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Informal earnings and domestic production – the size of the shadow economy of the household: Case of Turkey

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Abstract

We performed our calculations to find out the value of domestic production and the size of the informal economy of the households. The dataset used in this estimation was obtained by matching the Turkey Time Use Survey of 2006 with the Household Budget Survey for the years 2007–2011. Informal earnings were measured using household budgetary declarations and the concept of full income (including monetary values of time use on non-market activities). In our analysis, we use terms of extended incomes (i.e. monetary incomes with the informal earnings of households) and extended full incomes (i.e. monetary incomes and monetary time values including informal earnings). An important finding is that higher domestic production reduces the size of the informal economy among the self-employed, yet it has the opposite effect for wage earners. The average estimation of

Keywords

- informal economy
- time use
- extended full income
- full prices

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the size of the informal economy in Turkey decreased on average from 73.59% to 70.89% of GDP respectively for monetary and full expenditure for the years 2007–2011. Further, deeper analysis is needed to analyse income inequality among wage earners and self-employed workers participating in informal activities.

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Introduction

It is crucial for governments to be specific in their policies and programmatic interventions in order to avoid any undesired economic and social costs arising from poverty and informal markets. Some researchers have examined the effect of time allocation decisions (as a substitution between working in informal and domestic activities) on income inequality. A reasonable hypothesis is that the monetary value of time spent on domestic activities is highly correlated with the socioeconomic characters of the households. The unit monetary value of time spent (i.e. the opportunity cost of time) varies depending on elastic market structures, family types, professional activities, etc. Aktuna-Gunes et al. (2014) demonstrate that participation in informal activity at the micro-decision level necessitates integrating the conditions of shortage relating to the resources used in domestic production. Especially for developing economies, insufficient monetary incomes along with lower opportunity costs of time for households result in an increase in the rate of participation in informal activities to obtain the necessary goods and services. As a complementary study, Aktuna-Gunes et al. (2017) investigated the behaviour of households through price, time use and income elasticities. According to their findings, time-cost elasticities are shown to be larger in absolute value than their monetary price counterparts. While for income effects, the time-resource elasticities are lower in absolute value than the monetary income ones. These results show a large difference in the substitution effect between time and money among households participating or not participating in informal activities.

As far as the organisation of this article is concerned, we first get cross-sectional data by matching the classic Household Budget and Time Use surveys for Turkey for the years 2007–2011. Secondly, we use cross-sectional data within a complete demand system framework but estimated on full prices and full expenditures (i.e. monetary expenditures plus the monetary time values of domestic activities). Next, we measure the size of informal earning of both the self-employed and wage earner population.

The remainder of the paper proceeds as follows: Section 1 presents the full price concept and the theoretical model of the complete demand system in the context of the under-reporting of income from various sources with the model of full prices. Section 2 derives the econometric specification of the complete demand model. Section 3 introduces the combined datasets of the Household Budget and Time Use surveys used in the estimations with a short description of the matching procedure in Section 4. Section 5 reports the empirical results, and the last part concludes the paper[5].

1. Domestic production

Full price values and estimations of the size of the informal economy are computations that are both necessary to obtain the full incomes of households. Briefly speaking, the full price approach is used to define the cost of the final goods produced in domestic production. This is a new method used to estimate the opportunity cost of time (OCT) and price elasticities at the micro level (see Aktuna-Gunes et al., 2017; Gardes, 2019). The methodology that was mainly used so far assumed that OCT is equal to the market wage rate for a person working in a given profession, or for people with irregular work – "reservation wage" – the minimum wage for which one is willing to work (Cornet et al., 2022; Hecman, 2015; Jara-Díaz et al., 2008). We suppose that full prices (as the cost of final goods production) also play a role in participation decisions regarding informal activities.

[5] An earlier working-paper version of this research, which focused primarily on income inequality, was presented by O. Gunes (2017) at the 18th Annual Meeting of the Association for Public Economic Theory (APET), held at Université Paris-Panthéon-Assas in Paris, France, on July 10–13, 2017. In the current version of the paper, the section on income inequality has been completely removed, resulting in a more coherent article. Neither this version nor any earlier versions of the paper have been published previously.

1.1. The full price concept

The full price approach is explained in Aktuna-Gunes et al. (2017). Becker (1965) considers a set of final goods, Z_i for $i = 1$ to m, whose quantities enter the direct utility function of the consumer $u(Z_1, Z_2, \dots, Z_m)$. In order to simplify the analysis, Becker states that a separate activity i produces the final good i in quantity Z_i using a unique market good in quantity x_i and unit time t_i per unit of activity i. Finally, the time to produce activity i is supposed to be proportional to the quantity of the market factor: $t_i = \tau_i x_i$[6]. Thus, the final goods are produced by a set of domestic production functions f_i: $Z_i = f_i(x_i, \tau_i; W)$; with all other (socio-economic) characteristics of the household in the vector W. This assumption allows Becker to create the consumer theory: Max $u(Z_1, Z_2, \dots, Z_m)$ such that $Z_i = f_i(x_i, \tau_i; W)$, $\sum_i p_i x_i = y$ and $\sum_i \tau_i x_i + t_w = T$, with $y = wt_w + V$ being monetary income which incorporates labour and other incomes, t_w the labour time on the market and T the total disposable time for one period. In the case of multiple market goods used in activity i, a generalisation for the bundle of market goods used to produce the activity can be performed by defining the aggregate commodities of these market goods for i: the monetary price p_i can be defined as a price index for the bundle of corresponding goods coherent with the monetary budget constraint.

The sum of these three constraints gives the full budget constraint, which depends on full income y^f, defined as the maximum monetary income which could be earned if all available time T were supplied to the market at the net wage rate w: $y^f = wT$. The full price for each final good i expressed as $p_i x_i + \omega t_i$, where ω represents the opportunity cost of time, which can eventually be taken as the agent's market wage rate. If the agent's opportunity cost ω differs from the net wage, the full budget constraint is written as:

$$\sum_i (p_i x_i + \omega t_i) = y^f + (\omega - w)(T - t_w) = y^f + (\omega - w)\sum_i \tau_i x_i \qquad (1)$$

In this case, the full income is corrected by means of a function of the domestic production time which represents the difference between the market and the personal valuation of that time – the agent substrates from their full income the transaction cost between their leisure and market labour opportunity cost of time (this correction applies whence the market labour supply t_w is predetermined, which defines the monetary income).

[6] For a description of complementarity between market goods and time use in domestic production see Table A1 in the Appendix.

$$\pi_{ih} = \frac{(p_{it} + \omega_{ht}\tau_{ht})x_{ih}}{p_i x_{ih}} = \frac{p_{it} + \omega_{ht}\tau_{ht}}{p_i} = 1 + \frac{\omega_{ht}\tau_{ht}}{p_i} = \frac{1}{p_i} p_{ih}^f \quad (2)$$

Under the assumption of a common monetary price p_i for all households in a survey during the same period, this ratio contains all the information on the differences of full prices between households derived from their opportunity cost of time ω_h and the coefficient of production τ_{ih}. If the monetary price changes between households or periods, the full price can be computed as the product of this proxy π_{ih} with p_{ih}: $p_{ih}^f = p_{iht}\,\pi_{ih}$. With these definitions, it is possible to measure the full prices, observing only monetary and full expenditures by Equation (1). The market wage net of taxes has been used to calibrate the opportunity cost of time (for a discussion on this subject, see, for example, Gardes & Starzec, 2015).

1.2. Informal production

The lack of reliable direct statistics on the informal economy requires both a specific methodological solution and appropriate databases to indirectly evaluate the size of unreported incomes. The most frequently used methods are based on a macroeconomic approach, very often giving disparate evaluations (Schneider & Enste, 2000)[7]. The background of these various macroeconomic methods is frequently discussed and criticised. For instance, Thomas (1999) points out that they are not based on any theory.

In our study, we use the complete demand system approach developed by Lyssiotou et al. (2004) (see also Aktuna-Gunes et al., 2014; Fortin et al., 2009), for an estimation of the size of the shadow economy in Turkey. The model will be estimated on individual cross-section household data covering the period 2007–2011. The basic idea of this approach is to estimate the individual Engel curves and compare the observed expenditures and income. Underreported income is described as the difference between the level of reported income and its theoretical level

[7] The large differences between the estimates are essentially due to the method used. These differences prevent policy makers from evaluating the gravity of the problem so as to adopt appropriate policies. This is also the case in Turkey. Many methods have been used in the past such as the money demand method by Ögunç and Yılmaz (2000) as well as by Cetintas and Vergil (2003), the tax collection method by Ilgın (2002), the electricity usage method by Us (2004), and the Dynamic Multiple Indicators Multiple Causes Method (DYMIMIC) by Schneider and Savaşan (2007), which creates a discussion about the reliability of the estimated size of the Turkish informal sector (see Ülgen & Öztürk, 2006). Indeed, these studies give very different estimations of the informal economy in Turkey, from 3.61% (Temel et al., 1994) to 139% (Akalin & Kesikoğlu, 2007), depending on the method used for relatively recent and comparable periods.

corresponding to the observed expenditures which are supposed to be exactly as reported. We propose a complete demand system approach for the estimation of the under-reported part of incomes both for self-employed and wage-earners[8]. This approach allows us to identify more accurate coefficients for under-reporting due to self-employed incomes and to wages by assuming that the consumption of each good, related to its marginal propensity of consumption, is the same as in the case of the revenue actually observed. Thus, it is possible to compute the size of the black economy on the basis of the information regarding the relative amount of self-employment and wage incomes in GDP. In this model, we compare all goods, services and full incomes with the full price values proposed by Alpman and Gardes (2016) (see also Aktuna-Gunes et al., 2017) in a quadratic demand system in order to better identify the influences of domestic activities on informal earnings. "Full" values are obtained by integrating monetary time use values in income and in price.

A widely accepted approach for quantifying the extent of underreported income among the self-employed is the method introduced by Pissarides and Weber. In their seminal study, Pissarides and Weber (1989) were the first to provide an empirical estimate of concealed income in this population. Their framework rests on two key assumptions: (i) household food expenditure is accurately reported in survey data, and (ii) wage and salary workers disclose their earnings fully. Using these premises, the authors inferred the magnitude of unreported income by comparing discrepancies between reported income and food expenditure across households headed by employees and the self-employed. This methodology has since been refined and applied extensively in subsequent research examining informal income or tax evasion.

The study by Pissarides and Weber focused on household expenditure on food. A similar approach, examining food expenditure shares among the self-employed and wage employees, was presented, among others, by Kim et al. (2009). In turn, the works of Lyssiotou et al. (2004) and Fortin et al. (2009) introduced the AIDS model (including its quadratic extension, QAIDS) for modelling expenditure shares across various goods. The approach proposed by Lyssiotou et al. (2004) initially attracted criticism regarding the plausibility of the Engel curve assumptions employed in the model-building procedure. An example of such critique is Tedds (2010), who, while also drawing on the Pissarides-Weber framework, proposed nonparametric estimation methods. However, advances in numerical techniques have led to a growing body of research building on ideas similar to those of Lyssiotou et al. (2004). More recent contributions include Aktuna-Gunes et

[8] According to research conducted by the Republic of Turkey Social Security Institution in 2011, 75% of wage-earners declared a minimum wage lower than their real wage-rate. Undeclared wage earners represent 45.63% of total wage earners.

al. (2014), Cabral et al. (2018, 2019). In Cabral et al. (2018), the authors applied a demand system to two categories of expenditure (food and durable goods), whereas Cabral et al. (2019) extended the analysis to a broader set of expenditure categories. The previously cited study by Kim et al. (2009) was recalculated using more recent data and subsequently published as Kim et al. (2017). This demonstrates the substantial potential of this approach for estimating the scale of the black economy.

Following Lyssiotou et al. (2004), Fortin et al. (2009) and Aktuna-Gunes et al. (2014), we consider households with separable preferences in durable and nondurable goods represented by a cost function: $C(p, U) = F(c(p, U), d(r, U), U)$, where p, r and U correspond to the price vector of nondurable and durable goods, and to the household utility level. The $c(.)$ and $d(.)$ functions represent aggregate price indexes for nondurable and durable goods, respectively. In other words, they are the sub-cost functions which reflect the prices of unit costs paid by households for each type of good. Each of these functions increases in U and is linearly homogeneous in price. This structure implies that household consumption decisions can be decomposed into two-stage budgeting.

1. The household begins with allocating its total revenue Y^* to the expenditure of durable and nondurable goods according to the cost minimising rule (with the help of $c(.)$ and $d(.)$).

   For example, demand for the i^{th} good in the nondurable group is defined as:

$$q_i = \frac{\partial F(.)}{\partial c(.)} \cdot \frac{\partial c(.)}{\partial p_i} \tag{3}$$

Therefore, we can aggregate the demand of q_i to obtain the household total expenditure of nondurable goods by using Shephard's lemma and the first-degree homogeneity property on p of the $c(.)$ function.

$$y = \sum_i p_i q_i = \frac{\partial F(.)}{\partial c(.)} \sum_i p_i \frac{\partial c(.)}{\partial p_i} = \frac{\partial F(.)}{\partial c(.)} c(.) \tag{4}$$

2. In the second step, the household chooses the part of the expenditure for each good which belongs to a given group (durable, nondurable) within the total expenditure of each group according to the price vector of this group and to the total utility level.

More precisely, the share of nondurable expenditures w_i within the total expenditure (y) is given by:

$$w_i = \frac{p_i q_i}{y} = \frac{p_i \dfrac{\partial F(.)}{\partial c(.)} \cdot \dfrac{\partial c(.)}{\partial p_i}}{\dfrac{\partial F(.)}{\partial c(.)} c(.)} = \frac{p_i \dfrac{\partial c(.)}{\partial p_i}}{c(.)} = \frac{p_i}{\partial p_i} \cdot \frac{\partial c(.)}{c(.)} = \frac{\partial \ln c(.)}{\partial \ln p_i} \tag{5}$$

Following Banks et al. (1997), $c(.)$ and $d(.)$ are specified as Pig-log cost functions, and Equation (5) can thus be written as a Quadratic Almost Ideal Demand System (see Section 2).

2. Complete demand system estimation using full prices

It can be assumed that the unit cost of goods has the following quadratic logarithmic form (Lewbel, 1990):

$$\ln c(p, U) = a(p) + b(p)\left[\frac{U}{1 - g(p)U}\right] \tag{6}$$

where $a(p)$, $b(p)$ and $g(p)$ are some functions homogeneous in p. Hicksian shares are budget shares:

$$w_i = a(p) + b(p)\left[\frac{U}{1 - g(p)U}\right] + \lambda_i(p)\left[\frac{U}{1 - g(p)U}\right]^2 \tag{7}$$

where $a_i(p) = \partial \ln a(p)/\partial \ln p_i$, $b_i(p) = \partial \ln b(p)/\partial \ln p_i$ and $\lambda_i(p) = b_i(p)\partial \ln g(p)/\partial \ln p_i$, and U is the households utility level. In order to calculate the budget share within the system of Engel Curves, the base period prices can be assumed to be equal to 1, such as $p = r = 1$, by introducing the h subscript which denotes the individual households:

$$w_{ih} = \alpha_i + \beta_i\left[\ln Y_h^*\right] + \delta_i\left[\ln Y_h^*\right]^2 \tag{8}$$

where Y^* is the total (true) income and using Equation (7), $U/(1 - g_0 U) = (\ln Y^* - a_0)/b_0$, where a_0, b_0 with g_0 are the values corresponding functions at $p_i = r_i = 1$. The parameters are α, β, δ. This equation represents the quadratic Engel curve derived from the Pig-log cost function.

We assume in our model that Y^* is separated into three sources denoted a, s, r, which respectively correspond to other income sources, wages and self-employ-

ment income. Thus, the total reported (true) income is supposed to be a weighted sum of these three sources.

$$Y_h^{\star} = \sum_{m=a,s,r} \theta_m Y_{mh} \tag{9}$$

This equation implies that the true income must be equal to the sum of the observed incomes (Y_a, Y_s, Y_r) multiplied by their corresponding factors (θ_a, θ_s, θ_r), where we suppose θ_r, $\theta_s \geq 1$ (i.e. underreporting) and $\theta_a = 1$ (correct observation of the other incomes). It allows us to calculate the size of the underground economy and the saving tendencies with respect to the underreporting part of declared incomes by an estimation of θ_r and θ_s.

Finally, the sum of each source of income can be determined as a ratio of the reported total income: $y_m = Y_m/Y$, where Y is the sum of the other sources such as fees, government transfers, etc., as well as wages and self-employment incomes. Following the model proposed by Aktuna-Gunes et al. (2014, based on Banks et al., 1997), we consider all goods and services with full price values in a quadratic demand system:

$$w_{ih} = \alpha_i + \sum_j \alpha_{ij} Z_{jh} + \beta_{1i}\left[\ln Y_h + \ln\left(\sum_{m=a,s,r} \theta_m y_m\right)\right] + \\ + \beta_{2i}\left[\ln Y_h + \ln\left(\sum_{m=a,s,r} \theta_m y_m\right)\right]^2 + \sum_j \gamma_{ij} \log \pi_{jh} + e_{ih} \tag{10}$$

where w, π, Z, represent respectively budget share, full prices and the household characteristics vector (which allows us to take into account the heterogeneity of preferences), and y_m the tree components of income. We cannot expect individuals from different social groups to have the same reaction in terms of consumption and saving choices with respect to different types of incomes especially when there is uncertainty about these revenues.

3. Micro data, matching statistics

We use two household surveys from the Turkish Statistical Institute (TURKSTAT): the 2006 Time Use Survey (TUS) and the Household Budget Survey (HBS) covering the years 2007–2011. The HBS was conducted with 720 households each month, totalling 8,640 households per year. Three basic groups of variables were obtained from these surveys: 1) variables of the socio-economic status of the households,

such as the status of the property or house, living in a village or rural area, etc., 2) variables related to the individuals (age, gender, academic background), and 3) consumption expenditure variables (food and non-alcoholic beverages, alcoholic beverages along with cigarettes and tobacco, clothing, health, transportation, education services, etc.). In the 2006 TUS, approximately 390 households were selected each month giving a total of 5,070 households during the whole year. Within these households, 11,815 members aged 15 and over were interviewed and asked to complete two diaries – one for a weekday and one for a weekend day – in which they recorded all their activities over a 24-hour period in ten-minute intervals. The 2006 Time Use Survey is matched independently with the Household Budget Survey in terms of monetary and time expenditure data. In this application, we do not take into account the possible spatial autocorrelation within regions.

We combine the monetary and time expenditures into a unique consumption activity at the individual level. We proceed with the matching of these surveys by using similar exogenous characteristics in both datasets, such as age, household size (based on OECD equivalence scales), the share of children, marital status, home ownership, number of household members and geographical location, applied separately for household heads and women. The selection equation focuses on households that report a positive time use in terms of their activities. More precisely, we estimate 8 categories of time use in the TUS which are also compatible with the data available from the HBS, defined as follows:

1. Food Time (TUS) – Food Expenditures (HBS);
2. Personal Care and Health Time (TUS) – Personal Care and Health Expenditures (HBS);
3. Housing Time (TUS) – Dwelling Expenditures (HBS);
4. Clothing Time (TUS) – Clothing Expenditures (HBS);
5. Education Time (TUS) – Education Expenditures (HBS);
6. Transport Time (TUS) – Transport Expenditures (HBS);
7. Leisure Time (TUS) – Leisure Expenditures (HBS);
8. Other Time (TUS) – Other Expenditures (HBS).

Food Time includes household and family care activities related to food preparation and management. Personal Care Time covers personal care, commercial-managerial-personal services, and caring for a sick or elderly household member. Housing Time corresponds to household and family care activities such as home maintenance, gardening, pet and animal care, construction or repair work, and tasks related to managing the household. Clothing Time consists of washing clothes and ironing clothes. Education Time includes study-related activities (education) and childcare. Transport Time consists of travel and periods of unspecified time use. Leisure Time encompasses voluntary work and meetings, social and entertainment activities, cultural events, rest and holidays, sports and physical exer-

cise, including hunting, fishing, etc., along with hobbies, games and mass-media consumption such as reading, watching television or listening to radio and music. Other Time includes time spent in employment and in searching for work.

4. Matching procedure

The high level of domestic production in developing countries[9] increases the possibility of substitution between formal and informal incomes via, among other things, domestic activities. In this respect, in the estimation, we combined the Household Budget Surveys for the years from 2007 to 2011 with the Time Use Survey for 2006.

However, time use surveys are often conducted only periodically and the variables available for imputation are not the same between surveys. It is rare to find datasets with both budget and time use data. The most common approach is to impute the value of household production income to individuals in the budget dataset. First, the time spent in household production is predicted from the time-use data in a regression framework using covariates that are common to both datasets. The predicted values are converted to the same time period as the income variables and then merged into the income dataset using a set of common variables.

In this study, we use Rubin's (1986) matching approach, which is considered to be distinct from almost all other work on this topic (Moriarity & Scheuren, 2003). The matching procedure proposed by Rubin allows us to overcome two major problems relating to traditional matching methods. When imputing the monetary expenditure allocated to activity i, denoted x_i, into the time use survey, traditional procedures use the regression coefficients of x_i for the whole dataset (where Z is a set of variables such as age and education common to both datasets). Traditional procedures assume that monetary and time expenditures t_i allocated to activity i are conditionally independent given Z, disregarding as a consequence, the possible substitution between monetary and time inputs. Rubin (1986) showed that this assumption may considerably bias the regression coefficients. Rubin's concatenation methodology allows the regression coefficients of x_i on $(1, Z, t_i)$ and t_i on $(1, Z, x_i)$ to be obtained by assuming a partial correlation value between x_i and t_i given Z (where t_i is time allocated to activity i). Thus, x_i is predicted as a function of t_i and Z, while t_i is predicted as a function of x_i and Z for the whole dataset.

[9] Domestic production takes up the largest share of daily life in Turkish households. According to İlkkaracan and Gunduz (2009), this production represented values between 25% and 45% of GDP in 2006.

The second problem concerns the decrease in variance of the imputed values since traditional matching procedures smooth the variations in individual's expenditure data. As a consequence, inequalities in full income decrease, which is a major concern when seeking to address income inequalities. Rubin's approach matches each unit of the time survey to the observation with the closest predicted values of x_i in the consumer expenditure survey, conditional on identical characteristics as informed by Z. It follows that the observed value of the match is imputed to the missing values.

In order to overcome the two aforementioned problems, we take into account the concatenation between imputed variables in the time dataset[10]. To summarise the concatenation methodology proposed by Rubin (1986, 1987), the variable Y in survey A is imputed in survey B and the variable Z in survey B is imputed in survey A. The software used for this matching was developed by Alpman (2016). The details of the matching procedure are as follows:

1. We consider three different kinds of variable sets: the first group of variables (Y) include the above-explained time use categories in the TUS. The second group (Z) represents the expenditure variables in the HBS corresponding to (Y) in the TUS. The third set is the common variables (X) such as sex, age, marital status, education level, geographic location, employment status, sector of work and type of firm in both surveys. The main hypothesis is that the partial correlation between Y and Z given X is supposed to be other than zero, and is thus denoted: $\rho_{Y, Z|X \neq 0}$.
2. Therefore, the partial variance of Y and Z given X, respectively $\rho_{Y|X}$ and $\rho_{Z|X}$, can be obtained by linear regressions of Y and Z on X. We begin with a linear regression model, where Y and Z are successively regressed on X:

$$Y = a_0 + aX + \epsilon \tag{11}$$

$$Z = b_0 + bX + \mu \tag{12}$$

3. The partial covariance of (Y, Z) given X, denoted $\sigma_{Y, Z|X}$, can be deduced from $\rho_{Y, Z|X} (\rho_{Y|X} \cdot \rho_{Z|X})^{1/2}$.
4. Supposing that α and β are the column vectors of the regression coefficients of Y on $(1, X)$ and Z on $(1, X)$ respectively, Y and Z values may be generated for the dataset formed by A and B by using these regression coefficients. In this prediction, it is assumed that Y and Z values are conditionally independent for a given X. Rubin (1986) applies the sweep matrix operator: sweeping on Y gives the regression coefficients of Z on $(1, X, Y)$ while sweeping on Z gives the re-

[10] We would like to thank A. Alpman for his help in the application of this matching procedure. See a discussion of matching procedure in Alpman and Gardes (2016).

gression coefficients of Y on $(1, X, Z)$. The new regression coefficients are used to create new predicted Y and Z values for the dataset formed by A and B.

5. Thus, the predicted Y and Z are used in the prediction equation for Y given X and Z and in the prediction equation for Z given X and Y. These are the new prediction coefficients used to create new Y and Z values for the dataset formed by A and B: each missing unit of Z in A (and Y in B) is matched with the closest new predicted Z value in B (and Y in A), dependent on identical characteristics informed by X.

5. Empirical results

We estimate a complete demand expenditure system (Equation 10) using the Generalized Method of Moments (GMM) for both full expenditure (time plus money) and for monetary expenditure alone. We integrate prices in the equation and the income variables are taken as endogenous. The same estimation is found in by Aktuna-Gunes et al. (2017), which measures the size of the informal economy for the years from 2003 to 2006 inclusive. The control variables included in the model are the OECD equivalence scale, home ownership, indicators for men and women in white-collar occupations, and the natural logarithm of household members' ages. We also account for two interaction terms: self-employed men and male wage earners in white-collar occupations with permanent contracts, along with fixed-term contracts for both men and women. Additional controls include household type – classified as single, single with children, couple, couple with children, and other family types – educational attainment dummies for men and women, and durable-goods indicators such as computer ownership and the presence of an effective heating system. We further control for the number of rooms in the dwelling and the number of mobile phones. After several trials to identify suitable instruments, we selected the following: the logarithm of the OECD equivalence scale, sex, the natural logarithm of age for men and women, its squared term for each, and the ratio of children to adults within the household's characteristics vector (see Lyssiotou et al., 2004; Aktuna-Gunes et al., 2014).

The estimation of the model for full expenditures and exclusively monetary expenditures from the pooled cross-sectional data covering the 2007–2011 period of investigation is presented in Table A2 and Table A3 respectively in the Appendix[11].

[11] Based on the 2007 variables, the over-identifying restriction in the estimation is 6.56. The Chi-square *p*-value for monetary estimations is 0.83, which is bigger than 0.05, so the null hypotheses and the validity of the identifying instruments cannot be rejected for the chosen control variables.

The size of the pooled sample increased to 33,765 households. The parameters of the estimates of only seven budget share equations are reported in these tables since the parameters of Equation 8 (other goods/services) are redundant due to the adding up condition.

We obtain the size of the informal economy for each year (Table 1) by scaling up the under-reported parameters *k* and *l* (estimated by monetary and full expenditure) with the income part of self-employed and wage earners in GDP (Table A4 in Appendix). The corresponding size of the informal economy between 2007 and 2011 for self-employed workers varies between 32.12% and 29.52%, and from 25.34% to 23.30% of GDP for the monetary and the full expenditure estimations. The size of the informal economy decreases on average by 6.53% (= 30.96% to 24.43%) due to the time use intensive domestic production of self-employed households.

Table 1. The size of informal economy in Turkey for the years between 2007 and 2011 (in %)

Data range	Type of employment	2007	2008	2009	2010	2011	Avg.	Total
Monetary expenditure	Wage earners	39.21	41.63	39.64	46.04	46.61	42.63	73.59
	Self employed	32.12	30.98	31.61	30.57	29.52	30.96	
Full expenditure*	Wage earners	42.74	45.38	43.21	50.18	50.81	46.46	70.89
	Self employed	25.34	24.45	24.94	24.12	23.30	24.43	

Note: * Full expenditure = monetary expenditures + monetary time use values.

Source: own calculations.

Conversely, however, this estimation points out inverse results for wage earners. The corresponding size of the informal economy between 2007 and 2011 for wage earners varies between 46.61% and 39.21% and from 50.81% to 42.74% of GDP for the monetary and the full expenditure estimations, respectively. This indicates that the size of the informal economy increases on average by 3.83% (= 42.63% to 46.46%) due to the commodity intensive domestic production of wage-earning households. The last column in Table 1 shows the total effect domestic activities have on the under-reporting of income. When domestic activities are included, the size of the informal sector decreases by 2.7 points (from 73.59% to 70.89%).

We keep the same control variables and do not add new ones in order to compare the results obtained from both estimations.

Conclusions

In this paper, we show how the time use values of households may determine the size of the informal economy in Turkey between 2007 and 2011. The model is well estimated with almost all significant parameters in place. The informal economy results are three-fold:

1. An increase in domestic production yields a decrease in the size of the informal economy for the self-employed (on average from 30.96% to 24.43% when we consider domestic production). The main argument underpinning this result is that the time use substitution elasticity of final goods production for self-employed workers would be elastic, implying that they have more time-intensive domestic production technology than other workers.
2. An increase in domestic production yields an increase in the average size of the informal economy among wage earners, which rose from 42.63% to 46.46% in Turkey. When we look at the national statistics[12], the average weekly hours worked by wage earners are high while they consume less. Wage earners participated in informal activities in order to compensate for a lack of monetary resources to use in domestic production.
3. We consider all goods taking into account domestic production in a complete demand system framework by adding the monetary value of time use to the monetary expenditures. The average estimation of the size of the informal economy in Turkey decreased on average from 73.59% to 70.89% of GDP, respectively, for monetary and full expenditure for the years 2007–2011. Comparing our results for a developing country such as Turkey with findings for the Quebec region (Fortin et al., 2009), using the same methodology, reveals a striking contrast. The informal sector accounted for about 6% in Quebec in 2002, whereas for Turkey it reached 65.6% when measured with monetary income and 79.28% when measured with full income for the years 2003–2006 (Aktuna-Gunes et al., 2017).
4. The results obtained should also rise specific actions within the framework of socio-economic policy. The significant size of the informal economy demonstrates that Turkey requires a multi-dimensional strategy that would combine tax, insurance, institutional and social reforms. Specific actions that could improve the situation include reducing the costs of legality, especially for small

[12] According to the Turkish Statistical Institute, during these years the average inflation rate was 8.66 and the unemployment rate was 14.14 with an increasing tendency. The average weekly hours worked on the main job was 51.12 hours, while it was 36.82 for OECD countries. According to the OECD statistics, purchasing power parities in Turkey are an average of 0.9, while this is 0.77 for European Countries.

businesses and the self-employed, administrative simplification, increasing the transparency of trade through the digitalisation of economic activity, combating informal employment through inspections and various incentives (strengthening labour inspections, rewarding legal employment with a temporary tax reductions).

Taken together, these findings highlight the importance of accounting for households' time-allocation decisions between domestic and informal activities when measuring inequality and poverty. The Gini Index may be useful for measuring and explaining income inequality across the entire distribution of informal earnings and socioeconomic status. However, an additional methodology could be useful to demonstrate how informal earnings can be decomposed into the contributions of individual socioeconomic factors to income-related inequality. Finally, additional analysis is required for the poverty computation. It is reasonable to assume that the elasticity of substitution and complementarity between time use in domestic activities can be used to explain the reasons for the decrease in poverty for different sub-populations and countries. These analyses are left for future work.

Appendix

Full prices proxies for complementary factors

In the case of complementary factors (market goods and time) used for domestic commodities, Becker's full price for commodity i can be written as follows:

$$p_{ih}^{f} = p_i + \omega_h \tau_{ih}$$

with τ_{ih} being the time use necessary to produce one unit of that activity and p_i the monetary price. Suppose that a Leontief technology allows the quantities of the two factors to be proportional to the activity:

$$x_{ih} = \xi_{ih} z_{ih}$$
$$t_{ih} = \theta_{ih} z_{ih} \text{ so that } t_{ih} = \tau_{ih} x_{ih} \text{ yields } \tau_{ih} = \frac{\theta_{ih}}{\xi_{ih}}$$

This case corresponds to an assumption of complementarity between the two factors in domestic technology[13], which allows calculating a proxy for the full price of activity *i* by the ratio of full expenditure (monetary expenditure and the value of time defined as time use per unit of the commodity multiplied by the opportunity cost of time ω) over its monetary component.

[13] An alternative hypothesis based on the substitutability between the two factors is discussed in Alpman and Gardes (2016).

Table A1. Descriptive statistics

Budget Shares	Variable	Mean	Std Dev	Minimum	Maximum
Monetary expenditures	Food	0.2953	0.1481	0	0.9930
	Personal Care (with Health)	0.0823	0.0835	0	1.0000
	Housing	0.3995	0.1590	0	1.0000
	Clothing	0.0529	0.0637	0	0.8424
	Education	0.0157	0.0455	0	0.8726
	Transport	0.1166	0.1347	0	0.9284
	Leisure	0.0251	0.0497	0	0.7868
	Other	0.0127	0.0370	0	0.7920
Full expenditures	Food	0.1328	0.0800	0	0.9264
	Personal Care (with Health)	0.1509	0.0435	0	0.8018
	Housing	0.1741	0.1077	0.01	1.0000
	Clothing	0.0273	0.0328	0	0.5578
	Education	0.0222	0.0288	0	0.8190
	Transport	0.1110	0.0729	0	0.8460
	Leisure	0.2210	0.0918	0	0.6910
	Other	0.1608	0.1200	0	0.6697
Occupation dummies	Men in white collar occupation	0.1459	0.3530	0	1
	Women in white collar occupation	0.0463	0.2102	0	1
	Men wage worker	0.3079	0.4616	0	1
	Women wage worker	0.0703	0.2556	0	1
	Men self-employed	0.1750	0.3800	0	1
	Women self-employed	0.0378	0.1908	0	1
	Men with permanent contract	0.3082	0.4617	0	1
	Women with permanent contract	0.0707	0.2563	0	1
	Men with fixed-term contract	0.0222	0.1475	0	1
	Women with fixed-term contract	0.0150	0.1216	0	1
	Men without a diploma	0.1868	0.3897	0	1
	Men primary education	0.1048	0.3063	0	1
	Men secondary education	0.4745	0.4994	0	1
	Men superior education	0.1383	0.3452	0	1
	Men other eduaction	0.0957	0.2941	0	1
	Women without a diploma	0.8132	0.3897	0	1
	Women primary education	0.0295	0.1693	0	1
	Women secondary education	0.0917	0.2886	0	1
	Women superior education	0.0307	0.1724	0	1
	Women other eduaction	0.0349	0.1835	0	1

cont. Table A1

Budget Shares	Variable	Mean	Std Dev	Minimum	Maximum
Household income share	ln(Total Income)	6.8961	0.9378	0.6931	11.5179
	Other income / Total Income	0.0752	0.1284	0	0.9747
	Self employment / Total Income	0.3117	0.4632	0	1
	Extended (Self employment / Total Income)	0.3937	0.5868	0	1.5940
	Full extended (Self employment / Total Income)	0.3820	0.5721	0	1.6541
	Wage income / Total Income	0.6131	0.4292	0	1
	Extended (Wage income/ Total Income)	0.7423	0.5069	0	1.2918
	Full extended (Wage income/ Total Income)	0.7460	0.5220	0	1.4812
	ln(Total Income) instrumented	6.8423	0.6817	4	9.0783
	ln(Total full Income) instrumented	6.7708	0.6786	4	8.8271
Demographic and regional character-istics	ln(age)	3.7933	0.2922	2.8904	4.5326
	Household type	2.4743	1.2993	1	5
	OECD equivalence scale	2.2141	0.7613	1	11.3
	City	0.6946	0.4606	0	1
Durables and luxury goods	Home ownership	0.6353	0.4814	0	1
	Number of rooms in the house	3.4991	0.8181	1	10
	Computer	0.3738	0.4838	0	1
	Good heating system	0.2995	0.4581	0	1
	Number of cell phone	2.0024	1.1325	0	9

Note: N = 33,765.

Source: own calculations.

Table A2. Results for monetary expenditures based on the complete demand system: all populations (GMM), 2007–2011

Variables	Food	*t*-ratio	Pc& Health	*t*-ratio	Housing	*t*-ratio	Clothing	*t*-ratio	Other	*t*-ratio	Trans-port	*t*-ratio	Leisure	*t*-ratio
Constant	0.921	1.690	2.621	2.680	−8.114	−4.490	0.030	0.030	0.119	0.120	3.606	5.200	0.628	1.210
2007	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2008	0.005	2.190	−3.950	0.001	0.017	7.420	−0.006	−4.700	−0.003	−5.390	−0.002	−0.850	−0.002	−2.770
2009	0.000	0.020	4.080	0.001	0.013	5.430	−0.013	−10.220	−0.002	−3.140	−0.001	−0.450	0.002	2.810
2010	0.000	0.150	2.260	0.001	0.016	6.830	−0.013	−10.680	0.000	−0.320	−0.001	−0.470	0.001	1.350
2011	0.001	0.420	5.150	0.001	0.015	6.460	−0.016	−12.080	−0.001	−2.340	0.000	−0.060	0.000	0.020
OECD equivalence scale	0.019	14.500	−0.005	−7.890	−0.033	−27.020	0.011	14.510	0.000	0.420	0.003	2.660	−0.001	−1.780
Home ownership	0.012	7.410	−0.004	−5.110	0.008	4.900	−0.002	−1.930	−0.001	−2.380	−0.011	−7.810	−0.001	−2.660
Men in white collar occupation	−1.026	−2.960	−2.530	0.044	0.559	3.080	−0.030	−0.820	0.150	2.690	0.494	2.790	0.031	0.750
Female in white collar occupation	0.020	5.020	−0.003	−1.250	−0.019	−3.270	0.015	5.960	0.000	−0.130	−0.005	−1.040	−0.008	−4.550
ln(age)	0.041	8.760	0.019	8.550	0.063	14.190	−0.033	−15.890	−0.008	−6.720	−0.034	−9.400	0.014	11.020
Men self employed × Male in white collar occupation	0.906	2.850	0.169	4.040	−0.499	−3.070	−0.072	−2.000	−0.117	−2.300	−0.413	−2.500	−0.007	−0.190
Men wage worker × Male in white collar occupation	1.132	3.030	1.570	0.047	−0.591	−2.990	0.093	2.330	−0.169	−2.810	−0.568	−3.000	−0.051	−1.140
Men having permenent contract	−0.113	−6.140	0.028	7.070	0.031	2.710	−0.032	−10.130	0.015	4.710	0.063	6.530	0.013	4.930
Women having permenent contract	0.002	0.370	0.006	2.170	−0.022	−4.910	0.009	4.600	−0.002	−1.450	0.011	2.680	−0.005	−3.860
Men having fixed-term contract	−0.023	−1.960	0.020	6.720	−0.013	−1.870	−0.011	−4.290	0.000	0.090	0.022	3.390	0.003	1.960
Women having fixed-term contract	0.005	1.090	−0.003	−1.130	−0.018	−3.580	0.013	5.830	0.000	−0.040	0.011	2.270	−0.006	−3.700
Men don't have education	−3.175	−1.870	−0.891	−1.510	5.816	2.770	−0.478	−0.470	−0.032	−0.020	−0.643	−0.600	0.000	0.000
Men having primary education	−0.027	−2.260	−0.017	−4.300	−0.090	−9.020	0.054	14.720	−0.002	−1.070	0.056	7.670	0.006	2.820
Men having secondary education	−0.019	−1.250	−0.005	−1.270	−0.073	−6.550	0.037	10.530	−0.004	−1.770	0.039	4.980	0.005	2.330
Men having superior education	−0.017	−1.450	0.000	−0.100	−0.044	−4.980	0.024	8.400	−0.006	−2.780	0.028	4.260	0.003	1.640
Women don't have education	−3.182	−1.880	−0.886	−1.500	5.874	2.790	−0.493	−0.490	−0.028	−0.020	−0.669	−0.620	−0.002	−0.730
Women having primary education	0.085	6.390	−0.105	−12.660	0.008	0.560	0.110	18.780	0.000	0.090	−0.071	−5.600	−0.026	−6.120
Women having secondary education	0.029	3.220	−0.069	−12.500	−0.040	−4.000	0.087	20.270	0.003	1.060	−0.008	−0.880	−0.015	−5.100

cont. Table A2

Variables	Food	*t*-ratio	Pc& Health	*t*-ratio	Housing	*t*-ratio	Clothing	*t*-ratio	Other	*t*-ratio	Trans-port	*t*-ratio	Leisure	*t*-ratio
Women having superior education	–0.014	–2.600	–0.013	–4.040	–0.068	–9.750	0.035	12.100	–0.001	–0.310	0.043	6.660	0.004	1.700
Computer	–0.006	–3.200	–1.600	0.001	0.005	2.670	–0.003	–3.320	0.000	0.500	0.001	0.830	0.000	0.360
Good heating system	–0.009	–5.130	–7.750	0.001	0.043	24.740	–0.007	–6.930	0.000	0.770	–0.018	–10.690	–0.002	–4.480
Number of rooms in the house	–0.003	–3.710	–4.120	0.000	0.009	10.880	–0.002	–4.140	–0.001	–3.790	–0.001	–1.790	0.000	0.170
Urban	–0.021	–4.310	–4.040	0.001	0.069	19.070	0.001	1.110	–0.006	–6.900	–0.029	–10.330	–0.005	–6.480
Household type	–0.001	–1.230	1.810	0.000	0.003	5.440	–0.001	–3.390	0.000	0.150	–0.001	–2.140	0.000	1.860
Number of cell phone	–0.007	–7.820	0.001	3.130	0.004	4.420	0.002	3.410	0.001	2.860	–0.002	–3.110	0.000	–0.460
Full price-Food	–0.270	–55.410	0.017	26.010	0.186	38.880	0.024	19.390	0.007	13.340	0.025	28.860	0.006	15.060
Full price-Pc&Health	0.017	26.010	–0.060	–92.060	0.020	26.680	0.000	–0.380	0.002	13.650	0.013	30.320	0.004	22.110
Full price-Housing	0.186	38.880	0.020	26.680	–0.281	–50.070	0.016	12.680	0.009	14.760	0.036	40.800	0.007	13.900
Full price-Clothing	0.024	19.390	0.000	–0.380	0.016	12.680	–0.045	–52.840	0.000	1.140	0.005	12.620	–0.001	–5.760
Full price-Education	0.007	13.340	0.002	13.650	0.009	14.760	0.000	1.140	–0.001	–2.720	0.003	13.630	0.001	11.450
Full price-Transport	0.025	28.860	0.013	30.320	0.036	40.800	0.005	12.620	0.003	13.630	–0.092	–92.260	0.006	25.540
Full price-Leisure	0.006	15.060	0.004	22.110	0.007	13.900	–0.001	–5.760	0.001	11.450	0.006	25.540	–0.025	–84.360
Full price-Other	0.005	9.090	0.003	15.720	0.008	13.970	0.002	7.890	–0.023	–80.340	0.004	17.380	0.001	8.330
Y	0.740	9.810	–9.780	0.045	0.703	7.390	0.130	4.300	0.008	0.350	–0.847	–14.470	–0.166	–7.640
Y^2	–0.057	–10.670	9.250	0.003	–0.055	–8.090	–0.006	–2.940	0.000	–0.120	0.066	16.050	0.012	7.630

Under-reporting Self-employment (Yr) and Wage earners (Ys)	Parameter	*t*-ratio
k (under reporting ratio for Yr)	1.418	18.880
v (under reporting ratio for Ys)	1.098	24.720

Stock-Yogo weak ID test (endogenous regressor: income)	(Critical values) 2SLS relative bias	>5%	>10%	>20%
Minimum eigenvalue statistic $F(5, 33732) = 17.94$		18.37	10.83	6.77

Sargan statistic (overidentification test of all instruments): 6.560 — Chi-sq(4) p-value = 0.8335

Source: own calculations.

Table A3. Results for full expenditures based on the complete demand system: all populations (GMM), 2007–2011

Variables	Food	*t*-ratio	Pc& Health	*t*-ratio	Housing	*t*-ratio	Clothing	*t*-ratio	Other	*t*-ratio	Trans-port	*t*-ratio	Leisure	*t*-ratio
Constant	17.890	0.770	–15.19	–1.99	65.685	4.400	11.528	3.410	–27.9077	–1.240	–15.540	–1.250	–18.910	–1.220
2007	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2008	–0.006	–1.530	0.003	0.930	–0.010	–1.190	–0.005	–3.060	0.004	0.840	0.004	1.410	0.010	1.920
2009	–0.003	–0.760	0.007	2.620	–0.013	–1.630	–0.008	–5.030	–0.005	–1.010	0.005	1.810	0.014	2.840
2010	0.002	0.670	–0.002	–0.630	0.012	1.540	–0.003	–2.130	–0.008	–1.780	–0.001	–0.380	0.000	–0.090
2011	–0.015	–3.390	0.012	4.290	–0.035	–3.400	–0.013	–6.610	0.015	3.010	0.010	2.800	0.021	4.160
OECD equivalence scale	0.014	6.770	–0.006	–4.880	0.001	0.250	0.006	5.980	–0.001	–0.460	–0.001	–0.280	–0.011	–5.120
Home ownership	–0.012	–3.960	0.005	3.080	–0.016	–2.130	–0.005	–3.710	0.008	2.620	0.004	1.640	0.012	4.430
Men in white collar occupation	–0.080	–2.470	–0.619	–5.520	0.495	3.810	–0.296	–6.040	0.983	5.480	1.510	5.880	–1.985	–5.820
Women in white collar occupation	0.042	4.520	–0.026	–4.720	0.105	5.720	0.027	7.350	–0.043	–4.300	–0.033	–6.090	–0.062	–6.360
ln(age)	0.002	0.230	0.031	5.100	–0.071	–2.970	–0.038	–8.200	–0.013	–1.120	0.001	0.100	0.121	12.040
Men self employed × Male in white collar occupation	0.108	2.680	0.511	4.600	–0.408	–2.630	0.245	5.110	–0.842	–4.910	–1.304	–5.330	1.689	5.100
Men wage worker × Male in white collar occupation	0.029	0.860	0.715	6.170	–0.631	–4.880	0.322	6.180	–1.019	–5.360	–1.656	–6.130	2.224	6.260
Men having permenent contract	0.001	0.070	–0.046	–7.590	0.053	2.430	–0.023	–4.820	0.055	4.280	0.097	7.720	–0.135	–9.940
Women having permenent contract	0.087	6.900	–0.043	–5.810	0.138	3.970	0.026	4.120	–0.075	–5.690	–0.013	–1.180	–0.107	–11.240
Men having fixed-term contract	–0.003	–0.420	0.006	0.850	0.001	0.080	0.000	0.100	–0.011	–1.070	–0.013	–0.930	0.021	1.110
Women having fixed-term contract	0.104	6.830	–0.051	–5.600	0.134	3.400	0.025	3.440	–0.065	–4.180	–0.005	–0.420	–0.127	–10.380
Men don't have education	0.123	0.010	4.931	0.350	–32.963	–1.420	–5.633	–1.080	9.549	1.640	10.100	0.780	0.000	0.000
Men having primary education	0.307	5.870	–0.164	–6.420	0.553	4.350	0.153	6.590	–0.384	–8.650	–0.100	–2.320	–0.294	–11.120
Men having secondary education	0.340	6.520	–0.179	–7.020	0.641	4.980	0.158	6.770	–0.433	–9.780	–0.153	–3.540	–0.300	–11.950
Men having superior education	0.248	6.630	–0.127	–6.830	0.468	5.040	0.113	6.750	–0.327	–10.190	–0.119	–3.850	–0.208	–11.030
Women don't have education	0.000	0.000	4.987	0.360	–33.133	–1.420	–5.680	–1.090	9.680	1.660	10.141	0.780	0.096	7.190
Women having primary education	–0.392	–5.430	0.231	5.970	–0.725	–4.180	–0.054	–1.750	0.371	5.140	0.151	3.010	0.385	7.120
Women having secondary education	–0.079	–2.330	0.038	1.790	–0.112	–1.340	0.043	2.800	0.026	0.620	0.052	2.210	0.044	1.300

cont. Table A3

Variables	Food	*t*-ratio	Pc& Health	*t*-ratio	Housing	*t*-ratio	Clothing	*t*-ratio	Other	*t*-ratio	Trans-port	*t*-ratio	Leisure	*t*-ratio
Women having superior education	0.266	6.480	–0.159	–7.510	0.492	4.640	0.119	6.140	–0.311	–8.400	–0.062	–1.760	–0.295	–13.810
Computer	–0.001	–0.460	0.000	–0.290	–0.004	–0.610	–0.003	–1.890	0.005	1.340	0.006	1.790	–0.002	–8.660
Good heating system	–0.015	–5.260	0.003	1.580	0.003	0.380	–0.005	–3.420	0.005	1.640	0.001	0.190	0.007	2.230
Number of rooms in the house	0.000	–0.240	–0.001	–1.460	0.003	1.500	0.000	–0.800	–0.003	–2.400	0.000	–0.240	0.000	0.340
Urban	–0.028	–4.400	0.024	6.500	–0.034	–2.170	–0.011	–3.590	0.018	2.900	–0.031	–5.290	0.053	8.380
Household type	0.004	5.050	–0.002	–3.610	0.008	4.470	0.001	3.070	–0.005	–5.380	0.001	0.940	–0.006	–5.340
Number of cell phone	0.001	1.510	0.000	–0.740	0.007	3.810	0.002	5.410	–0.004	–3.760	–0.005	–5.260	–0.002	–1.190
Full price-Food	–0.043	–14.620	0.007	4.500	0.003	0.450	0.000	0.200	0.012	5.900	0.014	5.790	0.004	3.230
Full price- Pc&Health	0.007	4.500	–0.019	–21.560	0.016	3.890	0.001	1.950	–0.002	–1.450	–0.001	–0.480	–0.002	–3.830
Full price-Housing	0.003	0.450	0.016	3.890	–0.084	–3.810	0.003	0.780	0.012	1.920	0.029	4.170	0.013	5.820
Full price-Clothing	0.000	0.200	0.001	1.950	0.003	0.780	–0.012	–14.860	0.001	0.790	0.005	3.650	0.001	1.930
Full price-Education	0.012	5.900	–0.002	–1.450	0.012	1.920	0.001	0.790	–0.017	–6.260	0.001	0.490	–0.004	–4.090
Full price-Transport	0.014	5.790	–0.001	–0.480	0.029	4.170	0.005	3.650	0.001	0.490	–0.042	–18.440	–0.004	–4.410
Full price-Leisure	0.004	3.230	–0.002	–3.830	0.013	5.820	0.001	1.930	–0.004	–4.090	–0.004	–4.410	–0.005	–5.410
Full price-Other	0.003	3.650	–0.002	–4.680	0.008	3.870	0.001	3.840	–0.004	–5.880	–0.002	–3.670	–0.003	–10.600
Y	–5.333	–6.710	3.099	8.160	–9.707	–5.010	–1.754	–5.070	5.599	8.480	1.617	2.620	5.620	15.500
Y^2	0.389	6.700	–0.228	–8.220	0.711	5.000	0.131	5.150	–0.411	–8.560	–0.114	–2.510	–0.414	–16.020

Under-reporting Self-employment (Yr) and Wage earners (Ys)	Parameter	*t*-ratio
k (under reporting ratio for Yr)	1.184364	32.22
v (under reporting ratio for Ys)	1.180907	29.73

Source: own calculations.

Table A4. The income part of wage earners and self-employed, 2007–2011 (as % of GDP)

Years	Shares	
	Self-employed	Wage earners*
2007	0,211	0,355
2008	0,204	0,377
2009	0,208	0,359
2010	0,201	0,417
2011	0,194	0,423

* Including regular employee.

Source: Republic of Turkey Social Security Institution, 2016.

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