Do Aid for Trade Flows Help Reduce the Shadow Economy in Recipient Countries?

Sëna Kimm GNANGNON (kgnangnon@yahoo.fr)
World Trade Organization

Research Article

Keywords: Aid for Trade, Trade costs, Real exchange rate, Shadow economy

Posted Date: August 23rd, 2022

DOI: https://doi.org/10.21203/rs.3.rs-1912461/v2

License: This work is licensed under a Creative Commons Attribution 4.0 International License. Read Full License
Abstract

The present analysis has assessed the effect of Aid for Trade (AfT) flows on the shadow economy using an unbalanced panel dataset of 106 countries over the period from 2002 to 2015. Empirical results obtained by means of the two-step system generalized method of moments, show that higher AfT flows are associated with a fall in the size of the shadow economy, with less developed countries experiencing a greater negative effect of AfT flows on the shadow economy than relatively advanced countries among recipient countries of AfT flows. AfT interventions reduce the size of the shadow economy in countries that face high trade costs as well as in those that experience a depreciation of the real exchange rate. Finally, AfT interventions reduce the size of the shadow economy in countries that improve economic sophistication.

1. Introduction

A common feature of almost all, if not, all nations in the world is the prevalence of the shadow economy or informal economic activities (also referred to as the informal sector), although to varying degrees across countries (e.g., Elliat, 2002; Medina and Schneider, 2018; Schneider, 2005; Schneider and Enste, 2000). The expansion of the shadow economy does not occur in a vacuum, but is the consequence of imperfections in the economic system and inadequacies in economic policy (e.g., Arsić et al., 2015).

According to Schneider and Enste (2000), the shadow economy comprises, in general, activities that involved unreported or underreported income from the legal production of goods and services. These activities are unregistered economic activities that would have contributed to the official GDP if they had been counted (Schneider and Williams 2013). In a narrower sense, shadow economy encompasses legal economic and productive activities that, if recorded, would contribute to national GDP (see Mai and Friedrich 2016). Schneider and Enste (2000) had estimated that sub-Saharan Africa had the largest shadow economy ranging between 39% and 76% of GDP, while high income countries experienced lower sizes of the shadow economy, ranging from 8% to 30% of GDP.

The literature has shown that the expansion of the shadow economy reduces economic growth[1] (e.g., Younas et al., 2022), increases inflation (e.g., Dumitrescu et al., 2022; Mazhar and Jafri, 2017), raises income inequality (e.g., Saha et al., 2021), impedes government taxation effort (Ishak and Farzanegan, 2020), reduces pollution in particular when high levels of corruption are prevalent (e.g., Biswas et al., 2012), and may undermine countries’ integration into the global economy (e.g., Bacchetta et al., 2009).

Developing countries, and the least developed countries[2] (LDCs) among them face severe trade-related infrastructure and capacity constraints to effectively participate in international trade (e.g., Hallaert, 2010; Hallaert and Munro, 2009). The Aid for Trade (AfT) Initiative was launched by the Members of the World Trade Organization (WTO) at the Hong Kong Ministerial Conference held in 2005, to help these countries overcome these constraints, and easily connect to the international markets. Specifically, the declaration (outcome document of this ministerial conference) states that “Aid for Trade should aim to help developing countries, particularly LDCs, to build the supply-side capacity and trade-related infrastructure that they need to assist them to implement and benefit from WTO Agreements and more broadly to expand their trade.” (WTO, 2005: paragraph 57).

According to the OECD, three main categories of official development assistance constitute total AfT flows (e.g., OECD/WTO, 2007, 2019). These are AfT flows for building economic infrastructure, AfT flows for strengthening productive capacities, and AfT flows related to trade policy and regulation (see the sectoral coverage of each AfT category in Appendix 1). AfT interventions for economic infrastructure help build hard and soft infrastructure[3]. AfT interventions for productive capacities help foster the production and export capacity of recipient countries, and AfT interventions related to trade policy and regulation aim to improve the capacity of policymakers in recipient countries to design trade policy, develop trade-related institutions in a way consistent with WTO Agreements, and participate in trade negotiations. This last category of AfT promotes directly the cross-border movement of goods by helping reduce administrative costs and regulatory trade barriers, notably through the streamlining of the time, cost, and number of documents necessary for export and import procedures. Its trade-related adjustment component is also instrumental in compensating less productive firms for their losses from trade reforms towards trade liberalization.

Since the launch of the AfT Initiative, several works have been undertaken to investigate the effect of AfT flows (in other words, AfT interventions) on recipient countries’ export performance as well as on various other macroeconomic outcomes (see the literature review of Benziante et al. 2022). However, the effect of AfT flows on the shadow economy in recipient countries has not been explored in this literature. The present analysis investigates how AfT flows affect the shadow economy in recipient countries. In so doing, it aims to contribute to both the literature on the effect of AfT flows on recipient countries’ economies and the literature on the determinants of shadow economy in developing countries.

The analysis has been performed using an unbalanced panel dataset of 106 countries over the period from 2002 to 2015 (non-overlapping sub-periods of 3-year have been used), and primarily the two-step system generalized method of moments. We hypothesize that the shadow economy effect of AfT interventions works through the influence of these interventions on trade costs, as well as on the real exchange rate. Results have shown that total AfT flows, including its three components, have exerted a negative and significant effect on the shadow economy. AfT interventions for building economic infrastructure appear to exert the largest negative effect on the shadow economy. This is followed by AfT interventions for trade policy and regulation, and finally by AfT interventions for productive capacities. On another note, we obtain that total AfT flows exert a higher negative effect on the shadow economy in less developed countries than in relatively advanced recipient countries of AfT flows. Moreover, total AfT flows contribute to reducing the shadow economy in countries that face higher trade costs, that is, the higher the trade costs, the larger is the magnitude of the negative effect of total AfT flows on the shadow economy. This finding applies also to all three components of total AfT flows. The analysis has also revealed that total AfT flows reduce the size of the shadow economy in countries that experience a depreciation of the real exchange rate. Finally, AfT interventions reduce the size of the shadow economy in countries that export increasingly complex products, as well as in those that improve their level of productive capacities.
In this context, and as it is unlikely that wages inequality falls to the same extent in the informal sector, informal rms operating in the underground economy benefit of AfT flows could lead rms operating in the informal sector to be incited to move to the formal sector as it becomes more profitable to enter the encourages the diversification of employment across the agriculture, industry and services sectors in AfT recipient-countries (Gnangnon, 2019). To improve the competitiveness of rms operating in the formal tradable sector. In so doing, these capital inflows enhance rms' performance in terms of unregistered forms of the latter does not allow them to import or export easily, and ultimately benefit from trade agreements. By the same token, these rms could also take advantage from the trade costs reduction arising from the build-up of economic improvements of the competitiveness by raising uncertainty about their profits (e.g., Deardorff, 2014; Dixit and Pindyck, 1994), and hinder their participation in international trade (e.g., Anderson and Marcouiller, 2002; Diakantoni et al., 2017; Hoekman and Nicita, 2011; Papalia and Bertarelli, 2015; Portugal-Perez and Wilson, 2012; Yanase and Tsubuku, 2022; Wilson et al., 2005).

Conversely, trade costs reduction encourages the import of intermediate inputs. It facilitates access to knowledge and technology and expands the range of goods and services available to consumers (e.g., Aggarwal et al., 2022; Defever et al., 2020; Grossman and Helpman, 2015; Porteous, 2020). It also enhances export upgrading (e.g., Bas and Strausz-Kahn, 2015; Mukherjee and Chanda, 2021; Saadi, 2020). Reduction in per-unit trade costs lowers export-market prices for low-costs exporters relative to high-costs exporters, and allows low-cost exporters to gain market shares at the detriment of high-cost exporters (e.g., Sörensen, 2014). Hence, falls in trade costs increases domestic competition, and results in a reallocation of economic activity towards high-productivity firms (e.g., Abeberese and Chen, 2022; Bernard et al., 2006; Fiorini et al., 2021; Melitz, 2003). Less efficient and less productive firms are driven out of the formal sector, and move to the informal sector. However, the trade-related adjustment component of AfT could be instrumental in limiting the number of less efficient and less productive firms that would move to the informal sector, as these financial compensations can allow these firms to survive in the formal sector. These firms can even become progressively competitive in the international trade market if in addition to these financial compensations, they benefit from AfT flows for productive capacities to increase the production of goods and services for export markets.

The present analysis posits that AfT interventions could affect the shadow economy primarily through their effect on trade costs, but also through their effect on the real exchange rate.

AFT flows can affect the shadow economy through its effect on trade costs considered in a broader sense, and include costs associated with both tariff policies and non-tariff policy measures (e.g., Milner, 1996; Anderson and van Wincoop, 2004; Arvis et al., 2016). According to Ali and Milner (2016: p 1918), non-tariff trade costs entail “the costs (time delays, charges, etc.) involved in moving goods through customs and ports, of transporting goods to and between home and foreign ports, and additional costs (communication, information, etc.) of conducting business across national frontiers”. Anderson and van Wincoop (2004: p691) have considered trade costs as encompassing “all costs incurred in getting a good to a final user other than the marginal cost of producing the good itself: transportation costs (both freight costs and time costs), policy barriers (tariffs and nontariff barriers), information costs, contract enforcement costs, costs associated with the use of different currencies, legal and regulatory costs, and local distribution costs (wholesale and retail).” Trade costs undermine firms’ competitiveness by raising uncertainty about their profits (e.g., Deardorff, 2014; Dixit and Pindyck, 1994), and hinder their participation in international trade (e.g., Anderson and Marcouiller, 2002; Diakantoni et al., 2017; Hoekman and Nicita, 2011; Papalia and Bertarelli, 2015; Portugal-Perez and Wilson, 2012; Yanase and Tsubuku, 2022; Wilson et al., 2005).

2. Theoretical Discussion On The Effect Of AFT Flows On The Informal Economy

The rest of the paper is organized as follows. Section 2 presents the theoretical motivation of the analysis, including the theoretical hypotheses to be tested empirically. Section 3 lays down the baseline econometric model. Section 4 makes a brief data presentation. Section 5 discusses the appropriate econometric estimators to perform the empirical analysis. Section 6 interprets the empirical outcomes, and Section 7 deepens the analysis. Section 8 concludes.

[1] Afonso et al. (2022) have, however, reported evidence of no significant effect of the shadow economy on economic growth.
[2] The United Nations have defined the category of LDCs as countries in the world that are the poorest and most vulnerable to exogenous economic and environmental shocks. The list of LDCs and criteria used for the inclusion of a country in the LDC category and the graduation of a country from this category are available online at: https://www.un.org/ohrlls/content/least-developed-countries
[3] Hard infrastructure can include highways, railroads, ports, etc., and soft infrastructure refers to transparency, customs efficiency, institutional reforms (Portugal-Perez and Wilson, 2012: p 1296).

The literature has demonstrated that higher AFT flows - including AFT flows for the build-up of economic infrastructure, AFT flows for strengthening productive capacities and AFT flows for trade policy and regulation - are associated with lower trade costs in recipient countries (e.g., Busse et al., 2012; Cali and te Velde, 2011; Gnangnon, 2018; Helble et al., 2012; Hoekman and Nicita, 2010; OECD/WTO, 2015; Tadesse et al., 2019; Tadesse et al., 2021; Vijil and Wagner, 2012), and the

AFT interventions for productive capacities are likely to benefit to micro, small and medium-sized enterprises, including those that were initially operating in the informal sector. Thus, the supply of financial resources (i.e., AFT flows for productive capacities) to allow new and existing firms to become competitive in the international trade markets, and expand their production of goods and services for exports, could incite informal firms to register in the formal economy so as to benefit from such resources. By the same token, these firms could also take advantage from the trade costs reduction arising from the build-up of economic infrastructure (e.g., Cali and te Velde, 2011; Tadesse et al., 2021; Vijil and Wagner, 2012), by starting exporting (for new firms). It is important to note here that through their trade costs reduction effect, AFT interventions for economic infrastructure could benefit more to formal firms than informal ones as the status of unregistered forms of the latter does not allow them to import or export easily, and ultimately benefit from trade agreements.

AFT flows also help facilitate the import of goods by recipient countries (Hühne et al., 2014), import diversification (Gnangnon, 2021a; Ly-My, 2021), and the improvement of the competitiveness of firms operating in the formal tradable sector. In so doing, these capital inflows enhance firms’ performance in terms of export of goods and services (see the literature review of Benziane et al. 2022), induce greater export product diversification (e.g., Gnangnon, 2019a,b; Kim, 2019), promote services export diversification (e.g., 2021b), generate higher employment opportunities in recipient countries (Gnangnon, 2019c), and encourage the diversification of employment across the agriculture, industry and services sectors in AFT recipient-countries (Gnangnon, 2020a). All these benefits of AFT flows could lead firms operating in the informal sector to be incited to move to the formal sector as it becomes more profitable to enter the formal tradable sector.

On another note, Gnangnon (2020b) has found, among others, that AFT interventions lead to lower wage inequality in the manufacturing sector of countries that have liberalized trade policies, enjoy greater trade openness, experience higher exports of labour-intensive, low-skill and high skill manufacturing products. In this context, and as it is unlikely that wages inequality falls to the same extent in the informal sector, informal firms operating in the underground economy could be encouraged to move to the formal tradable sector, including to the formal manufacturing sector. This is because even low-skilled workers may earn a
higher wage in formal manufacturing industries. This effect of AfT flows can notably take place in developing countries that implement policies to expand their manufacturing sector.

In light of the foregoing, we formulate the following hypothesis:

**Hypothesis 1**

Higher AfT flows are associated with a reduction in the size of the shadow economy, especially in countries that face higher trade costs, and the higher the trade costs, the larger will be the shadow economy reduction effect of AfT flows.

On another note, AfT flows can affect the shadow economy through their effect on the real exchange rate in the recipient countries. In fact, AfT flows are associated with the depreciation of the real exchange rate, i.e., the fall in the relative price of non-tradables to tradables exports Gnanagnon (2022). Hence, by altering relative prices of tradable to non-tradables and making exports more profitable, AfT flows would encourage the development of export activities, and provide greater incentives for underground trading firms (which were de facto less competitive) to develop their activities in the formal trade sector. Against this background, we postulate the following hypothesis:

**Hypothesis 2**

Higher AfT flows lead to a reduction in the size of the shadow economy in countries that experience a depreciation of the real exchange rate, and the larger the real exchange rate depreciation, the greater will be the shadow economy reduction effect of AfT flows.

Besides, it is possible to envisage that higher AfT flows could result in an expansion of the shadow economy. This would particularly be the case if less efficient and less productive local trading firms did not benefit from AfT financial support, or from government financial support to survive to import competition. A survival strategy for such firms could be to recourse to cheaper inputs produced informally (Fugazza and Fiess, 2010). In the same vein, Escobar et al. (2022) have reported that the informal economy can help firms have a better export performance, including on manufactured exports. Using Mexican firm-level data covering manufacturing plants between 2005 and 2012, the authors have obtained that firms in industries that source inputs from industries with a large informal economy enjoy a cost-related competitive advantage and leverage it both to export and enhance export performance. In this scenario, we expect that AfT flows would be associated with an expansion of the size of the shadow economy (hypothesis 3).

The empirical analysis will provide guidance as to whether hypotheses 1 and 2 dominate hypothesis 3.

### 3. Model Specification

To investigate the effect of AfT flows on the shadow economy, we build on the previous literature on the drivers of the shadow economy (e.g., Berdiev and Saunoris, 2018; Berdiev et al., 2018a; Berdiev et al., 2018b; Berdiev et al., 2020; Canh and Thanh, 2020a,b; Nguyen, 2022; Ha et al., 2021; Kelmanson et al., 2019). We consider a baseline model specification where the dependent variable is the indicator of the shadow economy (denoted “SHADOW”), and the main variable of interest is the indicator of AfT flows (denoted “AFT”). Control variables include the real per capita income (denoted “GDPC”) (which is a proxy for the development level), financial development (denoted “FINDEV”), the institutional and governance quality (denoted “INST”) and the tax burdensome (denoted “TAXBURD”).

We consider the following baseline model specification:

\[
SHADOW_{it} = \alpha_1 SHADOW_{i,t-1} + \alpha_2 \Log(AFT)_{it} + \alpha_3 \Log(NonAFT)_{it} + \alpha_4 \Log(GDPC)_{it} + \alpha_5 FINDEV_{it} + \alpha_6 INST_{it} + \alpha_7 TAXBURD_{it} + \mu_i + \delta_t + \epsilon_{it}
\]

The panel dataset is unbalanced and includes 106 countries over the period from 2002 to 2015. It has been built on the basis of data availability concerning variables used in the analysis, in particular for the variable representing the shadow economy, which is, at the time of writing this paper, available at best until the year 2015 (see Medina and Schneider, 2018). Non-overlapping sub-periods of 3-year average have been used to reduce the effect of business cycles on the variables of model (1). There are indeed 6 sub-periods, which are 2002–2004; 2005–2007; 2008–2010; 2011–2013; 2014–2015.

The subscripts \(i\) and \(t\) identify respectively a given country and each of the above-mentioned sub-periods. \(\alpha_1\) to \(\alpha_7\) are coefficients that will be estimated. \(\mu_i\) and \(\delta_t\) are time invariant specific characteristics of each country in the panel dataset. \(\epsilon_{it}\) are sub-period dummies that represent global shocks influencing the shadow economy in all countries together. \(\epsilon_{it}\) is an error-term.

All variables introduced in model (1) have been described in Appendix 1. Appendix 2 contains descriptive statistics (mean, standard deviation, minimum and maximum) associated with variables in model (1) as well as all other variables used in the analysis. Appendix 3 presents the list of countries contained in the panel dataset.

The dependent variable “SHADOW” is the indicator of the size of the shadow economy. It is extracted from Medina and Schneider (2018) who have used the multiple indicators, multiple causes (MIMIC) method, to build this dataset. This approach extracts covariance information from observable variables classified as causes or indicators of the latent shadow economy (see Schneider et al. 2010 for more details on this approach). This shadow economy indicator has been used in many empirical analyses, and more recently by Berdiev and Saunoris (2018), Berdiev et al. (2018b); Berdiev et al. (2020), and Canh et al., (2021). The lagged dependent variable has been introduced in model (1) to capture the path dependence process in the shadow economy. It also helps address omitted variables problems.
The covariate \( \textit{AFT} \) is our regressor of main interest. It is the real gross disbursement of AFT flows, expressed in constant prices 2019, US Dollar. Four types of AFT indicators have been used in the analysis. These include the total AFT flows (denoted \( \textit{AFTTOT} \)), as well as the three major components of the latter, namely AFT flows for building economic infrastructure (denoted \( \textit{AFTINFRA} \)), AFT flows for enhancing productive capacities (denoted \( \textit{AFTPROD} \)), and AFT related to trade policy and regulation (denoted \( \textit{AFTPOL} \)). The effects of AFT interventions on the shadow economy were already discussed in the previous section.

The regressor \( \textit{NonAFT} \) represents the portion of total development aid (i.e., official development assistance) that is allocated for other purposes than to support the trade sector in developing countries. The effect of \( \textit{NonAFT} \) flows on the shadow economy could be ambiguous, given that it may operate through various channels. For example, the portion of \( \textit{NonAFT} \) flows allocated for the accumulation of human capital (i.e., aid for education and health) can help reduce the size of the shadow economy. This is the case if such an aid genuinely improves human capital in recipient countries (e.g., Birchler and Michaelowa, 2016; Kotsadam et al., 2016), insofar as an improvement in human capital raises the opportunity of producing in the shadow economy (e.g., Berdiev et al., 2015; Berdiev and Saunoris, 2018; Buehn and Farzanegan, 2013; Gërxhani and van de Werfhorst, 2013). On the other hand, higher \( \textit{NonAFT} \) flows can result in an appreciation of the real exchange rate, i.e., an increase in the relative price of non-tradables to tradables (Gnangnon, 2022) and makes exports less profitable, and consequently increases trading firms’ incentives to operate underground. Overall, the net effect of \( \textit{NonAFT} \) flows on the size of the shadow economy is a priori undetermined theoretically. The issue is, therefore, empirical.

The variable \( \textit{GDPC} \) represents the real per capita income, which is a proxy for the level of economic development. Following for example, Berdiev and Saunoris (2018), we postulate that an improvement in the real per capita income reflects a greater sophistication of the economy, and an improvement in the institutional and governance quality, which could in turn, discourage shadow operations.

In the baseline model (1), we have applied the natural logarithm to AFT indicators, as well as the variables \( \textit{NonAFT} \) and \( \textit{GDPC} \) in order to reduce their skewed distributions.

The literature has also shown that financial development reduces the size of the shadow economy, although the latter could also influence financial development (e.g., Berdiev and Saunoris, 2016; Canh and Thanh, 2020a; Hajlee et al., 2021). Nevertheless, according to Loayza (2016), the improvement of financial and contractual participation for informal firms will increase both informal wages and the expansion the informal sector. Thus, while we can expect a negative effect of firms’ access to credit allocated by banks to be negatively associated with the size of the shadow economy, we do not rule out the possibility of a positive effect of financial development on the size of the shadow economy.

Many studies have shown that the improvement in the institutional and governance quality reduces the participation in underground activities (e.g., Berdiev et al. 2018a; Canh et al., 2021; Dreher et al., 2009; Friedman, 2000; Schneider, 2010). Likewise, burdensome taxes can lead economic agents that are not willing to pay high taxes to operate underground or outsource to the underground (e.g., Berdiev and Saunoris, 2018; Dreher and Schneider, 2010; Gërxhani, 2004; Schneider and Enste, 2000; Tanzi, 1999).

4. Brief Data Analysis

Using the dataset of 106 countries over the period from 2002 to 2015 (non-overlapping sub-periods of 3-year), we present in Fig. 1 the developments of the gross disbursements of total AFT flows (expressed in million US$, constant 2019 prices) and the size of the shadow economy over the full sample. We also present in Fig. 2 (and over the full sample) the correlation pattern in the form of scatter plot between total AFT flows and the size of shadow economy, and between each of the above-mentioned component of total AFT flows and the shadow economy. These two Figures allow getting a first insight into the relationship between AFT flows and the size of the shadow economy. We note from Fig. 1 that total AFT flows rose steadily from US$ 90.73 million in 2002–2004 to US$ 234.3 million in 2014–2015. Meanwhile, the size of the shadow economy increased from 31.17 in 2002–2004 to 32.37 in 2008–2010 (it reached its peak over the full period), and then moved downward to reach 30.9 in 2014–2015. Overall, from 2002–2004 to 2008–2010, total AFT flows and the shadow economy tended to move in the same direction, while over the rest of the period, they moved in opposite directions.

[Insert Fig. 1, here]

[Insert Fig. 2, here]

Figure 2 suggests slightly positive correlation patterns between total AFT flows (including its productive capacities, and trade policy and regulation components) and the size of the shadow economy, while the correlation pattern between AFT flows for economic infrastructure and the size of the shadow economy is unclear.

5. Econometric Approach

Model (1) is likely plagued with several endogeneity problems. The first of these problems arises from the presence of the lagged dependent variable as a right-hand side regressor. This creates a bias\(^1\) due to the correlation between the lagged dependent variable and countries’ time-invariant fixed effects in the error term, in particular if the model is estimated using the fixed effects estimator. The second endogeneity concern stems from the potential reverse causality from the dependent variable to each of the regressors introduced in model (1). For example, yet we expected that AFT flows would influence the shadow economy (as discussed in section 2). At the same time, one may argue that the size of the shadow economy prevailing in a recipient country can determine the amount of AFT flows (or eventually \( \textit{NonAFT} \) flows) allocated by donors to the concerned recipient country. This is because countries with larger shadow economies are likely to be less sophisticated economies, to have a less educated population, and fewer public revenue to supply requisite public goods and
services. These countries are, therefore, in need of financial assistance in order to address these challenges, and reduce underground activities. The endogeneity of the other variables in model (1) has been pointed out by previous studies (see above) on the drivers of the shadow economy.

In light of these endogeneity concerns, we commence the empirical analysis by using the within fixed effects estimator (denoted FE) to estimate a static specification of model (1), i.e., model (1) from which we exclude the lagged dependent variable as a covariate. In this static specification of model (1), all variables have been lagged one-period in order to limit the reverse causality problem highlighted above. In using the FE estimator, we correct standard errors of estimates by means of the technique suggested by Driscoll and Kraay (1998), which addresses the heteroscedasticity, autocorrelation and the correlation among countries in the error term. The outcomes of the estimation of this static specification of model (1) where the covariate "AfT" is measured by total AfT and each of its three major components, are reported in Table 1.

Next, we estimate the dynamic specification of model (1) and other variants of this dynamic model using the two-step system GMM estimator of Blundell and Bond (1998). This estimator has the advantage of handling endogeneity problems related to measurement errors, omission of variables, the Nickell bias, and the bi-directional causality between regressors and the dependent variable. Its utilization involves estimating a system of equations that includes an equation with variables in first-difference and an equation with variables in levels. In the absence of external instruments (that are difficult to be found), the two-step system GMM estimator relies on 'internal instruments' to handle endogeneity concerns. Lags of the variables in first differences are used as instruments in the equation in levels, and lags of the variables in levels are utilized as instruments in the first-difference equation. In so doing the two-step system GMM estimator makes use of additional moment conditions that reduce the imprecision and potential bias arising from the use of the difference GMM estimator of Arellano and Bond (1991) (e.g., Blundell and Bond, 1998). In particular, it is asymptotically more efficient than the difference GMM estimator, especially in the context of persistent time series (e.g., Alonso-Borrego and Arellano, 1999; Bond, 2002).

To assess the correctness of the model specifications that will be estimated by means of the two-step system GMM, we use the standard tests of the Arellano-Bond test of the presence of first-order serial correlation in the first-differenced error term (AR (1)); the Arellano-Bond test of the absence of second-order autocorrelation in the first-differenced error term (denoted AR (2)) and the Sargan/Hansen test of over-identifying restrictions (OID). It is expected for the AR(1) test that the p-value of the related statistic would be lower than 0.10 at the 10% level. For the AR(2) test and the OID test, we expect that at the 10% level, the p-values of the related statistics will be higher than 0.10. To avert the problem of instruments proliferation (e.g., Roodman, 2009), we limit the number of lags used for instrumental variables at three, as with lower lags, the above-mentioned requirements of the two-step system GMM estimator are not met.

The regressions based on the two-step system GMM approach are as follows. First, we estimate the baseline model (1) where the regressor "AfT" is measured respectively by total AfT and each of its three major components. The outcomes of the estimation of these specifications of model (1) are presented in columns [1] to [4] of Table 2. Outcomes presented in column [5] of this Table allow examining how the effect of total AfT flows on the shadow economy varies across countries in the full sample. The literature has pointed out the adverse effects of trade costs on development (e.g., Carmignani, 2015; Pham and Sim, 2020). As trade costs represent a major avenue through which AfT interventions can affect the shadow economy, we can expect that AfT flows would reduce the size of the shadow economy in less developed countries, including to a greater extent than in relatively advanced countries. Results reported in column [5] of Table 2 are obtained by estimating a variant of model (1) where the indicator "AfT" is measured by total AfT flows, and that contains the multiplicative variable between the variable measuring total AfT and the real per capita income indicator.

Table 3 contains estimates that help examine on the one hand, how the effect of NonAfT flows on the shadow economy varies across countries in the full sample (see column [1]), and on the other hand, the extent to which the effect of total AfT flows on the shadow economy depends on the institutional and governance quality. Results in column [1] of this Table are obtained by estimating a variant of model (1) that contains total AfT flows as the measure of "AfT", and the interaction between the indicator of NonAfT flows and the real per capita income indicator. Results in column [2] of the Table arise from estimating a specification of model (1) that contains total AfT flows as the measure of "AfT", and in which we include the interaction between total AfT flows and the indicator of the institutional and governance quality. The rationale for estimating these two variants of model (1) is discussed later.

Columns [2] to [5] of Table 4 report outcomes that allow testing hypothesis 1 (including whether it dominates hypothesis 3) that the effect of AfT flows on the shadow economy works through the channel of trade costs. These outcomes are obtained by estimating several variants of model (1), i.e., with total AfT and each of its three components, along with the multiplicative variable between each AfT indicator and the indicator of the overall trade costs. However, before performing these regressions, we check whether trade costs represent genuinely a channel through which AfT flows affect the shadow economy. We do this by estimating a variant of model (1), which is nothing else than model (1) (with "AfT" being measured by total AfT flows) in which we introduce the indicator of trade costs. In principle, if trade costs represent an avenue through which total AfT flows can affect the shadow economy, then the introduction of this variable in the baseline model (1) (where "AfT" being measured by total AfT flows) should either reduce the magnitude of the coefficient of the variable capturing total AfT flows (the coefficient is expected to still be significant at least at the 5% level) or render the coefficient non-statistically significant at the conventional significance levels. The estimates stemming from the estimation of this model specification are provided in column [1] of Table 4. The indicator of the overall trade costs (denoted "TRCOST") used in the analysis has been constructed for a given country in a given year, as the average of the bilateral overall trade costs on goods across all trading partners of this country. Data on bilateral overall trade costs has been computed by Arvis et al. (2012, 2016) following the approach proposed by Novy (2013). Arvis et al. (2012, 2016) have built on the definition of trade costs provided by Anderson and van Wincoop (2004) (see Appendix 1 for details on the computation of this indicator). We have applied the natural logarithm to the variable "TRCOST" to reduce its skewed distribution.

Finally, we test hypothesis 2 (including whether it dominates hypothesis 3) that AfT interventions can affect the size of the shadow economy through their effect on the real exchange rate. To test this assumption, we start by simply including the variable "REER" (which measures the real effective exchange rate) in model (1) (where "AfT" is measured by total AfT flows) in order to see how the coefficient of the indicator measuring total AfT changes. As noted above, if the real exchange rate is genuinely a channel through which total AfT flows can affect the shadow economy, then the introduction of the real exchange rate
variable in the baseline model should reduce the magnitude of the coefficient related to the variable representing total AfT flows, or render it statistically nil at the conventional significance levels. The results of the estimation of this specification of model (1) are provided in column [1] of Table 5.

Second, we examine the extent to which the effect of total AfT flows on the shadow economy depends on the real exchange rate. As NonAfT flows also exert a significant effect on the real exchange rate (yet an appreciation real exchange rate effect), we seize this opportunity to additionally investigate whether the effect of NonAfT flows on the shadow economy depends on the real exchange rate. To address these two questions, we estimate another specification of model (1) that includes yet both total AfT flows as the measure of "AfT", and the real exchange rate indicator, but also both the multiplicative variable between these two indicators, and the multiplicative variable between NonAfT flows and the real exchange rate. The outcomes of the estimation of this model specification are reported in column [2] of Table 5. The variable "REER" is the real effective exchange rate computed on the basis of the consumer price index, and using the nominal effective exchange rate based on 66 trading partners. An increase in the values of this index indicates an appreciation of the real effective exchange rate, i.e., an appreciation of the home currency against the basket of trading partners' currencies. The natural logarithm has been applied to the indicator 'REER' in the regressions in order to reduce its skewed distribution. It is important to underline here that both trade costs and the real exchange indicators have not been included simultaneously (as channels through which AfT flows can affect the shadow economy) in the analysis because they are highly correlated.

[1] This bias is referred to as the Nickell bias (Nickell, 1981).

6. Interpretation Of Empirical Results

Outcomes presented in Table 1 indicate that the coefficients of all AfT indicators in columns [1] to [4] are negative and significant at the conventional significance levels (i.e., at least at the 10% level). Specifically, total AfT flows and AfT flows for economic infrastructure are negatively and significantly (at the 1% level) associated with the shadow economy. AfT flows for productive capacities reduce the shadow economy at the 5% level. However, AfT interventions related to trade policy and regulation affect negatively the shadow economy only at the 10% level. In terms of magnitude of the effects, we find that doubling total AfT flows (i.e., an increase in total AfT flows by 100%) in period t-1 reduces the size of the shadow economy by 1.2 point in period t. Likewise, doubling AfT flows for economic infrastructure, and AfT flows for productive capacities in period t-1 induces a fall in the size of the shadow economy respectively by 0.64 point and 1.14 point in period t. Finally, at the 10% level, doubling total AfT flows for trade policy and regulation in period t-1 reduces the size of the shadow economy by 0.34 point in period t. It, therefore, ensues that at the 5% level, AfT flows for productive capacities exert here a higher reduction effect on the shadow economy than AfT flows for economic infrastructure, while AfT flows for trade policy and regulation exert no significant effect on the shadow economy. All these outcomes tend to support hypothesis 1.

[Insert Table 1, here]

Across all four columns of Table 1, we note that NonAfT flows and the institutional and governance quality influence positively and significantly (at the 1% level) the shadow economy. The real per capita income exerts no significant effect on the shadow economy at the 10% level, while financial development tends to be negatively and significantly (at least at the 10% level) associated with the shadow economy. Finally, burdensome taxes tend, with surprise, to exert a negative effect on the shadow economy, but only at the 10% level. These results should however be taken with caution given that the use of lags of regressors might not fully address the endogeneity concerns highlighted above.

We now turn to outcomes obtained when using the two-step system GMM estimator. The coefficients of the lagged dependent variable in Tables 2 to 5 are all significant at the 1% level. This, therefore, underlines the existence of a state dependent path in the development of the shadow economy in countries under analysis. We also note that all specifications of model (1) whose results are reported in Tables 2 to 5 pass with success the diagnostic tests, including the AR(1), AR(2) and OID tests (see the results reported at the bottom of these Tables). In other words, all models estimated using the two-step system GMM approach, and whose results are reported in Table 2 to 5 are correctly specified. We conclude that the two-step GMM estimator is suitable for performing the empirical analysis.

[Insert Table 2, here]

Taking up estimates in Table 2, we find that at the 5% level, both total AfT and its three components exert a negative and significant effect on the shadow economy, although with magnitudes of effects different from the ones obtained in Table 1. These results lend support to hypothesis 1. Doubling total AfT flows induce a fall in the size of the shadow economy by 0.73 point. Doubling AfT flows for economic infrastructure reduces the size of the shadow economy by 0.615 point. Likewise, doubling AfT flows for productive capacities leads to a decline in the size of the shadow economy by 0.373 point, and doubling AfT flows for trade policy and regulation results in a fall of the size of the shadow economy by 0.50 point. Hence, total AfT flows affect negatively the size of the shadow economy, and AfT interventions for building economic infrastructure appear to exert the highest reduction effect on the shadow economy. This category of AfT flows is followed by AfT flows related to trade policy and regulation, and finally by AfT flows for enhancing productive capacities. Not only were the magnitude of these effects not obtained in Table 1, but the ranking in terms of the magnitude of the effect of each of three categories of total AfT on the shadow economy in Table 2 is different from the ones obtained in Table 1.

Results in column [5] of Table 2 indicate that the coefficient of the variable "AfTTOT" is negative and significant at the 5% level, while the interaction term of the variable \[\text{Log(AfTTOT)}\times\text{Log(GDPC)}\] is yet positive, but not significant at the conventional significance levels. On the basis of these two outcomes, we may be tempted to infer that the effect of total AfT flows on the shadow economy is yet negative, but is not dependent on countries' development level. To get a better insight into this effect, we present in Figure 3, at the 95 per cent confidence intervals, the marginal impact of total AfT flows on the shadow economy for varying levels of the real per capita income. It appears from this Figure that the marginal impact of total AfT flows on the shadow economy is always negative and significant, but its magnitude (including in absolute value) diminishes as the real per capita income rises. In other words, less developed
countries experience a larger negative effect of total AfT flows on the shadow economy than relatively advanced economies among recipient countries of AfT flows. We conclude that total AfT flows are more effective in reducing the size of the shadow economy in less developed countries (including poorest countries) than in relatively advanced countries.

Estimates related to control variables are, with few exceptions, broadly similar across all columns of Table 2. Focusing on estimates in column [1] of Table 2, we obtain, as expected, that an increase in the real per capita income is negatively and significantly (at the 1% level) associated with the development of underground activities. The effect of burdensome taxes on the shadow economy is not significant at the conventional significance levels in column [1] of the Table, but is, as expected, positive and significant at the 1% level in columns [4] and [5] of the Table. We may then infer, as expected, that burdensome taxes tend to encourage the development of shadow activities. Greater financial development reduces the size of the shadow economy at least at the 5% level (see for example results in columns [1], [4] and [5]). Surprisingly, we obtain across all columns of Table 2 that at the 1% level, higher NonAfT flows and an improvement in the institutional and governance quality induce an expansion of the size of the shadow economy.

We suspect that the positive effect of the institutional and governance quality on the shadow economy may hide the existence of an interaction effect between AfT flows (including total AfT flows) and the institutional quality on the shadow economy. Our assumption is all the more relevant that Gnango (2020) has shown empirically that AfT flows can promote regulatory policies in recipient countries. We also suspect that the positive effect of NonAfT flows on the shadow economy may reflect differentiated effects across countries in the full sample. It is for these reasons that we indicated in the previous section that Table 3 would report the outcomes concerning on the one hand, the extent to which the effect of total AfT flows on the shadow economy depends on the quality of institutions and governance (see column [1] of Table 3), and on the other hand, how the effect of NonAfT flows on the shadow economy is conditioned on countries’ level of real per capita income (see column [2] of Table 3).

We observe in column [1] of Table 3 that both the coefficient of the variable ["Log(AfTTOT)"] and the interaction term of the interaction variable ["[Log(AfTTOT)]*INST"] are negative and significant respectively at the 1% level, and the 5% level. We conclude that, on average over the full sample, total AfT flows always reduce the size of the shadow economy, regardless of the quality of institutions and government. The magnitude of this reduction effect increases as countries improve their institutional and governance quality. Figure 4 shows, at the 95 per cent confidence intervals, the marginal impact of total AfT flows on the shadow economy for varying levels of the quality of institutions and governance. It appears from this Figure that in countries with weak institutional and governance quality (especially when the values of the variable "INST" are lower than -2.643), there is no significant effect of total AfT flows on the shadow economy. However, for the other countries, total AfT flows exert a negative effect on the shadow economy, and the magnitude of this reducing effect becomes larger, the better the institutional and governance quality.

We note from column [2] of Table 3 that the coefficient of the variable ["Log(NonAfT)"] is positive and significant at the 1% level, while the interaction variable ["[Log(NonAfT)]*Log(GDPC)"] is negative and significant at the 1% level. These two outcomes suggest that NonAfT flows reduce the shadow economy in countries whose real per capita income[2] exceed US$ 17738.44 (= exponential(6.281/0.642)). Otherwise, higher NonAfT flows lead to an expansion of the shadow economy. We obtain a better picture on this effect by displaying in Figure 5, at the 95 per cent confidence intervals, the marginal impact of total NonAfT flows on the shadow economy for varying levels of the real per capita income. This Figure shows that the marginal impact of NonAfT flows on the shadow economy is significant only for countries whose real per capita incomes are lower than US$ 8148.7. For these countries, the lower the real per capita income, the higher is the magnitude of the positive effect of NonAfT flows on the shadow economy. In other words, among countries that have a real per capita income lower than US$ 8148.7, poor countries experience a higher positive effect of NonAfT flows on the shadow economy than other countries. In contrast, countries whose real per capita income exceeds US$ 8148.7 experience no significant effect of NonAfT flows on the shadow economy. The positive effect of NonAfT flows on the shadow economy may also reflect the fact this effect works through the real exchange rate appreciation. In other words, it is possible that the real exchange appreciation effect of NonAfT flows on the shadow economy likely dominates the eventual negative effects that these resources inflows may exert on the shadow economy, for example through the human capital accumulation. We will test latter in the analysis the extent to which NonAfT flows affect the shadow economy through the real exchange rate avenue.

We now consider outcomes reported in Table 4. We note from column [1] of this Table that the introduction of the trade costs indicator has led to the diminution of the magnitude of the effect of total AfT flows on the shadow economy from the value of -0.73 (see column [1] of Table 2) to the value of -1.533 in column [1] of Table 4. In other words, while the coefficient of the variable "AfTTOT" remains significant at the 1% level in column [1] of Table 4, its magnitude has diminished after the introduction of the indicator of the overall trade costs. This suggests that trade costs are genuinely a channel through which AfT flows affect the shadow economy. Incidentally, as expected, higher trade costs induce an expansion of the underground activities (at the 1% level). This positive and significant effect of trade costs on the shadow economy is confirmed in all other columns of Table 4, at least at the 5% level. The coefficients of the AfT indicators (total AfT or each of its components) are positive and significant at least at the 10% level, across columns [2] to [5] of Table 4. Concurrently, the interaction terms of the multiplicative variable between each of these AfT indicators and the trade costs indicator are all negative and significant at least at the 5% level. These outcomes suggest that on average over the full sample, AfT flows tend to exert a negative effect on the shadow economy in countries that face high trade costs, notably those whose overall trade costs[3] are higher than 185.2 [= exponential(11.90/2.279)] for the effect
of total AFT flows, higher than 143.8 [= exponential(5.768/1.161)] for the effect of AFT interventions for economic infrastructure, higher than 269.4 [= exponential(18.02/3.220)] for the effect of AFT interventions for productive capacities, and higher than 284.4 [= exponential(31.53/5.580)] for the effect of AFT interventions for trade policy and regulation on the shadow economy. For trade costs lower than these levels, the relevant AFT indicator influence positively the shadow economy. These outcomes tend to suggest that AFT flows reduce the shadow economy in countries that face high trade costs, and the greater the trade costs (especially when they exceed the above-mentioned levels), the larger is the magnitude of the negative effect of the relevant AFT intervention on the shadow economy.

To get a better insight into these effects, we provide in Figures 6 to 9, at the 95 per cent confidence intervals, the marginal impact respectively of total AFT flows, AFT flows for economic infrastructure, AFT flows for productive capacities, and AFT flows for trade policy and regulation, on the shadow economy, for varying levels of trade costs. We note from all these four Figures that the marginal impact of a relevant AFT indicator on the shadow economy decreases as the overall trade costs increase. However, this marginal impact is not always statistically significant. In particular, where this marginal impact is significant, the relevant AFT flows exert a negative effect on the shadow economy, and the magnitude of this negative effect is larger, the higher the overall trade costs. Specifically, we observe that total AFT flows exert no significant effect on the shadow economy in countries that face trade costs lower than 256.5 (see Figure 6). However, for countries whose overall trade costs exceed 256.5, total AFT flows lead to a reduction of the size of the shadow economy. A similar pattern is observed in Figure 7, with the marginal effect of AFT interventions for economic infrastructure being statistically nil when trade costs are lower than 236.2, and statistically significant for higher trade costs. We also obtain from Figure 8 that the marginal effect of AFT interventions for productive capacities on the shadow economy is negative and significant for trade costs higher than 296.5. Otherwise, this marginal effect is at best statistically nil (for trade costs ranging from 231.3 to 296.5), or positive when trade costs are lower than 231.3.

[Insert Figure 6, here]

[Insert Figure 7, here]

[Insert Figure 8, here]

[Insert Figure 9, here]

Figure 9 displays a pattern similar to the one observed in Figure 8: the marginal effect of AFT interventions for trade policy and regulation on the shadow economy is negative and significant for trade costs higher than 302.7. For countries facing levels of the overall trade costs lower than 261.9, AFT interventions related to trade policy and regulation induce an expansion of the shadow economy. Countries whose trade costs range from 261.9 to 302.7 experience no significant effect of AFT interventions for trade policy and regulation on the shadow economy.

Overall results in Table 4, and the related Figures 6 to 9 indicate that AFT flows, including total AFT flows and the major components of the latter reduce the size of the shadow economy in countries that face high trade costs: the greater the overall trade costs, the larger is the reduction effect of AFT flows on the shadow economy. These findings lend credence to hypothesis 1.

Estimates related to control variables in Table 4 are consistent with those in Table 2.

[Insert Table 5, here]

Taking up now the outcomes in Table 5, we note from column [1] that while the variable "REER" is not significant at the 10% level, its introduction in the baseline dynamic model (1) has led to a diminution of the magnitude of the coefficient of "AFTTOT" from the value of -0.73 (in column [1] of Table 2) to the value of -1.542 (see column [1] of Table 5). These outcomes indicate that the real exchange rate is another channel through which total AFT flows affect the shadow economy. We note from results in column [2] of Table 5 that the coefficient of the variable "Log(REER)" is yet positive but not significant at the 10% level. At the same time, the interaction term of the variable ("Log(AFTTOT)*[Log(REER)]") is positive and significant at the 1% level, and the interaction term of the variable ("Log(NonAFT)*[Log(REER)]") is negative and significant at the 1% level. These outcomes indicate that the effects of both total AFT flows and NonAFT flows on the shadow economy depend on the real exchange rate, with these effects moving in opposite directions as the real exchange rate appreciates. Specifically, total AFT flows induce a reduction in underground activities in countries that experience a depreciation of the real exchange rate: for these countries, the higher the depreciation of the real exchange rate, the larger is the magnitude of the negative effect of total AFT flows on the shadow economy. NonAFT flows induce an expansion of the shadow economy in countries that experience an appreciation of the real exchange rate, and the magnitude of this positive shadow economy effect increases as the real exchange rate further appreciates.

[Insert Figure 10, here]

[Insert Figure 11, here]

These findings are illustrated in Figures 10 and 11, which present, at the 95 per cent confidence intervals, the marginal impact of respectively total AFT flows and NonAFT flows on the shadow economy conditioning on the real exchange rate. Figure 10 indicates that the marginal effect of total AFT flows on the shadow economy increases as the real exchange rate appreciates. It is not statistically significant for values of the real exchange rate exceeding 137.2. Conversely, countries whose levels of real exchange rate are below 137.2 experience a negative and significant effect of total AFT flows on the shadow economy, and the magnitude of this negative effect is larger, the lower the value of the real exchange rate (i.e., the larger the depreciation of the real exchange rate). These findings clearly support hypothesis 2.

On the other hand, Figure 11 shows that the marginal effect of NonAFT flows on the shadow economy is always positive, in particular when it is significant. This marginal effect is not significant for values of the real exchange rate higher than 142.7. For lower levels of the real exchange rate, NonAFT flows exert a
positive and significant effect on the shadow economy as the real exchange rate appreciates, and the greater the appreciation of the real exchange rate, the higher is the shadow economy expansion effect of NonAfT flows.

Summing-up, results in Table 5 and the related Figures 10 and 11 convey the message that while total AfT flows reduce the shadow economy through their real exchange rate depreciation effect, higher NonAfT flows are associated with an expansion of underground economies through their real exchange rate appreciation effect. The finding concerning NonAfT flows help better understand why we obtained in Table 3 that NonAfT flows exert a positive effect on the shadow economy.

[1] In the full sample, the values of the variable "INST" range between -4.6 and 2.97 (see Appendix 3).
[2] Values of the variable representing the real per capita income in the full sample range from US$ 299.15 to US$ 109331.6 (see Appendix 3).
[3] Values of the variable representing the overall trade costs in the full sample range from 166.2 to 467.3 (see Appendix 3).
[4] Values of the variable capturing the real effective exchange rate range between 62.3 and 167.1 (see Appendix 2).

7. Further Analysis

The previous analysis demonstrated empirically that AfT interventions exert a higher negative effect of the shadow economy in countries that face higher trade costs than in countries that face relatively lower trade costs. This section deepens the analysis by investigating whether the effect of AfT flows on the shadow economy depends on countries' level of economic sophistication, including their level of economic complexity. The complexity of an economy is defined by the current stage of its production knowledge, or the knowledge materialized in the production system (e.g., Hausmann and Hidalgo, 2009; Hausmann et al., 2014). Thus, a complex economy is featured by a high level of diversity of export products and a low ubiquity of these products (the low ubiquity of products reflects the situation where products that are exported cannot be easily reproduced by other countries, as the production of such goods requires a set of exclusive capabilities) (e.g., Hartmann et al., 2017; Hausmann and Hidalgo, 2009; Hausmann et al., 2014; Mishra et al., 2020).

The relevance of the question addressed in this section lies on the fact that on the one hand, higher trade costs undermine export upgrading (including improvement in export product quality and export product diversification) (e.g., Bas and Strauss-Kahn, 2015; Beverelli et al., 2015; Chen and Juvenal, 2022; Dennis and Shepherd, 2011), and more generally, hinder countries' ability to produce and export sophisticated products (e.g., Hu et al., 2022; Weldemicael, 2014). On the other hand, Nguyen (2022) has found empirically that the improvement in the economic complexity level reduces the size of the shadow economy in the long run. In light of the foregoing, one could expect that by reducing trade costs and encouraging the export of complex products, AfT flows could help limit the development of underground activities, insofar as economic complexity has a negative effect on the size of the shadow economy. Overall, we postulate the hypothesis that AfT interventions would reduce the size of the shadow economy in economies that become increasingly sophisticated (hypothesis 4).

To test empirically hypothesis 4, we use two different indicators of economic sophistication. The first one is denoted "ECONC" and reflects the diversity and ubiquity of a country's export structure. It has been estimated using data connecting countries to the exported products, and applying the methodology described in Hausmann and Hidalgo (2009). Higher values of this indicator reflect greater economic complexity (see Appendix 1 for details on this indicator). The second indicator (denoted "PCI") is the level of productive capacities of a given country, and represents "the productive resources, entrepreneurial capabilities and production linkages which together determine the capacity of a country to produce goods and services and enable it to grow and develop" (e.g., UNCTAD (2006, p61; UNCTAD, 2020). It has been computed as a geometric average of eight components, namely, information communication and technologies, structural change, natural capital, human capital, energy, transport, the private sector and institutions (see UNCTAD, 2020). Its values range between 0 and 100, and with greater values reflecting greater productive capacities (see Appendix 1 for details on this indicator).

We estimate a first variant of model (1), that is, model (1) in which we incorporate the indicator of economic sophistication[1]. This specification of model (1) allows checking whether economic sophistication is a channel through which AfT interventions can affect the shadow economy. Put differently, we expect here that the introduction of the economic sophistication indicator in the baseline specification of model (1) would alter the coefficient of the variable "AfTTOT" (in Log) in column [1] of Table 2, either by diminishing the magnitude of this coefficient (which we remain significant at least at the 5% level - or eventually at the 10% level) or by cancelling out its statistical significance at the 5% level (or eventually at the 10% level). Columns [1] and [2] of Table 6 report the outcomes obtained from the estimation of this variant of model (1) (by means of the two-step system GMM estimator) using "ECONC" and "PCI" as measures of economic sophistication.

Second, we use the two-step system GMM estimator to estimate another specification of model (1) that contains the multiplicative variable between the indicator of total AfT flows and the indicator of economic sophistication (i.e., alternatively "ECONC" and "PCI"). This specification of model (1) would help test hypothesis 4, i.e., to examine the extent to which the effect of total AfT flows on the shadow economy is conditioned on economic sophistication. The outcomes of the estimation are presented in columns [3] and [4] of Table 6. Note that the specifications of model (1) where "PCI" is the measure of economic sophistication, do not contain the variables "FINDEV" and "INST", as these variables are components of the productive capacities index (see results in columns [2] and [4] of Table 6).

[Insert Table 6, here]

We note from all four columns of Table 6 that the coefficients of the lagged dependent variable are positive and significant at the 1% level, thereby suggesting the existence of a state dependence path in the shadow economy indicator. These outcomes validate the dynamic nature of model specifications whose results are reported in these columns of Table 6. In addition, these models are correctly specified, as exemplified by the outcomes of the diagnostic tests whose results are reported at the bottom of the Table. Thus, once again, the two-step system GMM estimator is well appropriate for the empirical analysis in this section.
Outcomes in columns [1] and [2] of Table 6 reveal that the introduction of the economic complexity indicator (either "ECONC" or "PCI") in the baseline model (1) has rendered the coefficient of the variable "AfTTOT" statistically nil. To recall, the coefficient of this variable in column [1] of Table 2 was significant at the 1% level, and amounted to -0.731. We conclude that the economic complexity measured either by the indicator "ECONC" or by "PCI" represents a channel through which AfT flows could affect the shadow economy.

Turning to outcomes in column [3], we observe that both the coefficient of the variable "[Log(AfTTOT)]" and the interaction term of the variable ("[Log(AfTTOT)]*ECONC") are negative and significant at the 1% level. Combined, these two results suggest that the effect of AfT flows on the shadow economy depends on recipient countries' level of economic complexity: AfT interventions are consistently associated with a reduction of the size of the shadow economy, and the magnitude of this negative effect increases (in absolute value) as countries increasingly export complex products, i.e., as their level of economic complexity improves. Figure 12 displays, at the 95 per cent confidence intervals, the marginal impact of total AfT flows on the shadow economy conditioning on the level of economic complexity. It appears that total AfT flows lead to an increase in the size of the shadow economy in countries with low levels of economic complexity (for example, this is the case of poor countries), especially in countries with a level of economic complexity[2] lower than -2.67. In contrast, AfT interventions have resulted in a reduction in the shadow economy size in countries whose level of economic complexity is higher than -0.18: for these countries, the higher the degree of economic complexity, the larger is the reduction of the shadow economy size. Finally, countries whose level of economic complexity ranges between -2.67 and -0.18 experience no significant effect of total AfT flows on the shadow economy.

[Insert Figure 12, here]

Estimates in column [4] of Table 6 show that the coefficient of [Log(AfTTOT)] is positive and significant at the 1% level, while the interaction term of the variable ([Log(AfTTOT)]*PCI) is negative and significant at the 1% level. Combined, these two results suggest that the effect of AfT flows on the shadow economy depends on recipient countries' level of productive capacities. On average, over the full sample, AfT interventions contribute to reducing the size of the shadow economy in countries whose level of productive capacities[3] is higher than 18.4 (= 1.769/0.0961), but result in an expansion of the shadow economy in countries that have weak productive capacities (i.e., those whose level of productive capacities is lower than 18.4 - example of poor countries).

[Insert Figure 13, here]

Figure 13 shows, at the 95 per cent confidence intervals, the marginal impact of total AfT flows on the shadow economy conditioning on the level of productive capacities. The pattern of the graph in this Figure is similar to the one observed in Figure 12. AfT interventions lead to an expansion of the shadow economy in countries with weak productive capacities, i.e., those whose level of productive capacities is lower than 17.7. In contrast, these resource flows reduce the size of the shadow economy in countries that have a relatively strong productive capacities, that is, those whose level of productive capacities exceeds the value of 28.2. For these countries, the stronger the productive capacities, the larger is the reduction effect of AfT interventions on the shadow economy. Finally, there is no significant effect of AfT interventions on the shadow economy in countries whose productive capacities range between -2.67 and 28.2.

[1] Note that we could not include here the trade costs indicator (in addition to the economic sophistication indicator), given that AfT interventions affect economic sophistication (and ultimately the size of shadow economy) through their effect on trade costs.

[2] Over the full sample, the values of the indicator 'ECONC' range from -3.01 and 1.28 (see Appendix 2).

[3] Over the full sample, the values of the indicator 'PCI' range from 13 and 39.2 (see Appendix 2).

8. Conclusion

Numerous studies have examined the drivers of the shadow economy. However, the shadow economy effect of development aid, let alone of AfT flows, has received little attention in the literature. The present analysis investigates the effect of AfT flows on the shadow economy using an unbalanced panel dataset of 106 countries over the period from 2002 to 2015. It has established empirically that over the full sample, higher AfT flows lead to a reduction of the size of the shadow economy. Among recipient countries of AfT flows, less developed countries enjoy a greater negative effect of AfT flows on the shadow economy than relatively advanced countries. Moreover, the negative effect of AfT flows on the shadow economy is larger in countries that face high trade costs, and the higher the overall trade costs, the larger is the magnitude of the negative effect of AfT flows on trade costs. The analysis has also revealed that AfT flows induce a shrinking of the shadow activities in countries that experience a depreciation of the real exchange rate, and the greater the depreciation of the real exchange rate, the larger is the reduction shadow economy effect of total AfT flows. Finally, AfT interventions reduce the size of the shadow economy in countries that export increasingly complex products, and in those that enhance their level of productive capacities.

These findings complement the existing works on the determinants of the shadow economy by showing that AfT interventions contribute significantly to reducing the size of the shadow economy in recipient countries. Participation in international trade promotes economic growth and development under certain conditions (e.g., Atkin and Donaldson, 2022; Singh, 2010), and AfT interventions help enhance countries' participation in international trade (e.g., Benziane et al., 2022). Especially, AfT flows allow recipient countries to reduce trade costs, upgrade exports, and ultimately reduce the size of the informal sector. It ensues that a greater financial support by the international trade community to developing countries through higher AfT flows would help them reduce underground activities. In turn, the resulting expansion of the formal sector could lead to higher public revenues, and reduce countries’ dependence on AfT flows in the medium term.

Declarations

‘Funding’ and/or ‘Competing interests’
The author has no relevant financial or non-financial interests to disclose. The author has also no competing interests to declare that are relevant to the content of this article. The article does not require any "Informed Consent".

**Data availability statement**

The data that support the findings of this study are accessible online, as described in Appendix 1 of the manuscript, and could also be obtained upon request from the corresponding author.

**References**


Tables

Table 1: Effect of AfT flows on the shadow economy

Estimator: Within Fixed Effects
### Table 2: Effect of AfT flows on the shadow economy

**Estimator:** Two-Step System GMM

<table>
<thead>
<tr>
<th>Variables</th>
<th>SHADOW (1)</th>
<th>SHADOW (2)</th>
<th>SHADOW (3)</th>
<th>SHADOW (4)</th>
<th>SHADOW (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log(AfTTOT)_{t-1}</td>
<td>-1.201***</td>
<td>-1.135**</td>
<td>-0.339*</td>
<td>-0.339*</td>
<td>0.633***</td>
</tr>
<tr>
<td>Log(AfTINFRA)_{t-1}</td>
<td>-0.644***</td>
<td>-0.644***</td>
<td>-0.615***</td>
<td>-0.615***</td>
<td>0.618***</td>
</tr>
<tr>
<td>Log(AfTPROD)_{t-1}</td>
<td></td>
<td>-1.135**</td>
<td>-0.373**</td>
<td>-0.373**</td>
<td>0.599***</td>
</tr>
<tr>
<td>Log(AfTPOL)_{t-1}</td>
<td></td>
<td></td>
<td>-0.498***</td>
<td>-0.498***</td>
<td>0.579***</td>
</tr>
<tr>
<td>Log(NonAfT)_{t-1}</td>
<td>1.382***</td>
<td>1.402***</td>
<td>3.229***</td>
<td>3.229***</td>
<td>0.599***</td>
</tr>
<tr>
<td>Log(GDPC)_{t-1}</td>
<td>0.618***</td>
<td>0.557***</td>
<td>2.942***</td>
<td>2.942***</td>
<td>0.579***</td>
</tr>
<tr>
<td>FINDEV_{t-1}</td>
<td>-0.0436*</td>
<td>-0.0551***</td>
<td>-0.0535*</td>
<td>-0.0535*</td>
<td>-0.0559**</td>
</tr>
<tr>
<td>TAXBURD_{t-1}</td>
<td>0.633***</td>
<td>0.618***</td>
<td>0.599***</td>
<td>0.599***</td>
<td>0.579***</td>
</tr>
<tr>
<td>INST_{t-1}</td>
<td>0.633***</td>
<td>0.618***</td>
<td>0.599***</td>
<td>0.599***</td>
<td>0.579***</td>
</tr>
<tr>
<td>Constant</td>
<td>38.28***</td>
<td>36.60***</td>
<td>14.56***</td>
<td>14.56***</td>
<td>14.56***</td>
</tr>
</tbody>
</table>

**Note:** *p-value<0.1; **p-value<0.05; ***p-value<0.01. Robust Standard Errors are in parenthesis.

### Table 3: Effect of AfT flows and NonAfT flows on the shadow economy respectively for varying levels of the institutional and governance quality, and varying levels of the real per capita income

**Estimator:** Two-Step System GMM

<table>
<thead>
<tr>
<th>Variables</th>
<th>SHADOW (1)</th>
<th>SHADOW (2)</th>
<th>SHADOW (3)</th>
<th>SHADOW (4)</th>
<th>SHADOW (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHADOW_{t-1}</td>
<td>0.633***</td>
<td>0.618***</td>
<td>0.599***</td>
<td>0.599***</td>
<td>0.579***</td>
</tr>
<tr>
<td>Log(AfTTOT)</td>
<td>-0.731***</td>
<td></td>
<td>-1.762**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log(AfTINFRA)</td>
<td>-0.615***</td>
<td>-0.615***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log(AfTPROD)</td>
<td></td>
<td></td>
<td>-0.373**</td>
<td>-0.373**</td>
<td></td>
</tr>
<tr>
<td>Log(AfTPOL)</td>
<td></td>
<td></td>
<td>-0.498***</td>
<td>-0.498***</td>
<td></td>
</tr>
<tr>
<td>[Log(AfTTOT)]*[Log(GDPC)]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.115</td>
</tr>
<tr>
<td>Log(NonAfT)</td>
<td>1.357***</td>
<td>1.372***</td>
<td>1.191***</td>
<td>1.191***</td>
<td>0.959***</td>
</tr>
<tr>
<td>FINDEV</td>
<td>-0.0347**</td>
<td>-0.0347**</td>
<td>-0.0347**</td>
<td>-0.0347**</td>
<td>-0.0452***</td>
</tr>
<tr>
<td>INST</td>
<td>1.208***</td>
<td>1.061***</td>
<td>0.737**</td>
<td>0.737**</td>
<td>0.944***</td>
</tr>
<tr>
<td>Log(GDPC)</td>
<td>-0.209***</td>
<td>-2.122***</td>
<td>-2.284***</td>
<td>-2.284***</td>
<td>-4.296**</td>
</tr>
<tr>
<td>TAXBURD</td>
<td>0.0151</td>
<td>0.0304</td>
<td>0.00144</td>
<td>0.00144</td>
<td>0.0620**</td>
</tr>
</tbody>
</table>

**Note:** *p-value<0.1; **p-value<0.05; ***p-value<0.01. Robust Standard Errors are in parenthesis. All variables have been treated as endogenous. Time dummies have been included in the regressions.
### Table 4: Effect of AfT flows on the shadow economy

**Estimator:** Two-Step System GMM

<table>
<thead>
<tr>
<th>Variables</th>
<th>SHADOW (1)</th>
<th>SHADOW (2)</th>
<th>SHADOW (3)</th>
<th>SHADOW (4)</th>
<th>SHADOW (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHADOW_{t-1}</td>
<td>0.537***</td>
<td>0.584***</td>
<td>(0.0235)</td>
<td>(0.0281)</td>
<td>(0.0281)</td>
</tr>
<tr>
<td>Log(AfTTOT)</td>
<td>-0.937***</td>
<td>-0.559***</td>
<td>(0.218)</td>
<td>(0.178)</td>
<td>(0.178)</td>
</tr>
<tr>
<td>Log(NonAfT)</td>
<td>1.363***</td>
<td>6.281***</td>
<td>(0.154)</td>
<td>(1.428)</td>
<td>(1.428)</td>
</tr>
<tr>
<td>[Log(AfTTOT)]*[Log(NonAfT)]</td>
<td>-0.203**</td>
<td>(0.0892)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log(AfTTOT)*[Log(GDPC)]</td>
<td>-0.642***</td>
<td>(0.170)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FINDEV</td>
<td>-0.0237*</td>
<td>-0.0248**</td>
<td>(0.0139)</td>
<td>(0.0118)</td>
<td>(0.0118)</td>
</tr>
<tr>
<td>INST</td>
<td>4.470***</td>
<td>0.576**</td>
<td>(1.435)</td>
<td>(0.283)</td>
<td>(0.283)</td>
</tr>
<tr>
<td>Log(GDPC)</td>
<td>-2.656***</td>
<td>10.22***</td>
<td>(0.161)</td>
<td>(3.523)</td>
<td>(3.523)</td>
</tr>
<tr>
<td>[Log(AfTTOT)]*[Log(GDPC)]</td>
<td>4.470***</td>
<td>0.576**</td>
<td>(1.435)</td>
<td>(0.283)</td>
<td>(0.283)</td>
</tr>
<tr>
<td>FINDEV</td>
<td>0.0301</td>
<td>0.0401*</td>
<td>(0.0270)</td>
<td>(0.0207)</td>
<td>(0.0207)</td>
</tr>
</tbody>
</table>

**Note:** *p-value<0.1; **p-value<0.05; ***p-value<0.01. Robust Standard Errors are in parenthesis. All variables and the interaction variables have been treated as endogenous. Time dummies have been included in the regressions.

### Table 5: Effect of AfT flows on the shadow economy conditioned on the real exchange rate/economic sophistication

**Estimator:** Two-Step System GMM

<table>
<thead>
<tr>
<th>Variables</th>
<th>SHADOW (1)</th>
<th>SHADOW (2)</th>
<th>SHADOW (3)</th>
<th>SHADOW (4)</th>
<th>SHADOW (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHADOW_{t-1}</td>
<td>0.537***</td>
<td>0.584***</td>
<td>(0.0235)</td>
<td>(0.0281)</td>
<td>(0.0281)</td>
</tr>
<tr>
<td>Log(AfTTOT)</td>
<td>-0.937***</td>
<td>-0.559***</td>
<td>(0.218)</td>
<td>(0.178)</td>
<td>(0.178)</td>
</tr>
<tr>
<td>Log(NonAfT)</td>
<td>1.363***</td>
<td>6.281***</td>
<td>(0.154)</td>
<td>(1.428)</td>
<td>(1.428)</td>
</tr>
<tr>
<td>[Log(AfTTOT)]*[Log(NonAfT)]</td>
<td>-0.203**</td>
<td>(0.0892)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log(AfTTOT)*[Log(GDPC)]</td>
<td>-0.642***</td>
<td>(0.170)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FINDEV</td>
<td>-0.0237*</td>
<td>-0.0248**</td>
<td>(0.0139)</td>
<td>(0.0118)</td>
<td>(0.0118)</td>
</tr>
<tr>
<td>INST</td>
<td>4.470***</td>
<td>0.576**</td>
<td>(1.435)</td>
<td>(0.283)</td>
<td>(0.283)</td>
</tr>
<tr>
<td>Log(GDPC)</td>
<td>-2.656***</td>
<td>10.22***</td>
<td>(0.161)</td>
<td>(3.523)</td>
<td>(3.523)</td>
</tr>
<tr>
<td>[Log(AfTTOT)]*[Log(GDPC)]</td>
<td>4.470***</td>
<td>0.576**</td>
<td>(1.435)</td>
<td>(0.283)</td>
<td>(0.283)</td>
</tr>
<tr>
<td>FINDEV</td>
<td>0.0301</td>
<td>0.0401*</td>
<td>(0.0270)</td>
<td>(0.0207)</td>
<td>(0.0207)</td>
</tr>
</tbody>
</table>

**Note:** *p-value<0.1; **p-value<0.05; ***p-value<0.01. Robust Standard Errors are in parenthesis. All variables and the interaction variables have been treated as endogenous. Time dummies have been included in the regressions.
### Table 6: Effect of AfT flows on the shadow economy conditioned on export product diversification/economic sophistication

**Estimator:** Two-Step System GMM

<table>
<thead>
<tr>
<th>Variables</th>
<th>SHADOW (1)</th>
<th>SHADOW (2)</th>
<th>SHADOW (3)</th>
<th>SHADOW (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHADOW_{t-1}</td>
<td>0.720***</td>
<td>0.650***</td>
<td>0.752***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0284)</td>
<td>(0.0320)</td>
<td>(0.0246)</td>
<td></td>
</tr>
<tr>
<td>Log(AfTTOT)</td>
<td>0.181</td>
<td>-0.668**</td>
<td>2.299***</td>
<td>-0.588**</td>
</tr>
<tr>
<td></td>
<td>(0.245)</td>
<td>(0.317)</td>
<td>(0.744)</td>
<td>(0.0588)</td>
</tr>
<tr>
<td>ECONC</td>
<td>-2.706***</td>
<td>9.776**</td>
<td></td>
<td>1.769***</td>
</tr>
<tr>
<td></td>
<td>(0.720)</td>
<td>(3.937)</td>
<td></td>
<td>(0.521)</td>
</tr>
<tr>
<td>PCI</td>
<td>-0.180***</td>
<td>-0.588**</td>
<td>-0.0961***</td>
<td>0.205</td>
</tr>
<tr>
<td></td>
<td>(0.0588)</td>
<td>(0.205)</td>
<td>(0.0274)</td>
<td></td>
</tr>
<tr>
<td>[Log(AfTTOT)]*ECONC</td>
<td></td>
<td>-0.588**</td>
<td>-0.0961***</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.205)</td>
<td>(0.0274)</td>
<td></td>
</tr>
<tr>
<td>[Log(AfTTOT)]*PCI</td>
<td></td>
<td></td>
<td>-0.0961***</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.0274)</td>
<td></td>
</tr>
<tr>
<td>Log(NonAfT)</td>
<td>0.678</td>
<td>0.997**</td>
<td>0.655</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.471)</td>
<td>(0.409)</td>
<td>(0.410)</td>
<td></td>
</tr>
<tr>
<td>FINDEV</td>
<td>-0.0221</td>
<td>-0.0528***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0150)</td>
<td>(0.0130)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INST</td>
<td>0.178</td>
<td>0.425</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.430)</td>
<td>(0.497)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log(GDPC)</td>
<td>-1.495***</td>
<td>-1.794***</td>
<td>-0.940***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.282)</td>
<td>(0.340)</td>
<td>(0.227)</td>
<td></td>
</tr>
<tr>
<td>TAXBURD</td>
<td>0.0588***</td>
<td>0.0995***</td>
<td>0.0714***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0197)</td>
<td>(0.0203)</td>
<td>(0.0251)</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** *p-value<0.1; **p-value<0.05; ***p-value<0.01. Robust Standard Errors are in parenthesis. All variables and the interaction variables have been treated as endogenous. Time dummies have been included in the regressions. Note that the specifications of model (1) whose results are reported in columns [2] and [4] do not contain the variables “FINDEV” and “INST”, as these variables are components of the productive capacities indicator.
Figure 1

Total Aft and the shadow economy over the full sample

*Note: The variable “AFTTOT” is the gross disbursement of total Aid for Trade, and expressed in million US$, constant 2019 prices.*

Figure 2

Scatter plot between Total Aft and its components, and the shadow economy over the full sample

*Source: Author*
Figure 3
Marginal Impact of "AFTOT" on "SHADOW" for varying levels of the real per capita income

Source: Author

Figure 4
Marginal Impact of "AFTOT" on "SHADOW" conditioned on the quality of institutions and governance

Source: Author
Figure 5
Marginal Impact of "NonAFT" on "SHADOW" for varying levels of the real per capita income

Figure 6
Marginal Impact of "AFTTOT" on "SHADOW" for varying overall trade costs
Figure 7
Marginal Impact of "AfTINFRA" on "SHADOW" for varying overall trade costs

Figure 8
Marginal Impact of "AfTPROD" on "SHADOW" for varying overall trade costs
Figure 9
Marginal Impact of "AfTPOL" on "SHADOW" for varying overall trade costs

Figure 10
Marginal Impact of "AfTTOT" on "SHADOW" conditioned on the real exchange rate
Figure 11
Marginal Impact of "NonAfT" on "SHADOW" conditioned on the real exchange rate

Source: Author

Figure 12
Marginal Impact of "AFTOT" on "SHADOW" conditioned on the level of economic complexity

Source: Author
Figure 13

Marginal Impact of "AFFTOT" on "SHADOW" conditioned on the level of Productive Capacities

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- TablesandAppendices.docx