Economic Systems 44 (2020) 100746

Contents lists available at ScienceDirect

Economic Systems

journal homepage: www.elsevier.com/locate/ecosys

The non-observed economy and economic growth: A meta-analysis

Oscar Afonso[a,*], Pedro Cunha Neves[b], Tiago Pinto[c]

[a] Universidade do Porto, Faculdade de Economia, CEF.UP and OBEGEF, R. Roberto Frias, 4200-464 Porto, Portugal
[b] Departamento de Gestão e Economia and CEFAGE-UBI, Universidade da Beira Interior, Rua Marquês d'Avila e Bolama, 6200-001 Covilhã, Portugal
[c] Universidade do Porto, Faculdade de Economia, R. Roberto Frias, 4200-464 Porto, Portugal

ARTICLE INFO

JEL classification:
O10
O17
O40
C83

Keywords:
Economic growth
Parallel economy
Non-observed economy
Meta-analysis
Publication bias

ABSTRACT

Academics, politicians, the public in general and researchers have great interest in the non-observed economy. However, there is divergence in its definition, accounting methodology and economic effects. In this paper we conduct a meta-analysis on the empirical literature that estimates the impact of the parallel economy on economic growth. We conclude that there is no publication bias and that the average effect of the parallel economy on economic growth is insignificant. However, the reported effects differ considerably with the type and number of countries included in the sample of primary studies, the structure of the data, the methodology used to measure the parallel economy, the number of citations of primary studies, and the year they were published.

1. Introduction

The study of the non-observed (or parallel) economy has assumed increasing importance in the economic and social sciences. The parallel economy started out as a neglected subject, but there is now a great deal of literature about it (e.g., Schneider et al., 2010; Buehn, 2011; Ergene, 2015). This interest stems from the fact that in many countries the parallel economy represents a substantial part of the effective GDP – according to Schneider and Klinglmair (2004), it amounts to 41% in developing countries, 38% in transition economies, and 18% in OECD countries.[1] It has therefore become the target of several studies and has attracted great interest among politicians, researchers and the general public (Enste, 2010).

Despite this increasing importance, there is still a lack of consensus regarding the definition and measurement of the parallel economy. In fact, given its multiple causes, dimensions and trigger agents, which have varied in scope and over time, the parallel economy has been defined in several different ways. It is commonly accepted, however, that the parallel economy includes productive activities that are not observed due to economic reasons (e.g., Schneider and Enste, 2000; Giles and Tedds, 2002; Dell'Anno and Schneider, 2005). Among these are, for example, activities performed with the express intention of avoiding taxes and social contributions or legal requirements concerning minimum wages, working hours and health and safety regulations (e.g., Frey and Weck-Hannemann, 1984; Schneider, 2012; Medina and Schneider, 2018).

Since agents engaged in informal activities try to remain undetected, the parallel economy is hard to quantify. As a consequence, several methodologies to measure/ estimate its size have been developed and employed; the OECD (2002) emphasizes the indirect monetary methods, global indicator methods, and latent variable methods (i.e., the MIMIC model). In the same line, Elgin and

* Corresponding author.
E-mail address: oafonso@fep.up.pt (O. Afonso).

[1] However, some authors present evidence suggesting that it shows a decreasing trend (e.g., Schneider et al., 2010; Elgin and Schneider, 2016).

https://doi.org/10.1016/j.ecosys.2020.100746
Received 19 January 2019; Received in revised form 5 June 2019; Accepted 24 June 2019
Available online 04 February 2020
0939-3625/

Schneider (2016) and Duarte (2017) stress the MIMIC, currency/cash demand, and consumption of energy as the most commonly used measures to estimate the level of parallel economy.

Schneider (2005), Schneider and Enste (2000, pp. 95–98), Orsi et al. (2012) and Medina and Schneider (2018) provide excellent surveys and a comparison of different ways of estimating the size of the parallel economy. Schneider (2005) classifies parallel economy estimation methods into three categories: direct approaches, indirect approaches, and the application of both approaches in a mixed approach. Employing microeconomic or microeconometric methods, direct approaches generally use surveys, questionnaires, interviews and tax auditing of firms and/or households in the assessment of the parallel economy (e.g., Mogensen et al., 1995; Zukauskas and Schneider, 2016). Difficulties regarding the sample choice, the existence of selection bias, the time dimension, and measurement errors regarding interviews and surveys are among the main disadvantages of these approaches (e.g., Schneider, 2017; Williams and Schneider, 2016). In a more aggregated analysis, indirect estimation methods use inconsistencies between the expenditure, income and product data that are incorporated into national accounting (Breusch, 2005a) to capture the dimension of the parallel economy. Given its clandestine features and its multiple underlying illegal procedures, these methods have been criticized, with a continuous depreciation of such measurements. Therefore, the most popular quantitative methods are the mixed ones, which rely on the application of macroeconomic models – the above-mentioned monetary methods, global indicator methods, and latent variable methods – whose methodology is fed via econometric theory.

Economic growth is a far older and more widely discussed topic, since all countries, regardless of their development level, seek to increase their official Gross Domestic Product (GDP). Economists have long been interested in factors that cause countries to grow at different rates and thereby achieve different levels of wealth. Indeed, some countries have achieved sustained economic growth and high income levels and living standards, while many remain at lower levels. Hence, one of the most important issues challenging the research efforts of economists is finding the reasons for the differences in economic growth. Although neoclassic economic theory has become dominant in economic analysis, economists have been reluctant to adopt this theory in explaining growth differences, as it predicts stable growth independently of policy decisions (e.g., Barro and Sala-i-Martin, 2004). Thus, new models of endogenous economic growth have been developed that allow for policy influence on growth and divergent outcomes among countries. In the endogenous growth literature, R&D activity is essential to the progress of technological knowledge (e.g., Barro and Sala-i-Martin, 2004); it is carried out or supported by firms in search of profit, operating in competitive markets. Empirical evidence of this growth mechanism has been shown, for example, in Griliches and Lichtenberg (1984), Lichtenberg (1993), and Coe and Helpman (1995).

Several papers have estimated the effect of the parallel economy on economic growth, but the results have been quite diverse, regarding both the significance and the sign of the effect (Ergene, 2015). There are some authors who argue that the parallel economy has a positive influence on economic growth (e.g., Nabi and Drine, 2009; Ergene, 2015), others argue that it negatively affects growth (e.g., Davis, 2007; e.g., Quintano and Mazzocchi, 2010; Lisi, 2016), and still others sustain that the relationship is ambiguous (Schneider and Enste, 2000; Bhattacharya, 2011; Imamoglu, 2016), as it can be positive or negative under certain conditions.

The motivation for this paper is based on the ambiguity of the results emphasized in the previous paragraph. Our research questions are basically the following: why are the results of the empirical studies on this topic so different? Is it possible to establish a statistically significant link between the parallel economy and economic growth?

In order to answer these questions, we perform a meta-analysis on the empirical literature that estimates the impact of the parallel economy on economic growth. A meta-analysis is a statistical technique that combines and integrates the results of two or more studies examining the same research question (Stanley, 2001; Martinez, 2007). This technique has the potential to summarize, evaluate and analyze the results of empirical research (Stanley, 2001). It is especially useful when the findings of a specific literature are divergent, as it allows identifying patterns among study results and the sources of disagreement in an objective way (Greenland and O'Rourke, 2008).

Our meta-analysis suggests that there is no publication bias in this literature and that the average effect of the parallel economy on economic growth is statistically non-significant. We also find that the significant heterogeneity in the reported effect sizes is explained by differences in the type and number of countries included in the samples of the primary studies, the structure of the data, the methodology used to measure the parallel economy, the number of citations of the primary studies, and the year in which they were published.

After these introductory remarks, in Section 2 we present a brief review of the literature that examines the relationship between the parallel economy and economic growth. In Section 3, we present and describe the data collected from the studies included in the meta-analysis. Section 4 uses specific techniques of meta-analysis to estimate the average effect of the parallel economy on economic growth and check whether or not publication bias exists in this literature. In Section 5, we estimate a meta-regression with the goal of explaining the heterogeneity of the results reported in the primary studies. In Section 6 we conclude, presenting some final remarks and stressing some thoughts for further research.

2. Literature review

The non-observed (parallel) economy has many definitions. Eilat and Zinnes (2002) refer to it as those value-added activities that the official statistics do not register even though they should. In this work we will adopt the definition used by the OECD (2002), according to which the non-observed economy includes several components: the *underground economy*, the *illegal economy*, the *informal economy*, *self-consumption*, and the *economy unaccounted for by statistics*. The *underground economy* consists of legal activities that are deliberately hidden from the authorities to avoid payment of taxes, social security contributions and the fulfilment of legal regulations and administrative procedures. The *illegal economy* involves the production, sale or possession of prohibited goods/services, and the production of legal goods/services for which the producer is not legally authorized. The *informal economy* includes

the production of goods/services by unregistered small businesses to provide employment and income to families. *Self-consumption* is what households produce for their own use. These types of economic activities are present in day-to-day life, and there are strong indicators that they are considerable.

The main causes for the presence of these activities in the economy are: increase of taxes and social security contributions; increasing labor costs in the economy; market constraints (work schedules, early retirements); market over-regulation; increase in corruption and trade restrictions; quality and quantity of public services (Schneider and Enste, 2000; Eilat and Zinnes, 2002; Schneider et al., 2010; Enste, 2010). Using three different cross-national shadow measures and employing numerous model combinations of possible determinants of the parallel economy, Goel and Nelson (2016) identify business startup and property registration costs, tax code complexity and bureaucracy as robust determinants of the parallel economy. They also find that the incentives of new shadow entrepreneurs are somewhat different from established shadow operators, and that the determinants of the parallel economy vary with a country's level of development.

The five main negative consequences of the parallel economy as presented in the literature are the following (Schneider and Enste, 2000; Eilat and Zinnes, 2002; LaPorta and Shleifer, 2008; Elgin and Birinci, 2016): (i) reduction in state revenues; (ii) increase in tax rates for the official economy, causing revenue decay and increasing the incentives to move to the parallel economy; (iii) reduction of the provision of public goods, which leads to a reduction of potential growth; (iv) the corporate sector of an economy with a high percentage of parallel economy is composed of a large number of small-scale firms that are afraid of achieving an efficient scale and are run by low-skilled workers, which leads to a reduction of economic growth; (v) hidden output that misrepresents statistics and leads to ineffective policy decisions, since these are made based on incomplete information.

Authors such as LaPorta and Shleifer (2008) argue that the parallel economy varies between a third and a half of the official GDP, is greater in underdeveloped countries, and decreases as countries develop. At the same time, it is observed that regardless of the country, governments have centered the control policies on punishment instead of implementing reforms (Schneider and Enste, 2000).

According to Elgin and Birinci (2016), there are two schools of thought regarding the impact of the parallel economy on economic growth. One associates the parallel economy with low economic growth, while the other argues that the parallel economy can be growth-promoting. The first is based on the idea that excessive regulation leads to a high level of informality and consequently to a reduction of economic growth (Sarte, 2000; Loayza et al., 2004). In fact, a large parallel economy reduces the resources of the state, which in turn cannot provide public goods on an efficient scale, leading to a reduction of potential growth. In addition, the fear of detection leads firms to operate on a smaller scale, which makes them inefficient and reduces economic growth (De Soto, 1989). The second school claims that having a large parallel economy can bring benefits to economic growth. The key idea is that informal (or unregistered) firms tend to be less productive (Levy, 2008; LaPorta and Shleifer, 2008), to employ less skilled workers, and to operate with less capital (Amaral and Quintin, 2006). Consequently, they are unable to absorb the cost of operating in the formal sector, making the formal sector's productivity increase.

According to LaPorta and Shleifer (2008), growth comes from highly productive and efficient formal firms. Informal firms keep millions of people alive and pay low wages, but they disappear as countries grow because they are small, employ unskilled workers, are unproductive, operate in local and small markets, and do not have access to financing and public services. The authors discuss several ways to observe the relationship between formal and informal firms, and conclude that the best way to observe such a relationship is the "dual view". The "dual view" argues that formal and informal firms should be viewed as two separate realities, as the informal firms cannot threaten the formal ones and cannot compete with them at the wage level, product placement, or productive capacity. They work only as a means of subsistence for people, who, in any case, acquire human capital (like on-the-job training or academic education) and will eventually move to formal firms. As this change occurs at the macro-economic level, informal firms will disappear.

Regarding the empirical literature estimating the effect of the parallel economy on economic growth, the results are also mixed. For example, Sarte (2000) finds that the informal sector by itself does not hinder economic growth. Nikopour and Habibullah (2011) point to a non-linear relationship – they classify this relationship as following an "S"-shaped cubic function: (i) in the early stages of development, the relationship is positive; (ii) in the later stages of development, it is negative; and (iii) at a certain level of income, there is a new inflection point, and a new upward phase starts.

An important set of studies finds a positive impact of the parallel economy on growth. For instance, Alañón and Gómez-Antonio (2007) identify a positive relationship between GDP, demand for currency, and the parallel economy in Spain. Kim and Kang (2009) estimate the size of the parallel economy in all regions of Russia between 1992 and 1999 and conclude that: (i) the parallel economy is a result of a lack of reforms, low quality of institutions and corruption; (ii) it affects the growth of small firms; and (iii) it promotes the growth of official entrepreneurial activities, replacing inefficient public activities. In the same line, Mapp and Moore (2015) analyze the Caribbean region and point out that the parallel economy has a positive influence on economic growth. Olga et al. (2015) observe a positive correlation between GDP and the labor market in the informal sector. Zaman and Goschin (2015) also claim that the parallel economy can have positive effects, especially in countries dominated by corruption in which the corruption is a possible solution to unemployment, consumption and investment; they tested the connection between the parallel economy and economic growth in Romania between 1999 and 2012, and found a co-integration relationship.

Another set of studies finds that the parallel economy is harmful for economic growth. Ihrig and Moe (2000) conclude that tax policies significantly affect the growth of the informal sector, and that the increase in informal employment has a strong negative impact on real GDP per worker. Schneider and Feld (2010) study the parallel economy and undeclared earnings in OECD countries and find that the parallel economy has a negative effect on economic growth. Giles (2002) analyzes the case of Canada and also identifies a negative relationship between the two variables. Similarly, Lisi (2016) observes that the parallel economy is detrimental

to growth in the long run. Schneider and Hametner (2014) conclude, for Colombia, that the parallel economy has a negative effect on the official economy due to its lower productivity, human capital constraints and restrictions to financial capital.

Some studies also point to an ambiguous effect of the parallel economy on economic growth. Using data for the United States for the period 1870–2014, Goel et al. (2019) find that this ambiguity depends on the interaction of the parallel economy with the formal sector and its impacts on the provision of public goods – while prior to World War II the parallel economy affected growth negatively, it had a positive effect after the war. Schneider and Enste (2000) and Duarte (2017) conclude that the ambiguity in the relationship between the parallel economy and economic growth is explained by differences in the methods used to estimate/measure the parallel economy, which works independently of the official sector (there is thus a "dual view" perspective; LaPorta and Shleifer, 2008).

In fact, there is a wide variety of methods to estimate/measure the size of the parallel economy. They are usually grouped into three categories: direct methods, indirect methods, and mixed methods (e.g., Schneider, 2005; Orsi et al., 2012; Schneider, 2012; Medina and Schneider, 2018). Direct methods are extremely costly since they tend to use surveys, questionnaires, interviews and tax auditing of firms and/or households in the assessment of the parallel economy. Indirect (estimation) methods resort to econometric techniques, the most common being the monetary (currency/cash demand) method and the MIMIC.[2] The former establishes relationships between the official Gross Domestic Product (GDP) and monetary variables and assumes that changes in monetary variables that are not explained by the models are explained by the parallel economy. It covers three approaches: transaction, cash/deposit ratio and cash demand (e.g., Tanzi, 1980, 1983; Breusch, 2005b; Ahumada et al., 2007, 2009). Cash demand, for example, assumes that money demand is partly used to perform transactions that economic agents wish to keep hidden from official records (Ahumada et al., 2009).[3] The monetary methods neglect all determinants of the parallel economy. The MIMIC is a member of the linear structural relationships interdependent family and, by understanding the dimension of the unobserved parallel economy as a "latent variable", applies structural equation modeling (Dell'Anno, 2007). It is divided into two parts/equations: measurement and structural. The measurement part relates the unobserved variables to the indicators (which are observable). The structural equation specifies the relationship between the unobservable variables and their causes.

Given the differences in the assumptions and structure of all these methods, it is possible that different methods lead to different estimates of the effect of the parallel economy on growth, which can in part explain the ambiguity of the effects reported in the literature (Duarte, 2017). For example, the cash/currency demand approach is more likely to capture the dimension of illegal activities than the MIMIC method. In turn, the MIMIC often uses GDP as an indicator of the parallel economy, which can potentially introduce some bias into estimates of the relationship between the parallel economy and growth.

To sum up, the results of the empirical literature that estimates the effect of the parallel economy on economic growth are far from consensual. They differ significantly regarding the sign and significance of the effect, as well as the way the parallel economy is measured. The meta-analysis performed in the following sections may help to explain this heterogeneity in reported findings.

3. Selection of studies to be included in the meta-analysis

Meta-analysis is a method for a quantitative literary review in which specific statistical techniques are employed in order to combine the results of different studies investigating the same topic (Neves et al., 2016; Harmon et al., 2003). This technique is particularly useful in summarizing and explaining variations in the results of different studies (Stanley and Jarrel, 1989), especially on topics where the results are not consensual. In comparison with traditional literature reviews, meta-analysis has the advantage of summing the results up in a more objective way, thereby reducing the risk of misinterpretation and biased conclusions (Shadish, 1982). Although it was first employed in areas such as medicine and psychology, the use of meta-analysis has spread to other research fields, including economics and other social sciences.

The first step in conducting a meta-analysis is to select the studies that will be analyzed. We are interested in papers that estimate the impact of the parallel economy on economic growth. Thus, we started by searching on the "Web of Science" and "Scopus" for studies (published articles, working papers and conference papers) that contain the keywords *economic growth*, *Innovation*, *R&D*, *shadow economy*, *non-observed economy*, *underground economy*, *informal economy*, *illegal economy*, and *hidden economy*.[4]

[2] Frey and Weck-Hannemann (1984) point to the existence of four usual approaches for measuring the hidden/parallel economy's size, which consider just one indicator capturing its effects: (i) tax evasion in terms of GNP; (ii) discrepancy between national expenditure and income statistics; (iii) discrepancy between official and actual labor force; (iv) monetary (currency/cash demand) approach. They state that the general neglect of all causes of the parallel economy gives political decision-makers few hints about how to affect the parallel economy, thus considering multiple causes and indicators of the phenomenon. Medina and Schneider (2018) include in the direct approaches: (i) measurement by the system of National Accounts Statistics – discrepancy method; (ii) survey technique approach; (iii) the use of surveys of company managers; and (iv) the estimation of the consumption-income-gap of households. In turn, they consider as indirect approaches: the discrepancy between national expenditure and income statistics; the discrepancy between the official and actual labor force; the "electricity consumption" approach; the "monetary transaction" approach; and the "currency demand" approach.

[3] In most cases, the theoretical basis that supports the empirical component of the monetary method follows Tanzi (1983), but it can also be based on Ahumada et al. (2007, 2009) and Bajada (1999), capturing the heterogeneity existing among methodologies.

[4] We note that other keywords related to the labor market or to economic development were not considered in the search process, since our focus is on the effects of the parallel economy on economic growth, rather than other economic dimensions. Thus, we used the keywords *economic growth*, *Innovation* and *R&D*, which are the most important variables in the economic growth literature. In addition, we included the keywords *shadow economy, non-observed economy, underground economy, informal economy, illegal economy* and *hidden economy* in the search process, since these are terms commonly used in scientific empirical papers to refer to some dimensions of the parallel economy.

Table 1
The search protocol.

	Economic growth		Innovation		R&D	
	Web of Science	Scopus	Web of Science	Scopus	Web of Science	Scopus
Shadow economy	37	51	15	9	1	0
Non-observed economy	3	6	0	1	1	1
Underground economy	15	35	4	3	2	1
Informal economy	60	70	46	10	2	1
Illegal economy	2	1	0	0	0	0
Hidden economy	3	6	3	1	0	0
Total	120	169	68	24	6	3

Our research results are summarized in Table 1. We obtained 390 papers. Despite limiting our field of study to "Economics" and "Economics, Econometrics, and Finance", there were many repetitions of studies. In addition, many papers did not contain empirical data, and others were out of the scope of our topic. Since this left us with relatively few studies, we searched further on "Google Scholar" and in the references cited in the selected papers, which led to a total of 53 studies, listed in Table 2.

From these 53 studies, we selected only those that report at least one linear estimate of the impact of the parallel economy on economic growth. Thus, studies that estimate the relationship between the two variables in the inverse causality nexus or those that simply estimate a non-linear relationship were excluded. We also excluded those articles that do not report all the necessary empirical information to perform the meta-analysis.[5]

We were left with a final set of 15 primary studies, from which we collected 133 estimates of the effect size – the estimated effect of the parallel economy on economic growth. Table 3 summarizes the main features of these 15 studies. We note that the effect size is not exactly the coefficient taken directly from each study, but rather its partial correlation coefficient, *r*. This is a necessary adjustment, because studies use different measures for the parallel economy and thus the regression coefficients are not directly comparable. The partial correlation coefficient makes the effect sizes independent of the metrics used in the primary studies. It is equal to:

$$r_i = t_i / \sqrt{t_i^2 + df_i} \tag{1}$$

and its standard deviation is given by:

$$se_{ri} = \sqrt{(1 - r_i^2)/df_i} \tag{2}$$

where t_i and df_i are the *t*-statistic and the degrees of freedom associated with the estimates of the effect of the parallel economy on economic growth reported in the primary studies (Ugur, 2014).

4. Testing for the presence of publication bias and estimating the average effect of the parallel economy on economic growth

In this section, we estimate the average effect of the parallel economy on economic growth and check if there is publication bias in this empirical literature.

Publication bias refers to distortions in the process of reporting empirical results that occur for several reasons (Sutton et al., 2000; Stanley et al., 2005). This problem has long been recognized as a threat to empirical research, as it usually prevents obtaining reliable estimates of effect sizes and consequently may lead to incorrect scientific conclusions and poor policy decisions (Alinaghi and Reed, 2017; Doucouliagos, 2005; Stanley et al., 2005).

Several types of publication bias have been identified (Stanley et al., 2005): Authors can only submit research with statistically significant results; authors can report only conclusions consistent with their expectations, previous beliefs and ideological positions; journals can publish solely, or give preference to, studies with statistically significant results; or a journal may have a preference for publishing findings that are consistent with the expectations and the previous judgments of editors and reviewers.

We also stress the work of Goldfarb (1995), later developed further by Stanley et al. (2008), who claims that there is a "cycle of economic research" that translates into a predictable pattern in economic research motivated by fashion and novelty. Initially, researchers tend to report evidence that confirms a recently advanced hypothesis, producing a large amount of significant estimates, but as time passes, the confirmations accumulate and the informational content they offer grows increasingly smaller. Reviewers and editors will tend not to publish additional confirmations unless they offer something interesting or surprising. Over time, the refutations tend to become more interesting and to dominate the literature, thus becoming more likely to be published.

The presence of publication bias has been widely tested in meta-analyses. The "funnel plot" is probably the most popular graphic technique to detect it (Doucouliagos, 2005; Stanley et al., 2005). The name comes from the shape it takes when there is no bias, an

[5] Studies that estimate a co-integration relationship were excluded because most of them did not report the estimates of the standard errors/t-statistics, or did not find significant Granger causality from the parallel economy to economic growth.

Table 2
Studies before operationalization.

Author(s) Year	Journal	Title
Alañón and Gómez-Antonio, 2007	Applied Economics	Estimating the size of the shadow economy in Spain: A structural model with latent variables
Asfuroglu and Elgin, 2016	Bulletin of Economic Research	Growth effects of inflation under the presence of informality
Bhattacharya, 2011	Economic Modelling	Informal sector, income inequality and economic development
Birinci, 2013	Economics Bulletin	Trade openness, growth, and informality: Panel VAR evidence from OECD economies
Bologna, 2017	The Annals of Regional Science	Contagious corruption, informal employment, and income: evidence from Brazilian municipalities
Buehn, 2011	German Economic Review	The shadow economy in German regions: An empirical assessment
Buehn and Schneider (2012)	International Tax Public Finance	Shadow economies around the World: Novel insights, accepted knowledge, and new estimates
Chong and Gradstein, 2007	Journal Of Public Economics	Inequality and informality
D´Hernoncourt and Méon, 2011	Journal of Economic Behavior & Organization	The not so dark side of trust: Does trust increase the size of the shadow economy?
Davis, 2007	De Gruyter	Explaining the evidence on inequality and growth: Marginalization and redistribution
Dell'Anno and Schneider (2005)	Journal of Public Finance and Public Choice	The shadow economy of Italy and other OECD countries: What do we know?
Duarte, 2017	Empirical Economics	The relationship between GDP and the size of the informal economy: Empirical evidence for Spain
Eilat and Zinnes, 2002	World Development	The shadow economy in transition countries: Friend or foe? A policy perspective
Elgin and Birinci, 2016	Journal of Applied Economics	Growth and informality: A comprehensive panel data analysis
Elgin and Oztunali, 2013	Working Papers, Bogazici University, Department of Economics	Institutions, informal economy and economic development
Elgin and Schneider, 2016	Bogazici Journal: Review of Social, Economic & Administrative Studies	Shadow economies in OECD countries: DGE vs. MIMIC approaches
Enste, 2010	Constitutional Political Economy	Regulation and shadow economy: Empirical evidence for 25 OECD-countries
Ergene, 2015	Economics Bulletin	Growth, inflation, interest rate and informality: Panel VAR evidence from OECD economies
Friedman et al., 2000	Journal of Public Economics	Dodging the grabbing hand: The determinants of unofficial activity in 69 countries
Giles (1997)	Applied Economics Letters	Causality between the measured and underground economies in New Zealand
Giles (2002)	Applied Economics	The Canadian underground and measured economies: Granger causality results
Gillman and Cziráky, 2004	Working Paper Global Development Network Southeast Europe	Inflation and endogenous growth in underground economies
Goel and Saunoris, 2016	Public Finance Review	Casting a long shadow? Cross-border spillovers of shadow economy across American states
Ihrig and Moe, 2000	De Economist	The influence of government policies on informal labor: Implications for long-run growth
Imamoglu, 2016	International Journal of Economic Perspectives	Re-estimation of the size of underground economy in European countries: MIMIC approach
Johnson et al., 1997	Brookings Papers on Economic Activity	The unofficial economy in transition
Johnson et al., 1998	The American Economic Review	Regulatory discretion and the unofficial economy
Joshi et al., 2014	The Journal of Development Studies	Taxing the informal economy: The current state of knowledge and agendas for future research
Kim and Kang, 2009	Economics of Transition	The informal economy and the growth of small enterprises in Russia
Kim and Kim, 2016	Seoul Journal of Economics	The evolution of the informal economy in North Korea
LaPorta and Shleifer, 2008	Brookings Papers on Economic Activity	The unofficial economy and economic development
Lisi, 2016	International Review of Economics	Unemployment, underground economy and economic growth in a matching model of behavioural economics
Lisi and Pugno, 2015	International Journal of Economic Theory	A matching model of endogenous growth and underground firms
Loayza, 2016	World Bank	Informality in the process of development and growth
Loayza, 1996	Carnegie-Rochester Conference Series on Public Policy	The economics of the informal sector: A simple model and some empirical evidence from Latin America
Mapp and Moore, 2015	Macroeconomics and Finance in Emerging Market Economies	The informal economy and economic volatility
Nabi and Drine, 2009	Economics Bulletin	External debt, informal economy and growth
Nikopour and Habibullah, 2011	Actual Problems of Economics	Shadow economy in different stages of development
Olga et al., 2015	2nd Global Conference on Business, Economics, Management and Tourism	Assessment of influence of the labor shadow sector on the economic growth of the Russian economy with the using methods of statistical modeling
Pathak et al., 2015	International Journal of Emerging Markets	Informal institutions and technology use by entrepreneurs
Pickhardt and Pons, 2010	Applied Economics	Size and scope of the underground economy in Germany

(*continued on next page*)

Table 2 (*continued*)

Author(s) Year	Journal	Title
Quintano and Mazzocchi, 2010	International Economic Journal	Some alternative estimates of underground economies in 12 new EU member states
Sarte, 2000	Journal of Monetary Economics	Informality and rent-seeking bureaucracies in a model of long-run growth
Schneider and Dreher, 2010	Public Choice	Corruption and the shadow economy: An empirical analysis
Schneider and Hametner, 2014	De Gruyter	The shadow economy in Colombia: Size and effects on economic growth
Schneider and Buehn, 2012	International Tax Public Finance	Corruption and the shadow economy: Like oil and vinegar, like water and fire?
Schneider et al., 2010	International Economic Journal	New estimates for the shadow economies all over the world
Schneider and Enste, 2000	Journal of Economic Literature	Shadow economies: Size, causes, and consequences
Schneider and Feld, 2010	German Economic Review	Survey on the shadow economy and undeclared earnings in OECD countries
Schneider and Klinglmair, 2004	Discussion Paper, Center for Research in Economics, Management and the Arts	Shadow economies around the world: What do we know?
Torgler and Schneider, 2007	Discussion Paper, Center for Economic Studies & Ifo Institute for Economic Research	Shadow economy, tax morale, governance and institutional quality: A panel analysis
Trebicka, 2014	Academic Journal of Interdisciolinary Studies	Mimic model: A tool to estimate the shadow economy
Zaman and Goschin, 2015	Procedia Economics and Finance	Shadow economy and economic growth in Romania. Cons and pros

inverted funnel. On the horizontal axis, the plot displays estimates of the effect size and on the vertical axis it displays estimates of precision, given by the inverse of the standard errors observed in primary studies (Sutton et al., 2000). If there is no publication bias, estimates will vary randomly and symmetrically around the average effect size, with a higher dispersion in the bottom part of the plot; hence, the inverted funnel shape. But if there is publication bias in a given direction, studies with smaller samples and thus larger sampling errors tend to report estimates with a higher magnitude in order to find statistically significant results. In this case, the funnel will be asymmetrical toward that direction (Stanley, 2005).

Fig. 1 displays the funnel plot for the 133 observations of our meta-dataset.

Apparently, there is no publication bias. However, we can validate this visual result with a simple test, running a regression of the effect sizes on the respective standard errors:

$$r_i = \alpha_0 + \alpha_1 se_{ri} + \mu_i \tag{3}$$

where r_i is the partial correlation of each observation of the primary studies (calculated as in (1)), and se_{ri} is the respective standard error (calculated as in (2)). If there is a publication bias, r will depend on se; if there is no publication bias, the estimates of r will vary randomly around the average effect, α_0, regardless of the value of se. Therefore, a simple t-test for $\alpha_1 = 0$ is a test for the presence of publication bias (funnel asymmetry test, FAT), while a simple t-test for $\alpha_0 = 0$ is a test for the presence of a significant average effect beyond publication bias (precision effect test, PET). Regression (3) can thus be used to simultaneously test for the presence of publication bias and for a significant average effect, hence its name of PET-FAT regression (Egger et al., 1997; Stanley, 2005).

However, the estimation of the PET-FAT regression has two main econometric problems. The first problem is that the disturbances, μ_i, are heteroscedastic, as each reported effect size has its own standard error. This problem can be solved by dividing both sides of Eq. (3) by the standard errors (Stanley, 2005), which results in:

$$t_i = \alpha_0 precision_i + \alpha_1 + e_i \tag{4}$$

where $t_i = r_i/se_{ri}$ is the usual t-statistic taken from the primary studies, and $precision_i = 1/se_{ri}$. Since the coefficients are now reversed, the FAT is now a test for the constant, α_1, while the PET is a test on the slope, α_0.

The second problem is the existence of statistical dependence. When we have several observations from the same study, these share the same database, specifications and estimation procedures, and are thus likely to be correlated (Hunter and Schmidt, 1990; Nelson and Kennedy, 2009). In this case, OLS leads to biased estimates of coefficients α_0 and α_1. This problem could be easily solved by choosing only one observation from each study. This solution would, however, lead to a reduction in the meta-sample, which is not desirable, especially when the number of studies in the sample is limited. Alternatively, hierarchical models, panel data estimators, cluster data analysis, and bootstrapped standard deviations can be employed to deal with the problem of statistical dependence (Nelson and Kennedy, 2009; Doucouliagos and Laroche, 2009; Neves and Sequeira, 2018). We address this problem by estimating (4) using OLS with clustered standard errors and hierarchical models. The former technique allows correcting the standard errors for within-study correlation, as it assumes that observations are clustered by study (each study represents a cluster); hierarchical models, in their turn, allow not only correcting the standard errors for within-study correlation, but also estimating the regression coefficients considering the presence of heterogeneity between studies.

In hierarchical models, observations are nested into groups that have different characteristics. Thus, differences in observations can be attributed to both within-group variation and between-group variation, and the model's coefficients are allowed to vary randomly between groups. As explained in Ugur et al. (2016) and Neves and Sequeira (2018), a hierarchical linear univariate model can be generally written as:

$$Y_{i,j} = (\beta_0 + \gamma_{0,j}) + (\beta_1 + \gamma_{1,j}) X_{i,j} + \varepsilon_{i,j} \tag{5}$$

Table 3
Summary of the studies' main characteristics.

Study	Nr. of estimates	Mean of coefficients' estimates	Sample of countries	Data structure	PE Estimation Method
Loayza (1996)	5	−0.71	Developing countries	Cross section	MIMIC
Johnson et al. (1997)	5	−0.60	Developing countries	Panel; Cross section	Total electricity consumption
Ihrig and Moe (2000)	2	−0.32	Developed countries	Cross section	Constructed from the International Labor Statistics Yearbook
Giles (2002)	5	−0.14	Developed countries	Panel	MIMIC
Schneider and Klinglmair (2004)	3	0.07	Both	Panel	Total electricity consumption; Currency demand; DYMIMIC
Alañon and Gómez-Antonio (2007)	1	0.54	Developed countries	Panel	MIMIC
LaPorta and Shleifer (2008)	16	−0.04	Developing countries	Cross section	Estimate by the authors using seven different sources
Pickhardt and Pons (2010)	1	0.10	Developed countries	Cross section	Currency demand; MIMIC
Schneider and Feld (2010)	1	−0.23	Developed countries	Panel	MIMIC
Schneider et al. (2010)	7	0.32	Both	Panel	MIMIC
Buehn (2011)	15	0.06	Developed countries	Cross Section	MIMIC
Buehn and Schneider (2012)	6	0.34	Both	Panel	MIMIC
Schneider and Hametner (2014)	2	−0.37	Developing countries	Panel	Currency demand
Asfuroglu and Elgin (2016)	28	0.03	Both	Panel	Two-sector dynamic general equilibrium model (Elgin and Oztunali, 2013)
Bologna (2017)	36	−0.10	Developed countries	Cross section	Census, 2000

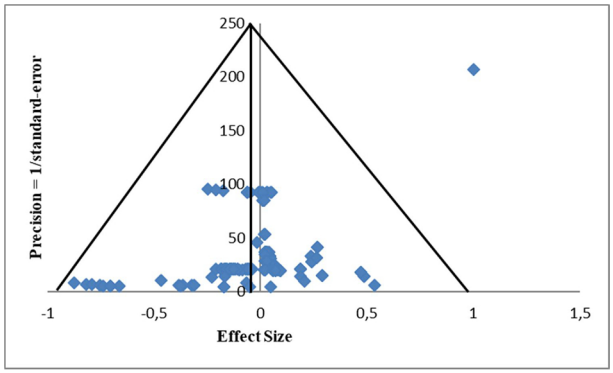

Fig. 1. Funnel plot for the 133 observations of our meta-dataset.

where subscript i refers to observations and subscript j refers to groups; β_0 and β_1 are the fixed effects intercept and slope, respectively; $\gamma_{0,j}$ and $\gamma_{1,j}$ are the group-specific intercept and slope, respectively, which follow a normal distribution. The hierarchical specification can be applied in meta-analysis: the observations (estimates of the effect size) are nested into groups (studies) with difference characteristics (random variation). Within-group variation represents the differences in estimates drawn from the same study, while between-group variation represents differences across studies. Some examples of meta-analysis in economics in which hierarchical models have been employed are Bateman and Jones (2003); Johnston et al. (2005) and Ugur et al. (2016).

Although both hierarchical models and OLS with clustered standard errors are appropriate techniques to deal with the problem of within-study correlation, they may lead to different results regarding coefficient estimates and statistical significance. First, while OLS assumes fixed coefficients, hierarchical models allow for coefficient heterogeneity across studies. Second, while OLS produces optimum estimates only for balanced datasets, hierarchical models, which typically use maximum likelihood estimation techniques, yield asymptotically efficient estimates even for unbalanced data (Garson, 2012, pp. 6).

Table 4 presents the results of the estimation of Eq. (4). The results in the top part of the table show that we do not reject $\alpha_1 = 0$, confirming that there is no evidence of publication bias in the empirical literature that estimates the effect of the parallel economy on economic growth, as was previously suggested by visual inspection of the funnel plot. The coefficient associated with *precision* is positive but very small (0.046; 0.025); it is not statistically different from zero, meaning that the average effect of the parallel economy on economic growth is statistically meaningless. However, this does not necessarily imply that the parallel economy has no effect on growth at all. Given the abovementioned heterogeneity in studies' findings, it is possible that the parallel economy exerts a positive effect on growth in some specific circumstances, and a negative effect in other circumstances. We will discuss this in more detail in Section 5.

In the middle part of Table 4 we report the estimates of the variances of the random slopes from the hierarchical models. While the variance of the constant, α_1, is practically zero, the variance of the slope associated with precision, α_0, is significant, which confirms that the underlying effect of the parallel economy on economic growth varies across studies.

5. Multivariate meta-regression

In this section we estimate a multivariate meta-regression in order to explain the heterogeneity in the reported effect sizes. We examine if and how differences in the methodological characteristics of the primary studies influence estimates of the effect of the parallel economy on economic growth.

Table 4
Estimation of Eq. (4).

Coefficients for:	Hierarchical models	OLS Clustered
Precision	0.046 (0.138)	0.265 (0.285)
Constant	−0.325 (1.066)	−7.601 (7.072)
RE Variances		
Var(Precision)	0.132	–
	[0.023; 0.747]	–
Var(Constant)	0.000	–
	[0.000; 0.000]	–
Var(residuals)	11.578	–
	[2.436; 55.024]	–
N. obs. (N. Studies)	133 (15)	133 (15)
Log likelihood	−374.271	–

Notes: The dependent variable is *t*; the standard errors for coefficient estimators are in parentheses; 95% confidence intervals for random effect variances are in square brackets; Significance levels: *** P-value < 0.01, ** P-value < 0.05, * P-value < 0.1.

Table 5
Moderating variables included in the multivariate meta-regression.

Variable	Type	Description	Mean	SD
Quality of journal	Dummy	1, if the study is published in a journal of the first quartile of the Impact Factor ranking; 0, otherwise.	0.16	0.37
MIMIC	Dummy	1, if MIMIC is used to measure the parallel economy; 0, otherwise.	0.33	0.47
Data structure	Dummy	1, if the study uses panel data; 0, otherwise.	0.41	0.49
IV Method	Dummy	1, if instrumental variables estimation techniques are employed; 0, otherwise.	0.13	0.34
Type of countries	Dummy	1, if the sample includes only developed countries; 0, otherwise.	0.49	0.50
Number of countries	Count	Number of countries used in the estimation.	48.25	64.99
Number of citations	Count	Number of citations that the study has.	207.65	343.78
Number of observations	Count	Number of observations used in the estimation.	128326	269406
Year of publication	Count	Publication year of the study (1996 = year 1).	16.56	6.18

As Table 3 shows, the studies included in the meta-analysis differ considerably regarding the structure of the data they use, the type of countries included in the sample, and the method employed to measure the size of the parallel economy. We thus consider dummies reflecting these differences as moderating variables in the multivariate meta-regression. In addition, we also consider the number of countries, the number of observations, the estimation technique, the year of publication, the quality of the journal in which the study is published, and the number of citations that the paper has. Table 5 presents and describes all the moderating variables included in the meta-regression.

For the estimation of multivariate meta-regression, we also use OLS with clustered standard errors and hierarchical models. Table 6 presents the estimation results.

In both estimations, the variables "Number of countries", "Number of observations", "Number of citations", and "Year of publication" are statistically significant with a negative coefficient. This means that the reported effects of the parallel economy on growth tend to be lower in studies with larger samples and in studies that are highly cited, as well as in more recent papers.

There is also some evidence that studies using the MIMIC methodology to measure the size of the parallel economy tend to report a higher impact of the parallel economy on economic growth than studies using other methodologies. Although the variable "MIMIC" is not statistically significant in the clustered OLS estimation, it is highly significant in the hierarchical estimation. The same happens with the variable "Type of countries", which indicates that the effect of the parallel economy on economic growth tends to be less pernicious to growth in developed countries. On the contrary, the variable "Data structure" is not significant in the hierarchical estimation but highly significant in the clustered OLS estimation; the positive sign of its coefficient indicates that studies using panel data tend to report higher effect sizes than studies using cross-section data.

As for the variables "IV Method" and "Quality of journal", they are not statistically significant at the 5% level in any of the regressions, meaning that estimation techniques and the quality of the journal in which the primary study is published are not relevant in explaining differences in the reported effect sizes.

Thus, we can point out as sources of the heterogeneity in the reported effects of the parallel economy on economic growth: the size of the sample of the primary studies; the structure of the data; the countries' development level; the method used to estimate the size of the parallel economy; the number of citations that the study has; and the year in which it was published.

Table 6
Estimation of the multivariate meta-regression.

Coefficients for:	Hierarchical models	OLS clustered
Precision	0.359*** (0.135)	2.788*** (0.504)
Quality of journal	0.156 (0.180)	−0.553* (0.267)
MIMIC	0.460*** (0.128)	−0.213 (0.183)
Data structure	0.169 (0.150)	0.557*** (0.164)
IV Method	0.003 (0.041)	0.033 (0.059)
Number of countries	−0.002** (0.001)	−0.005*** (0.001)
Type of countries	0.254*** (0.043)	0.024 (0.163)
Number of citations	−0.001** (0.000)	−0.001*** (0.000)
Number of observations	−0.000** (0.000)	−0.000*** (0.000)
Year of publication	−0.361* (0.191)	−0.099*** (0.018)
Constant	−3.673*** (1.409)	−14.830*** (2.183)
RE Variances		
Var (Precision)	0.000	–
	[0.000; 0.000]	–
Var (Constant)	15.652	–
	[1.488; 164.571]	–
Var (residuals)	11.562	–
	[2.202; 60.692]	–
N. obs. (N. Studies)	133 (15)	133 (15)
Log likelihood	−367.130	–

Notes: The dependent variable is t; all moderating variables are divided by se_{ri}; standard errors for coefficient estimators are in parentheses; 95% confidence intervals for random effect variances are in square brackets; Significance levels: *** P-value < 0.01, ** P-value < 0.05, * P-value < 0.1.

6. Conclusions

In this paper we performed a meta-analysis on the literature estimating the effect of the parallel economy on economic growth. After briefly reviewing this literature, we found that there is no evidence of publication bias and that the average effect is not significantly different from zero. However, this does not necessarily imply that the parallel economy has no effect on growth at all. In fact, there is considerable heterogeneity in the effect sizes reported by the primary studies, with some of them showing a positive impact of the parallel economy on growth, others a negative impact, and still others finding an ambiguous relationship.

We examined the sources of this heterogeneity by means of a multivariate meta-regression. The results suggest that the reported effect of the parallel economy on growth tends to be lower in studies with larger samples, in highly cited studies, and in articles published more recently. We also found some evidence that the parallel economy tends to be less pernicious to growth in developed countries, and that its effect is greater when panel data are used and when the MIMIC methodology is employed. This lends some support to the idea that the effects of the parallel economy on growth depend on how the former is measured and on the countries' development level.

Our findings highlight the complex nature of the relationship between the parallel economy and growth and call for a deeper analysis of the mechanisms through which the two variables interact. They also show that policymakers in this field should take into consideration that there is no single, universal pattern that defines how the parallel economy influences economic growth. Instead, there are specific effects that differ from country to country and that vary with the dimensions of the parallel economy that are considered, and these specificities should not be ignored in the process of political and economic decision-making.

Acknowledgement

This paper was financed by national funds of the FCT – the Portuguese Foundation for Science and Technology within the project UID/ECO/04007/2019.

References

Ahumada, H., Alvaredo, F., Canavese, A., 2007. The monetary method and the size of the shadow economy: a critical assessment. Rev. Income Wealth 53 (2), 363–371.
Ahumada, H., Alvaredo, F., Canavese, A., 2009. The monetary method to measure the size of the shadow economy. A critical examination of its use. Revue Économique 60, 069–1078.
Alañón, A., Gómez-Antonio, M., 2007. Estimating the size of the shadow economy in Spain: a structural model with latent variables. Appl. Econ. 37 (9), 1011–1025.
Alinaghi, N., Reed, R., 2017. Meta-analysis and publication bias: how well does the fat-pet-peese procedure work? Working Papers in Public Finances (Working Paper No. 14/2017). Victoria Business School.
Amaral, P., Quintin, E., 2006. A competitive model of the informal sector. J. Monet. Econ. 53, 1541–1553.
Asfuroglu, D., Elgin, C., 2016. Growth effects of inflation under the presence of informality. Bull. Econ. Res. 68 (4), 311–328.
Bajada, C., 1999. Estimates of the underground economy in Australia. Econ. Rec. 75 (4), 369–384.
Barro, R., Sala-i-Martin, X., 2004. Economic Growth, 2nd edt. MIT Press, Cambridge, Massachusetts.
Bateman, L.J., Jones, A.P., 2003. Contrasting conventional with multi-level modelling approaches to meta-analysis: expectation consistency in UK woodland recreation values. Land Econ. 79, 235–258.
Bhattacharya, P., 2011. Informal sector, income inequality and economic development. Econ. Model. 28 (3), 820–830.
Birinci, S., 2013. Trade openness, growth, and informality: panel VAR evidence from OECD economies. Econ. Bull. 33 (1), 694–705.
Bologna, J., 2017. Contagious corruption, informal employment, and income: evidence from Brazilian municipalites. Ann. Reg. Sci. 58 (1), 67–118.
Breusch, T., 2005a. Estimating the underground economy using MIMIC models. Working Paper No. 0507003. Faculty of Economics and Commerce, The Australian National University, Canberra.
Breusch, T., 2005b. Australia's cash economy: are the estimates credible? Econ. Rec. 81 (255), 394–403.
Buehn, A., 2011. The shadow economy in German regions: an empirical assessment. Ger. Econ. Rev. 13 (3), 275–290.
Buehn, A., Schneider, F., 2012. Shadow economies around the World: novel insights, accepted knowledge, and new estimates. Int. Tax Public Financ. 19 (1), 139–171.
Chong, A., Gradstein, M., 2007. Inequality and informality. J. Public Econ. 91 (1–2), 159–179.
Coe, D.T., Helpman, E., 1995. International R&D spillovers. Eur. Econ. Rev. 39 (5), 859–897.
D´Hernoncourt, J., Méon, P., 2011. The not so dark side of trust: does trust increase the size of the shadow economy? J. Econ. Behav. Organ. 81, 97–121.
Davis, L., 2007. Explaining the evidence on inequality and growth: marginalization and redistribution. De Gruyter 7 (1) Article 7.
De Soto, H., 1989. The Other Path: the Invisible Revolution in the Third World. Harper Row, New York.
Dell'Anno, R., 2007. The shadow economy in Portugal: an analysis with the MIMIC approach. J. Appl. Econ. 10 (2), 253–277.
Dell'Anno, R., Schneider, F., 2005. The shadow economy of Italy and other OECD countries: what do we know? J. Public Financ. Public Choice 21 (2–3), 97–120.
Doucouliagos, C., 2005. Publication Bias in the economic freedom and economic growth literature. J. Econ. Surv. 19 (3), 367–387.
Doucouliagos, C., Laroche, P., 2009. Unions and profits: a meta-regression analysis. Ind. Relat. 48 (1), 146–184.
Duarte, P., 2017. The relationship between GDP and the size of the informal economy: empirical evidence for Spain. Empir. Econ. 4 (2017), 1409–1421.
Egger, M., Smith, G., Schneider, M., Minder, C., 1997. Bias in meta-analysis detected by a simple graphical test. Br. Med. J. 316, 629–634.
Eilat, Y., Zinnes, C., 2002. The shadow economy in transition countries: friend or foe? A policy perspective. World Dev. 30 (7), 1233–1254.
Elgin, C., Birinci, S., 2016. Growth and informality: a comprehensive panel data analysis. J. Appl. Econ. 19 (2), 271–292.
Elgin, C., Oztunali, O., 2013. Institutions, informal economy and economic development. Working Papers. Bogazici University, Department of Economics.
Elgin, C., Schneider, F., 2016. Shadow economies in OECD countries: DGE vs. MIMIC approaches. Bogazici J.: Rev. Soc. Econ. Administrative Stud. 30 (1), 1–32.
Enste, D., 2010. Regulation and shadow economy: empirical evidence for 25 OECD-countries. Const. Political Econ. 21 (3), 231–248.
Ergene, S., 2015. Growth, inflation, interest rate and informality: panel VAR evidence from OECD economies. Econ. Bull. 35 (1), 750–763.
Frey, B.S., Weck-Hannemann, H., 1984. The hidden economy as an' unobserved' variable. Eur. Econ. Rev. 26 (1–2), 33–53.
Friedman, E., Johnson, S., Kaufmann, D., Zoido-Lobatón, P., 2000. Dodging the grabbing hand: the determinants of unofficial activity in 69 countries. J. Public Econ. 76 (4), 459–493.
Garson, G.D., 2012. Hierarchical Linear Modeling: Guide and Applications. Sage Publications, Inc.
Giles, D., 1997. Causality between the measured and underground economies in New Zealand. Appl. Econ. Lett. 4 (1), 63–67.
Giles, D., 2002. The Canadian underground and measured economies: granger causality results. Appl. Econ. 34 (18), 2347–2352.
Giles, D.E.A., Tedds, L.M., 2002. Taxes and the Canadian underground economy. Canadian Tax Paper No. 106. Canadian Tax Foundation., Toronto, Canada.
Gillman, M., Cziráky, D., 2004. Inflation and endogenous growth in underground economies. Working Paper. Global Development Network Southeast Europe.
Goel, R.K., Nelson, M.A., 2016. Shining a light on the shadows: identifying robust determinants of the shadow economy. Econ. Model. 58, 351–364.
Goel, R., Saunoris, J., 2016. Casting a long shadow? Cross-border spillovers of shadow economy across American States. Public Financ. Rev. 44 (5), 610–634.
Goel, R.K., Saunoris, J.W., Schneider, F., 2019. Growth in the shadows: effect of the shadow economy on U.S. economic growth over more than a century. Contemp.

Econ. Policy 37 (1), 50–67.
Goldfarb, R., 1995. The Economist-as-Audience needs a methodology of plausible inference. J. Econ. Methodol. 2, 201–222.
Greenland, S., O'Rourke, K., 2008. In: Rothman, K., Greenland, S., Lash, T. (Eds.), Modern Epidemiology. Lippincott Williams Meta-analysis, Philadelphia, pp. 652–682.
Griliches, Z., Lichtenberg, F., 1984. R&D and productivity growth at the industrial level: is there still a relationship? In: Griliches, Zvi (Ed.), R&D, Patents and Productivity. University of Chicago Press, Chicago, pp. 465–496.
Harmon, C., Oosterbeek, H., Walker, I., 2003. The returns to education: microeconomics. J. Econ. Surv. 17 (2), 115–155.
Hunter, J., Schmidt, F., 1990. Methods of Meta-Analysis: Correcting Error and Bias in Research Findings. Sage Publications, Newbury Park.
Ihrig, J., Moe, K., 2000. The influence of government policies on informal labor: implications for long-run growth. De Economist 148 (3), 331–343.
Imamoglu, H., 2016. Re-estimation of the size of underground economy in european countries: MIMIC approach. Int. J. Econ. Perspect. 10 (1), 171–193.
Johnson, S., Kaufmann, D., Schleifer, A., Goldman, M., Weitzman, M., 1997. The unofficial economy in Transition. Brookings Pap. Econ. Act. 1997 (2), 159–239.
Johnson, S., Kaufmann, D., Zoido-Lobatón, P., 1998. Regulatory discretion and the unofficial economy. Am. Econ. Rev. 88 (2), 387–392.
Johnston, R.J., Besedin, E.Y., Iovanna, R., Miller, C.J., Wardwell, R.F., Ranson, M.H., 2005. Systematic variation in willingness to pay for aquatic resource improvements and implications for benefit transfer: a meta-analysis. Can. J. Agric. Econ. 53, 221–248.
Joshi, A., Prichard, W., Heady, C., 2014. Taxing the Informal Economy: the current state of knowledge and agendas for future research. J. Dev. Stud. 50 (10), 15–1347.
Kim, B., Kang, Y., 2009. The informal economy and the growth of small enterprises in Russia. Econ. Transit. 17 (2), 351–376.
Kim, B., Kim, M., 2016. The evolution of the informal economy in North Korea. Seoul J. Econ. 29 (4), 457–480.
LaPorta, R., Shleifer, A., 2008. The unofficial economy and economic development. Brookings Pap. Econ. Activity 47 (1), 123–135.
Levy, S., 2008. Good Intentions, Bad Outcomes. Social Policy, Informality and Economic Growth in Mexico. Brookings Institution Press.
Lichtenberg, F., 1993. R&D investment and international productivity differences. In: Siebert, Horst (Ed.), Economic Growth in the World Economy. J. C. B. Mohr, Tubingen, pp. 89–110.
Lisi, G., 2016. Unemployment, underground economy and economic growth in a matching model of behavioural economics. Int. Rev. Econ. 63, 159–170.
Lisi, G., Pugno, M., 2015. A matching model of endogenous growth and underground firms. Int. J. Econ. Theory 11 (4), 347–369.
Loayza, N., 1996. The economics of the informal sector: a simple model and some empirical evidence from Latin America. Carnegie-Rochester Conference Series on Public Policy 45. pp. 129–162.
Loayza, N., 2016. Informality in the process of development and growth. World Econ. 39 (12), 1856–1916.
Loayza, N., Oviedo, A., Servén, L., 2004. Regulation and Macroeconomic Performance. Policy Research Working Paper 3469. World Bank, Washington, D.C.
Mapp, T., Moore, W., 2015. The informal economy and economic volatility. Macroecon. Finance Emerg. Market Econ. 8 (1–2), 185–200.
Martinez, E.Z., 2007. Metanálise de ensaios clínicos controlados aleatorizados: aspectos quantitativos. Medicina (Ribeirão Preto) 40 (2), 223–235.
Medina, L., Schneider, F., 2018. Shadow Economies Around the World: What Did We Learn Over the Last 20 Years? IMF Working Paper # WP/18/17.
Mogensen, G.V., Kvist, H.K., Körmendi, E., Pedersen, S., 1995. The Shadow Economy in Denmark 1994: Measurement and Results (Study No. 3). Rockwool Foundation Research Unit, Copenhagen.
Nabi, M., Drine, I., 2009. External debt, informal economy and growth. Econ. Bull. 29 (3), 1695–1707.
Nelson, J., Kennedy, P., 2009. The use (and abuse) of meta-analysis in environmental and natural resource economics: an assessment. Environ. Resour. Econ. 42 (3), 345–377.
Neves, P.C., Sequeira, T., 2018. Spillovers in the production of knowledge: a meta-regression analysis. Res. Policy 47, 750–767.
Neves, P.C., Afonso, O., Silva, S., 2016. A meta-analytic reassessment of the effects of inequality on growth. World Dev. 78, 386–400.
Nikopour, H., Habibullah, M., 2011. Shadow economy in different stages of development. Actual Problems Econ. 8, 409–418.
OECD, 2002. Handbook for Measurement of the Non-Observed Economy. OECD Publishing, Paris.
Olga, K., Eldar, S., Ruslan, F., Anastasiya, K., 2015. Assessment of influence of the labor shadow sector on the economic growth of the Russian economy with the using methods of statistical modeling. 2nd Global Conference on Business, Economics, Management and Tourism 3. Elsevier Science Bv., A. I. Iacob. Amsterdam, pp. 180–184.
Orsi, R., Raggi, D., Turino, F., 2012. Size, trend, and policy implications of the underground economy. Working Paper DSE No. 818. Bologna.
Pathak, S., Laplume, O., Xavier-Oliveira, E., 2015. Informal institutions and technology use by entrepreneurs. Int. J. Emerg. Markets 11 (1), 57–71.
Pickhardt, M., Pons, J., 2010. Size and scope of the underground economy in Germany. Appl. Econ. 38 (14), 1707–1713.
Quintano, C., Mazzocchi, P., 2010. Some alternative estimates of underground economies in 12 new EU member states. Int. Econ. J. 24 (4), 611–628.
Sarte, P., 2000. Informality and rent-seeking bureaucracies in a model of long-run growth. J. Monet. Econ. 46, 173–197.
Schneider, F., 2005. Shadow economies around the world: What do we really know? Eur. J. Polit. Econ. 21, 598–642.
Schneider, F., 2012. The shadow economy and work in the shadow: what do we (not) know? IZA Discussion Paper No. 6423.
Schneider, F., 2017. Estimating a shadow economy: results, methods, problems, and open questions. De Gruyter Open. Open Econ. 1, 1–29.
Schneider, F., Buehn, A., 2012. Corruption and the shadow economy: like oil and vinegar, like water and fire? Int. Tax Public Finance 19 (1), 172–194.
Schneider, F., Dreher, A., 2010. Corruption and the shadow economy: an empirical analysis. Public Choice 144 (1–2), 215–238.
Schneider, F., Enste, D., 2000. Shadow economies: size, causes, and consequences. J. Econ. Lit. 38, 77–114.
Schneider, F., Feld, L., 2010. Survey on the shadow economy and undeclared earnings in OECD countries. German Econ. Rev. 11 (2), 109–149.
Schneider, F., Hametner, B., 2014. The shadow economy in Colombia: size and effects on economic growth. De Gruyter 20 (2), 293–325.
Schneider, F., Klinglmair, R., 2004. Shadow economies around the world: what do we know? Discussion Paper No. 1043. Center for Research in Economics, Management and the Arts.
Schneider, F., Buehn, A., Montenegro, C., 2010. New estimates for the shadow economies all over the world. Int. Econ. J. 24 (4), 443–461.
Shadish, W., 1982. A review and critique of controlled studies of the effectiveness of preventive child health care. Health Policy Q. 2, 24–52.
Stanley, T., 2001. Wheat from chaff: meta-analysis as quantitative literature review. J. Econ. Perspect. 15 (3), 131–150.
Stanley, T., 2005. Integrating the empirical tests of the natural rate hypothesis: a meta-regression analysis. Kyklos 58 (4), 611–634.
Stanley, T., Jarrel, S., 1989. Meta-regression analysis: a quantitative method of literature surveys. J. Econ. 3, 161–170.
Stanley, T., Doucouliagos, H., Laroche, P., 2005. Publication bias in Union-productivity research? Ind. Relations 60 (2), 320–347 2005.
Stanley, T., Doucouliagos, H., Jarrell, S., 2008. Meta-regression analysis as the socio-economics of economics research. J. Socio-Economics 37, 276–292.
Sutton, A., Song, F., Gilbody, S., Abrams, K., 2000. Modelling publication bias in meta-analysis: a review. Stat. Methods Med. Res. 9, 421–445.
Tanzi, V., 1980. The underground economy in the United States: estimates and implications. Banca Nazionale Del Lavoro 135 (4), 427–453.
Tanzi, V., 1983. The underground economy in the United States: annual estimates, 1930–80. Int. Monetary Fund Staff Papers 30 (2), 283–305.
Torgler, B., Schneider, F., 2007. Shadow economy, tax morale, governance and institutional quality: a panel analysis. Discussion Paper No. 2593. Center for Economic Studies & Ifo Institute for Economic Research.
Trebicka, B., 2014. Mimic model: a tool to estimate the shadow economy. Acad. J. Interdiscip. Stud. 3 (6), 295–300.
Ugur, M., 2014. Corruption´s direct effects on per-capita income growth: a meta-analysis. J. Econ. Surv. 28, 472–490.
Ugur, M., Trushin, E., Solomon, E., Guidi, F., 2016. R&D and productivity in OECD firms and industries: a hierarchical meta-regression analysis. Res. Policy 45, 2069–2086.
Williams, C.C., Schneider, F., 2016. Measuring the Global Shadow Economy: The Prevalence of Informal Work and Labour. Edward Elgar Publishing, Cheltenham, UK.
Zaman, G., Goschin, Z., 2015. Shadow economy and economic growth in Romania. Cons and pros. Procedia Econ. Finance 22, 80–87.
Zukauskas, V., Schneider, F., 2016. Microbased results of shadow labour market in the Baltic States, Poland and Sweden. Appl. Econ.: Syst. Res. 10 (2), 117–133.