasion, and crime.

Structural components of the demand for cash

Krueger and Goodhart (2001) describe a number of variables that are identified with the structural component of the demand for cash payments. These include technologies for payments and macroeconomic variables, such as GDP, private consumption, disposable income, inflation, and the interest rate in the economy. In the current model, we considered the use of two macroeconomic variables: the ratio between aggregate consumption and GDP (RATIO1) and the ratio between aggregate disposable income and GDP (RATIO2). The assumption that disposable income and private consumption affect the demand for cash is based on the understanding that the higher an individual's income, the greater will be the level of expenditure and, therefore, the greater the desire to hold a larger amount of cash. It is worth emphasizing that all of the explanatory variables have a complex connection to the demand for cash and that the effect of this relationship on demand may be in opposite directions. A rise in GDP or in private consumption, for example, may also lead to a drop in the demand for cash where the result is dependent on individuals' preferred method of payment (Schneider & Enste, 2000). This relationship is influenced by, for example, the level of technology and the use of electronic means of payment, which in the current model are represented by total non-cash payments (VOP).

The economic literature points to a negative relationship between the interest rate in an economy and the demand for cash. It is assumed that the higher the interest rate and the higher the income earned on money "invested" in financial assets, the higher will be the opportunity cost of holding cash.

6 Finlay, Staib and Wakefield (2020) show that 15 to 35 percent of the total cash in circulation in Australia is used in transactions in the formal economy, between 4 and 7 percent is used in the NOE, and the rest is inactive and for the most part simply accumulated by the public. Their study did not include the accumulation of cash in estimating the size of the NOE.

In order to represent the effect of the interest rate on the demand for cash, the nominal interest rate on deposits (IOTD — interest on total deposits) is used.In addition, the model includes the rate of annual inflation (INF) and the annual rate of population growth (PG).

Tax evasion

There is expected to be a positive connection between the overall tax burden (apart from transfer payments, which are a type of negative tax) and the demand for cash. This assumption rests on the understanding that the higher the tax burden, the more individuals will engage in transactions that make it possible to evade taxation. Also, in this case, the effect of the tax burden on the demand for cash may be the opposite of what is claimed above, such that a higher tax burden may lead to a drop in the disposable income of households and thus to a drop in the use of cash. Furthermore, an increase in transfer payments (TR) and in particular the child allowance, unemployment benefits, and income support payments is liable to induce recipient households to shift to the NOE in order not to lose their eligibility should their formal income rise (Mazar & Reingewertz, 2018; Romanov & Zussman, 2001).

In order to determine the effect of the tax burden on the demand for cash, the net direct tax burden (TD — direct tax) and the indirect tax burden (the taxation of domestic production; TOG — tax on goods and services) are used. In addition, we isolate some transfer payments to households from the rest of the transfer payments and examine their effect on the demand for cash, in particular, child allowances, unemployment benefits, and income support payments (group TR1). The rest of the transfer payments were classified into a separate group (TR2). To the best of our knowledge, this is unique to the current research.

Crime

The NOE also includes components related to crime, such as trade in drugs. In order to isolate these components from simple tax evasion, two variables are used in the current model: the total annual number of police investigations (IF – investigation files) and the total annual number of vice investigations, including prostitution and trade in drugs (IFM – vice investigation files) and calculated the ratio between them (RIF). We chose vice, which includes prostitution and trade in drugs, in view of the need to include crimes of an economic nature that are the result of relations between a seller and a buyer

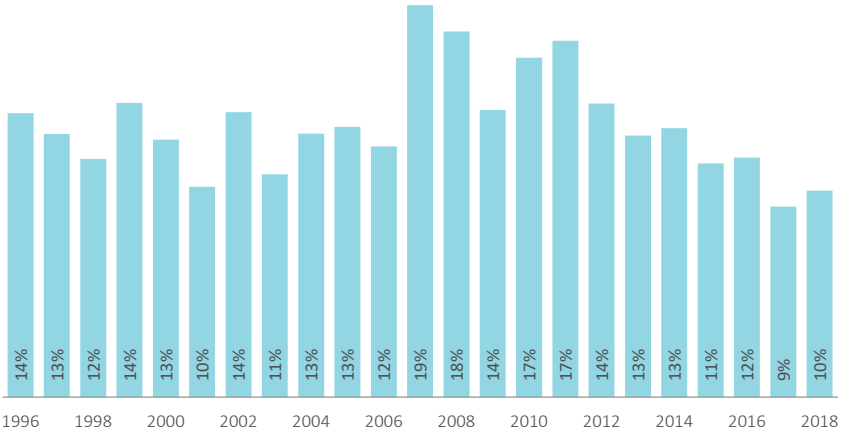
and that involve cash payment. Accordingly, a positive relation is expected between crime and the demand for cash. However, the level of crime in the country may have a negative effect on the desire of individuals to hold cash.

5. Results of estimating the NOE in Israel

Unlike the estimations from the MIMIC model, the size of the NOE in Israel has fluctuated over the years and has been characterized by a clear downward trend in recent years (see Figure 3). According to the model used in this study, the share of the NOE in Israel fell from 14 percent in 1996 to 10 percent in 2018, while GDP itself grew by about 260 percent during that period. These rates reflect an NOE of about NIS 49 billion in 1996 as opposed to NIS 134 billion in 2018. Relative to the results of the OECD survey in 2011, which estimated the size of the NOE in Israel in 2008 at 6.6 percent of GDP, the estimates in this study show the size of the NOE in Israel to be 18 percent of GDP in 2008. The NOE peaked in 2007 to 2008, during the global economic crisis, when it reached 19 percent of GDP (in 2007). These years were characterized by a sharp drop in total non-cash payments and a slowdown in the growth of GDP, in contrast to the continuous growth in the amount of cash withdrawals in Israel (Figure 6). This trend points to a higher-than-average use of cash that is not reflected in reported GDP and which leads to an increase in demand for untraceable payments in contrast to every shekel used for payment in a traceable transaction (such as a bank transfer, check or credit card). This accounts for the high share of the NOE during those years.

With respect to the components of the NOE in Israel, it appears that over the last decade the share of the tax evasion component within the NOE has been on a downward trend (Figure 4), in contrast to the clear upward trend in the share of the crime component within the NOE (Figure 5). Moreover, the share of tax evasion has been low in recent years: 4 percent in 2016 and only 1 percent in 2017 and 2018. The explanation can be found in Figure 6, which shows that cash withdrawals from checking accounts have been characterized by an upward trend over the years, in contrast to a mixed trend for non-cash transactions. However, in 2016, the trend in cash withdrawals reversed and at the same time the total amount of non-cash transactions grew. This reversal in trend, alongside the reduction in the tax burden that characterized the last decade in Israel, can be seen in the sharp drop in the share of the tax evasion component within the NOE during those years.

Figure 3. The share of the non-observed economy out of GDP in Israel

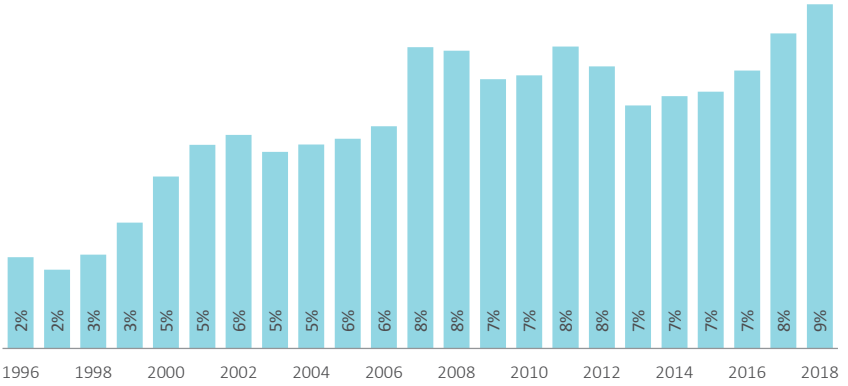


Source: Labib Shami, Taub Center, based on data from the Bank of Israel, CBS, and the OECD

Figure 4. The share of tax evasion in the non-observed economy out of GDP in Israel

Source: Labib Shami, Taub Center, based on data from the Bank of Israel, CBS, and the OECD

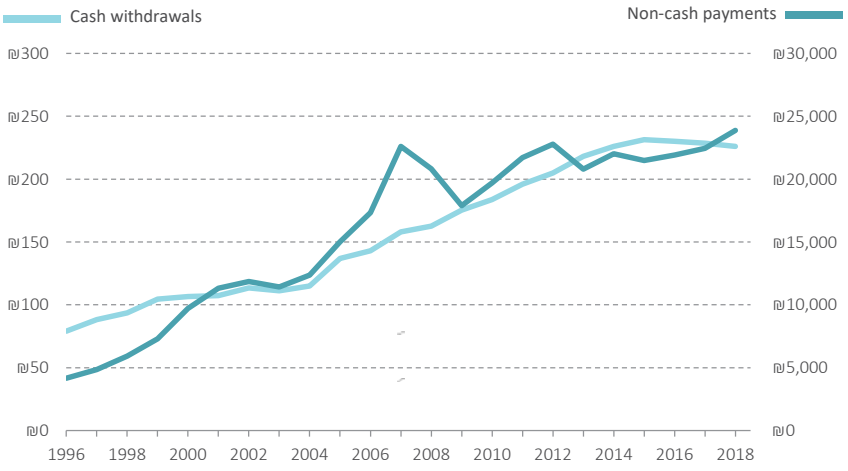
Figure 5. The share of criminal activity in the non-observed economy out of GDP in Israel



Source: Labib Shami, Taub Center, based on data from the Bank of Israel, CBS, and the OECD

Figure 6. Cash withdrawals from bank accounts and non-cash payments

NIS billion



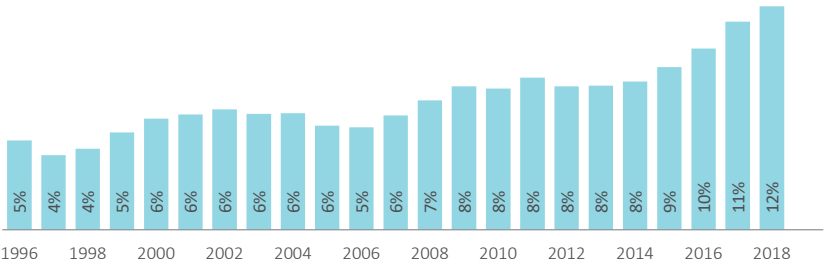
Source: Labib Shami, Taub Center | Data: Bank of Israel, the Regulator for the Bank

As mentioned, breaking down the total tax burden (indirect taxes, net direct taxes, and transfer payments) allows an examination of the effect of each variable on the size of the NOE in Israel. According to the model, indirect taxes and the child allowance, unemployment benefits, and income support payments have a positive effect on the size of the NOE. In other words, they contribute to the expansion of the NOE. These results support the conclusions of other studies examining this issue in Israel (Mazar & Reingewertz, 2018; Romanov & Zussman, 2001). According to these studies, assistance that is conditional on a means test (such as income support payments) and that involve an offset of the assistance or part of it against labor income is liable to create a poverty trap. A means test that also takes into account the benefits that accompany assistance (such as discounts and exemptions from payment for goods and services) leads to a reduction in the supply of labor among assistance recipients and, in essence, encourages them to conceal income. The contribution of indirect taxation to the expansion of the NOE may be the result of its contribution to reducing total non-cash transactions (a variable that appears in the denominator of the model's dependent variable) and the preference of individuals for paying in cash for goods and services. Therefore, it essentially contributes to increasing the value of the dependent variable in the model and the share of the NOE in the economy.

In contrast, net direct taxation and transfer payments (without the child allowance, unemployment benefits, and income support payments) have a negative effect on the size of the NOE, or in other words they lead to a reduction in its size. The negative effect of net direct taxation on the size of the NOE may be the result of its contribution to reducing individuals' labor income. This effect reduces total transactions both in cash and by electronic means and thus contributes to reducing the value of the dependent variable in the model (in the event that the numerator is reduced more than the denominator) and the share of the NOE in the economy.

The sharp increase that characterizes the share of the crime component within the NOE in Israel during the last two decades is consistent with the rise in the share of vice investigations (trade in drugs and prostitution) within total police investigations. According to Figure 7, this rate rose from 5 percent in 1996 to 12 percent in 2018 and, during the last two years, the share of the crime component within the NOE in Israel stood at 90 percent.

Figure 7. The ratio between investigations of vice crimes and the total number of investigations opened



Source: Labib Shami, Taub Center | Data: CBS

6. Summary and solutions

In recent years, policy makers worldwide have been promoting the idea of eliminating the use of cash, with the goal of limiting unreported economic activity (the NOE). Many studies offer support for this policy. Rogoff (2015) claims that the use of cash makes it possible to carry out transactions anonymously and to conceal them from the tax authorities and the law, thus helping individuals avoid taxes and violate the law. According to Rogoff's estimates, a large share of the cash in most countries — often in excess of 50 percent — is used to conceal financial transactions from the authorities.

When there is no restriction on the use of cash, income from illegal activity can be used to purchase goods from the formal sector of the economy. Thus, for example, drug dealers can purchase a car or a home. Countries that are able to diminish the use of cash should be able to mitigate this situation. Thus, in order to buy a car, for example, one would need income that is registered in a formal banking system; income that cannot be registered in the formal economy will have no economic value (Cohen, Rubinchik & Shami, 2019).

Indeed, many countries are currently shifting to a policy of reducing the use of cash in view of its expected positive effects and, in particular, the limits it will impose on various types of illegal activity and the reduction in money laundering and tax evasion. In addition to its contribution to limiting the NOE, reducing the use of cash will also positively affect economic growth in these

countries, will contribute to strengthening the central banks in the presence of economic shocks, and will lead to an improvement in the social and economic benefits that citizens can expect to receive in the future.

This type of policy has been adopted by, for example, Indian Prime Minister Narendra Modi who declared on November 8, 2016, that all 500 and 1,000 rupee notes would have no value within 50 days. These notes constitute about 86 percent of the total stock of coins and notes in India, a country in which about 90 percent of all transactions until then were in cash (ibid). The motive for adopting this measure was the desire to end the counterfeiting of these notes for the purpose of financing terror and also to reduce the amount of black money in the country (Dash, 2017). In other countries, such as Sweden, households are increasingly moving to the use of electronic methods of payments, such as bank cards and Swish, and are reducing their use of cash to a large extent, even without government intervention (Sveriges Riksbank, 2018).[7]

In contrast, there are places that refuse to shift to a cashless economy. The legislature of New Jersey and the city council of Philadelphia have imposed financial sanctions on stores that refuse cash as a means of payment, based on the claim that they are discriminating against both individuals who do not have sufficient access to financial services and the services that are usually offered by the banks (underbanked) and individuals who do not have a bank account at all (unbanked).

In the US, cash is still the most common method of payment and is used in 30 percent of all transactions and 55 percent of transactions under $10. According to the America's Federal Reserve, the quantity of cash has grown during the last 17 years, although currently, the number of $100 bills is larger than the number of $1 bills. Despite new methods of payment, payment in cash is still the simplest method of carrying out a transaction in the US since it does not require remembering a username and password.

George Osbourne, the former Chancellor of the Exchequer in the UK, related to the question of a cashless economy at a Fintech conference held at the end of 2018. Although he claims to have always supported a cashless economy he also proposed that it not be implement in Britain in view of its impact on low-income individuals (Mavadiya, 2019).

7 Swish is a service of the European Mobile Payment Systems Association. The service works through a smartphone application where the user's phone number is connected to their bank account, making it possible to transfer money in real time.

In Israel, the mandate of the Locker Committee which was created in 2013 was to reduce the use of cash, as part of the efforts to limit and reduce the scope of the NOE. The Committee published its recommendations in 2014 and the Law for Reducing the Use of Cash went into effect on January 1, 2019. The law is meant to reinforce efforts to reduce the size of the black economy and the amount of black capital. The law limits the amount that can be paid in cash to NIS 11,000 for payments to a business and NIS 50,000 for payments to a private individual. Since endorsed and open checks are similar in their characteristics to cash, the law established restrictions on their use as well. The law treats a business and a private individual separately and, for the first time, the law imposes financial sanctions also on the payer and even imprisonment for recurring violations. In July 2019, restrictions went into effect that prohibit the cashing of checks with no beneficiary or checks whose amount exceeds NIS 10,000 and which were endorsed more than once.[8]

There is no doubt that a policy to reduce the use of cash has positive effects. Nonetheless, a misguided implementation of the policy may have undesirable effects on certain groups and will thus miss the point of the legislation. The social consequences of a policy to reduce the use of cash can be illustrated using the example of countries like India, where the effects have been felt for a number of years. Apart from the fact that the reduction in the use of cash is liable to widen the gap between rich and poor, in India, it generated substantial chaos. Companies did not manage to pay salaries and millions of individuals without bank accounts could not purchase food and medicine. Moreover, the economy in India has been in recession for the past two years, during which time the population has spent long hours in lines at the banks in order to open an account and deposit their old notes.[9]

The destructive impact of the coronavirus pandemic did not bypass the NOE and its participants. The government of Israel, like many other governments, adopted a policy of social distancing in order to limit the spread of the virus. This policy also dampened business activity immediately in both the formal economy and the NOE. In order to limit the economic harm to its citizens and to the economy as a whole, the government provided, among other things, a budgetary safety

8 *The Law for Reducing the Use of Cash* on the Bank of Israel site and also Aviv (2018).

9 See *A Cashless Economy to Root Out Theft and Petty Crime?* the Cashless Economy site.

net in 2020 of NIS 135.5 billion.[10] This money is designated for assistance to the unemployed, support for small businesses, and the creation of growth engines for a rapid recovery. However, receipt of the grant had a number of conditions, including a drop of at least 25 percent in turnover during the period March to June 2020 relative to the same period in 2019. This condition is liable to encourage small businesses to conceal income in order to meet the threshold and, thus, it will contribute to expanding the NOE (Klingbail & Peretz, 2020).

On the other hand, small businesses operating in the NOE and the unemployed who were previously employed in the NOE did not receive these grants, since their income is not reported to the authorities. Although it seems fair to deny support to someone who has not in the past contributed to state revenues, it is reasonable to assume that the economic harm caused to these individuals will also affect businesses in the formal economy and will reduce their revenues. Even though it is not possible to ascertain the exact number of workers in the NOE in Israel and in particular the number who were fired in the NOE as a result of the coronavirus crisis, there were likely to have been tens of thousands of such layoffs, based on the estimates of the International Labor Organization (ILO).

According to the ILO, two billion individuals, who constitute more than 60 percent of all workers in the world, are employed informally. Informal employment is particularly common in the developing countries, but also exists in the developed countries (accounting for 25 percent of the employed in Europe) (ILO, 2018). These workers lack rights and a basic social security net and since the economic rescue plan ignores them, it is almost certain that they will be among the main victims who have lost their livelihood as a result of the coronavirus crisis. In Italy, for example, the government has already made an unprecedented announcement that it intends to provide assistance to the unemployed who up until the crisis were part of the NOE, based on a fear that these workers would riot (Follain, 2020). One way or another, this problem is liable to create a complex economic challenge for decision makers.

10 As of the beginning of August, the total extent of the economic program of Israel's government for 2020 for dealing with the coronavirus crisis stands at NIS 135.5 billion. It is important to note the latest amendment made to the Basic Arrangements Law: the State economy including budgets for use in 2021 (like extensions of unemployment benefits and bi-monthly assistance to the self-employed and business owners through the end of June 2021). These budgets do not appear in the economic budget plan for dealing with the coronavirus crisis in 2020.

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Appendix

The data were for 1996 to 2018. We chose 1996 as the starting point since in August 2014, the Central Bureau of Statistics updated the National Accounts system beginning in 1995, according to the SNA 2008 guide. The data were taken from the Bank of Israel, CBS, and the OECD websites.

The estimation was carried out using the following equation:

$$RCWVOP_t = \beta_0 + \beta_1 \cdot RATIO1_t + \beta_2 \cdot RATIO2_t + \beta_3 \cdot IOTD_t + \beta_4 \cdot INF_t + \beta_5 \cdot PG_t + \beta_6 \cdot RIF_t + \beta_7 \cdot TOG_t + \beta_8 \cdot TD_t + \beta_9 \cdot TR1_t + \beta_{10} \cdot TR2_t + \varepsilon_t$$

where:

$$t = 1,2,\dots,23$$

RCWVOP	The ratio between cash withdrawals from checking accounts and total non-cash payments
RATIO1	The ratio between aggregate private consumption and GDP in current prices
RATIO2	The ratio between aggregate disposable income and GDP in current prices.
IOTD	The nominal rate of interest on the public's deposits
INF	The annual rate of inflation
PG	The rate of population growth
RIF	The ratio between number of vice cases and the total number of cases investigated by the police
TOG	The indirect tax burden as a percent of GDP
TD	The net direct tax burden as a percent of GDP
TR1	The child allowance, unemployment benefits, and income support payments as a percent of GDP
TR2	Other transfer payments as a percent of GDP

In order to achieve optimal results, we used an estimation technique based on stepwise regression.[11] The procedure yields the following model:[12]

$$RCWVOP_t = \beta_0 + \beta_1 \cdot RATIO1_t + \beta_2 \cdot RATIO2_t + \beta_3 \cdot RIF_t + \beta_4 \cdot TOG_t + \beta_5 \cdot TD_t + \beta_6 \cdot TR1_t + \beta_7 \cdot TR2_t + \varepsilon_t$$

where: $t = 1,2,\ldots,23$

Appendix Table 1. Regression results

	The Model
(Intercept)	0.053***
	(0.017)
RATIO1	-0.152***
	(0.022)
RATIO2	0.044***
	(0.013)
RIF	0.043**
	(0.018)
TOG	0.289***
	(0.072)
TD	-0.034*
	(0.017)
TR1	0.170***
	(0.056)
TR2	-0.394***
	(0.080)
R^2	0.96
Adj. R^2	0.94
Number of observations	23
RMSE	0.001

Note: *p<0.1; **p<0.05; ***p<0.01. | Source: Labib Shami, Taub Center

11 Stepwise regression is a method for creating an optimal regression equation by choosing independent variables whose unique contribution to predicting the dependent variable has the strongest statistical significance. The method includes a number of steps: First, the independent variable which has the highest **simple** correlation — and the most significant coefficient — with the dependent variable is chosen. Second, the independent variable with the highest **partial** correlation — and the most significant coefficient — with the dependent variable is chosen, while excluding the effect of the independent variable chosen in the first stage. And so on. If the independent variable chosen in some stage is not statistically significant, then the process is halted.

12 The residuals are distributed normally with equal and fixed variance.

The size of the NOE in Israel is obtained by estimating the "excess demand" for cash, namely the demand that is not the result of the structural components of the demand for cash. This excess demand is calculated as the difference between the values generated from the model's equation and those obtained by setting the value of the variables related to the NOE (i.e. RIF, TOG, TD, TR1 and TR2) to zero. In order to arrive at the share of the NOE within the formal economy (GDP), we take the number obtained from the estimation and multiply it by the total payments in non-cash transactions (VOP) and then divide the result by GDP each year. To illustrate, the following is the calculation of the size of the NOE for 2006:

1. First, the ratio RCWVOP which is obtained from the estimation equation is calculated. The result is 0.0082.
2. The ratio RCWVOP is calculated and obtained when the values of the variables correlated to the NOE are set to zero. The result is 0.0034.
3. The difference between the two results obtained above is calculated. The result is 0.0048.
4. The result from step 3 is multiplied by total payments in non-cash transactions during 2006. The result is 83.16, which is the surplus demand for cash in NIS billions for 2006. This stage relies on the assumption that the denominator (total payments in non-cash transactions) in the RCWVOP ratio is not affected by transactions in the NOE.
5. The result from step 4 is divided by GDP with the result that the share of the NOE in 2006 was 12 percent. The assumption here is that every shekel of surplus demand is equivalent to a shekel channeled to final uses.

In order to obtain the rate of tax evasion in the NOE, the same process is repeated, except that in the second stage, only the variables related to the tax burden, i.e. TOG, TD, TR1 and TR2, are set to zero.

In order to analyze the results of the linear regression, three tests that indicate the model's ability to represent the real data are used. Following is a description of the tests:

a. Identification of serial correlation

It is well known that serial correlation in a time series describes a situation in which the residuals are correlated with their lagged values. In this study, the Durbin-Watson test is used to identify the existence of first-order serial correlation. If the statistic obtained is higher than a critical level or alternatively the *p*-value is lower than 5 percent, then the null hypothesis that there is no first order serial correlation is rejected. The conclusion is then that there is a problem of serial correlation. The test was conducted and the null hypothesis was not rejected (i.e., there was no evidence found of serial correlation in the residuals).

The following is the output for the model:

Durbin-Watson test
Data: the Model
DW = 2.67, *p*-value = 0.627

b. Heteroscedasticity (varying variance)

The assumption of constant variance of the random disturbances is called homoscedasticity. In the event that this assumption is not fulfilled, then the observations are not distributed evenly around the regression line, a problem that is referred to as heteroscedasticity. Heteroscedasticity leads to bias in the variance of the estimates and also a bias in the joint variance between the estimators and therefore the tests of the significance of the estimates are invalid. In this study, the Breusch-Pagan-Godfrey test is used in order to test for heteroscedasticity.

If the statistic obtained is higher than the critical value or alternatively the *p*-value is less than 5 percent, the null hypothesis of homoscedasticity is rejected and the conclusion is that there is a problem of heteroscedasticity. The test was conducted and the null hypothesis was not rejected. Therefore, the assumption that the variation is identical for all the random disturbances is valid.

The following is the output for the model:

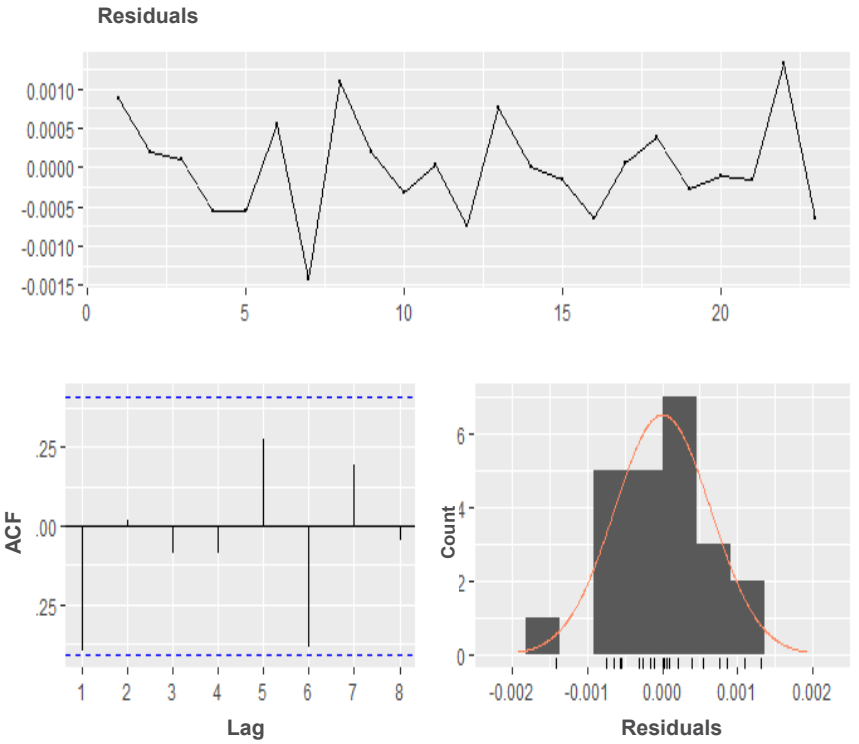
Studentized Breusch-Pagan test
Data: The Model
BP = 13.811, df = 7, *p*-value = 0.05465

c. The normal distribution of the residuals

The assumption of normally distributed random disturbances is essential in order to obtain linear and unbiased estimates with the least squares method. The validity of this assumption was examined using the Shapiro-Wilk Normality Test. According to this test, the distribution of the random variations is normal if the *p*-value is above 5 percent.

The following is the output for the model:

Shapiro-Wilk normality test
Data: residuals (The Model)
W = 0.98018, *p*-value = 0.9093



Source: Labib Shami, Taub Center