Income Taxation and Self-Employment: The Impact of Progressivity in Countries with Tax Evasion

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Abstract

Recently several developing and transitional countries changed their personal income tax from fairly progressive to flat in an effort to improve efficiency. But how do taxes affect incentives when people can sometimes tax evade and pay bribes? In this paper, I address this question by focusing on the effects of personal income tax progressivity on the decision to become self-employed. I develop a theoretical model of tax evading self-employed individuals who pay bribes to tax authorities. The model predicts that progressivity affects the decision to become self-employed even if people tax evade. I then test this prediction empirically using three sources of data. First, I use Russian longitudinal data and estimate the effects of progressivity on the individual decision to become self-employed. Second, I construct a data set of personal income tax schedules for 95 countries over 20 years and estimate the effects of progressivity on number of micro enterprises at the aggregate level. Third, I use Living Standards Measurement Surveys from 8 developing countries to estimate how much people are evading and the effect of progressivity on the amount that is not evaded. I find that increases in progressivity decrease the probability of choosing self-employment and decrease the number of micro enterprises. I also find that in countries with high tax evasion and frequent bribes, self-employment is less responsive to taxes than in the U.S.

1 Introduction

Estonia was the first transitional economy to adopt a flat income tax, in 1994. Shortly after, Lithuania, Latvia, Russia, Serbia, Slovak Republic, Ukraine, Georgia and Romania also switched to flat tax systems. The main objectives of these tax reforms were "the creation of a business and investment friendly environment for both individuals and companies" (Ministry of Finance of the Slovak Republic 2005) and "stimulating entrepreneurship, private investment and job creation" (SEE Monitor 2005). Although the effects of income taxes on entrepreneurship have been studied extensively for developed countries like the U.S., little is known about their effects in developing and transitional countries. How does personal income tax progressivity affect the decision to become self-employed? Do tax effects differ among countries with different levels of tax evasion and corruption? These are the main questions I address in this paper.

Taxes can have a number of effects on self-employment decisions. Self-employment income is uncertain and, thus, self-employment is often seen as adding one more risky asset to one's portfolio. Income taxation can encourage self-employment through its effects on risk-sharing. The government shares part of the risk of self-employment through progressive taxation. Individuals might wish to offset this by increasing the riskiness of their portfolio and becoming self-employed. This is an implication of the study on proportional tax and risk-taking by Domar and Musgrave (1944). However, Gentry and Hubbard (2000) argue that progressivity leads to less self-employment because high progressivity reduces the returns of successful self-employed individuals disproportionately relative to the unsuccessful ones and increases the average tax burden for self-employed individuals. Empirical studies find that in the U.S., high progressivity reduces the probability of entry into self-employment (Gentry and Hubbard 2000).

In developing and transitional countries, there are additional implications of taxation for self-employment. In these countries, tax compliance is low, bribes are common and the unofficial economy is large. For example, in 2000, Russia had an unofficial economy of 46.1% of the Russian GDP, while the U.S. had an unofficial economy of only 8.7% of its GDP (Schneider 2005). A self-employed individual from a country with low tax compliance is more likely to tax evade than his U.S. counterpart. Thus, the effects of an increase in tax progressivity are likely to be smaller for a person in a developing country because the increase in average tax burden is smaller due to tax evasion.

The possibility of bribes offsets this to some extent. Bribery is generally related to a firm's performance, so an increase in tax progressivity may lead to more taxes and more bribes than in a country with less common bribes. As a result, the effects of progressivity could be larger. In this paper, I focus explicitly on these channels through which taxes affect self-employment in developing and transitional countries.

First, I introduce a theoretical model in which an individual chooses between self-employment and wage employment. I assume that individual can tax evade all or part of his income in self-employment, while he cannot tax evade in wage employment. Self-employed individuals who choose to tax evade all their income are called unofficially self-employed and those who declare a part of their income are called officially self-employed. Official and unofficial self-employed individuals pay bribes if caught tax evading. The model predicts that an increase in income tax progressivity makes people more likely to choose unofficial self-employment over official self-employment and wage employment over any type of self-employment. It also predicts that an increase in the probability that self-employed individuals pay bribes discourages self-employment. Finally, it predicts that effects of progressivity are higher in countries with high probabilities of paying a bribe.

I test these predictions empirically, first, by exploring the effects of tax changes in one particular country, and second, by exploring the progressivity effects across countries. I start by exploiting the Russian tax reforms from 2001. I use individual longitudinal data and explore how individuals took self-employment decisions before and after the tax change in a differences-in-differences model. I show that after progressivity decreased, people were more likely to become officially self-employed and less likely to become wage employed.

Next, I investigate the relationship between the number of official micro enterprises in a country and the progressivity of that country's tax system. I construct a data set of income tax schedules for 95 countries and 20 years and use it to construct a measure of progressivity at the country level. I find that an increase in this measure of progressivity leads to a decrease in the number of official micro enterprises. I also show that the effects of progressivity are larger in countries where bribes are more common.

Finally, I use individual level data from 8 developing and transitional countries to estimate the amount people are tax evading and an individual progressivity measure on the amount that is not evaded. I estimate a multinominal logit model for official self-employment, unofficial self-employment,

and wage employment. I find that low progressivity leads people to choose both official and unofficial self-employment over wage employment.

The rest of the paper is organized as follows: Section 2 introduces a model of self-employment, tax progressivity and tax evasion. Section 3 looks at the individual decisions about self-employment before and after two tax reforms in Russia. Section 4 investigates the relationship between progressivity and self-employment across countries. Section 5 concludes.

2 A Theoretical Model of Self-Employment and Tax Evasion

This section describes a theoretical model of individuals who can tax evade if they are self-employed, who can avoid paying taxes by paying bribes and who can operate in the unofficial economy.

The individual in this model chooses between being wage employed and being self-employed. If he is wage employed, then he earns an income $y_e > 0$ that depends on the personal characteristics of the individual. If he is wage employed, he cannot tax evade, so he always declares his full income y_e to the tax authorities, and pays $\tau(y_e)$ in taxes, where $\tau(y) \geq 0$ for any income y and $\tau(0) = 0$. The individual has a utility function U that depends on his after-tax income. So, for a wage employed individual, the utility is

$$U = U(y_e - \tau(y_e)). \tag{1}$$

where $U' > 0$ and $U'' < 0$.

If he is self-employed, he earns an uncertain income. With probability q he earns a large income $\overline{y_s}$, called a successful income, and with probability $(1-q)$ he earns a small income $\underline{y_s}$, called an unsuccessful income. $\overline{y_s} > \underline{y_s} > 0$.

If a person is self-employed, he can also tax evade. He chooses what share k of his self-employed income he declares to tax authorities. He can choose 0 or K, where K is a fixed share of income usually evaded by self-employed individuals in his country. $K \in (0, 1)$. With probability p, he gets caught evading and he pays a bribe B to avoid paying the taxes he owns to the government. B depends on the amount evaded,

$$B = B(y(1 - k)), \tag{2}$$

where $B(0) = 0$, $B'(y(1-k)) > 0$. If the person pays the bribes, then he doesn't have to pay taxes on $y(1-k)$, the amount he evaded.

If the individual declares at least a part of his self-employed income ($k = K$), then he is considered to operate in the official self-employment sector, and if he declares no income at all ($k = 0$), then he operates in the unofficial self-employment sector.

The individual makes his occupational decision in two steps. First, he chooses the k he is going to report to the tax authorities if he becomes self-employed and earns an income y. I assume he knows the probability of being caught p, the amount he needs to pay in taxes τ, and the bribe he needs to pay if caught B.

He chooses a k that maximizes his expected utility

$$\begin{aligned} E(U) = pU(y - \tau(ky) - B(y(1-k)))+ \\ (1-p)U(y - \tau(ky)). \end{aligned} \tag{3}$$

He chooses official self-employment, $k = K$ if the following holds

$$\begin{aligned} pU(y - B(y)) + (1-p)U(y) \leq pU(y - \tau(Ky) - B(y(1-K)))+ \\ (1-p)U(y - \tau(Ky)) \end{aligned} \tag{4}$$

If an increase in tax progressivity also involves an increase in the amount paid τ, then this increase in progressivity makes people declare less income and, thus, makes them less likely to choose official self-employment over unofficial self-employment. The intuition is simple: An increase in taxes paid in the official sector makes the unofficial sector in which no taxes are paid more attractive.

The probability p, how common bribes are in the economy, also affects the decision between official self-employment and unofficial self-employment. In order to estimate the effect of p on the decision between the two types of self-employment, I rewrite (4) as,

$$\begin{aligned} (1-p)(U(y) - U(y - \tau(Ky)) \leq p(U(y - \tau(Ky) - B(y(1-K))- \\ U(y - B(y))). \end{aligned} \tag{5}$$

(5) implies that p has a positive effect on the probability of being officially self-employed if $\tau(Ky) + B(y(1-K)) < B(y)$ and a negative effect otherwise.

In the situation in which the bribe paid if caught evading everything is much larger than the bribe paid if caught evading only a part of the income, more common bribes make people more likely to choose official self-employment. An increase in probability of being caught makes people more likely to choose the alternative for which the amount paid in bribes is lower.

Second, the individual chooses between self-employment and wage employment. He knows his successful income $\overline{y_s}$, and his unsuccessful income $\underline{y_s}$. He has already decided what k he declares for each income. Let $\overline{k_s}$ be the share of income he declares for $\overline{y_s}$ and $\underline{k_s}$ the share for $\underline{y_s}$. He also knows his employment income y_e, the probability of getting caught p, the probability of earning a successful income q, taxes τ, and the bribe B. He chooses the occupation that gives him the larger expected utility, so he chooses self-employment if the following holds

$$\begin{aligned} U(y_e - \tau(y_e)) \leq\ & pqU(\overline{y_s} - \tau(\overline{k}\overline{y_s}) - B(\overline{y_s}(1-\overline{k})))+ \\ & (1-p)qU(\overline{y_s} - \tau(\overline{k}\overline{y_s}))+ \\ & p(1-q)U(\underline{y_s} - \tau(\underline{k}\underline{y_s}) - B(\underline{y_s}(1-\underline{k})))+ \\ & (1-p)(1-q)U(\underline{y_s} - \tau(\underline{k}\underline{y_s})). \end{aligned} \tag{6}$$

(6) implies that a decrease in progressivity encourages the individual to choose self-employment if $y_e \leq \min(\underline{k}\underline{y_s}, \overline{k}\overline{y_s})$, or if $\underline{k}\underline{y_s} \leq y_e \leq \overline{k}\overline{y_s}$ and q is high, or if $\overline{k}\overline{y_s} \leq y_e \leq \underline{k}\underline{y_s}$ and q is low. An increase in progressivity encourages the individual to choose self-employment if bribes don't increase too much as a result of the increase in progressivity and if $y_e \geq \max(\underline{k}\underline{y_s}, \overline{k}\overline{y_s})$, or if $\underline{k}\underline{y_s} \leq y_e \leq \overline{k}\overline{y_s}$ and q is low, or if $\overline{k}\overline{y_s} \leq y_e \leq \underline{k}\underline{y_s}$ and q is high. TABLE 1 shows the self-employment implications of the model in more detail.

Intuitively, if wage employed income is smaller than all the possible declared self-employed incomes, then a less progressive tax makes the high self-employed incomes more attractive since it reduces the average tax burden. If wage employed income is higher than all the declared self-employed incomes, then a progressive tax makes the low incomes in self-employment more attractive by lowering the average tax burden. When wage employment income is in between the two possible self-employment incomes, then the probability of success determines which type of tax makes self-employment more attractive. If wage employment income is smaller than the more likely income, then a less progressive tax makes this high and likely income more

attractive and, thus, makes self-employment more attractive. If the wage employed income is larger than the most likely self-employed income, then a progressive tax makes the low more likely income more attractive, and thus makes self-employment more attractive. But an increase in progressivity has an additional effect of making people tax evade more (follows from 6) and thus, pay more in bribes. Thus, an increase in progressivity leads to more self-employment only if the decrease in average tax burden is higher than the increase in bribes. Since data shows that wage employment income is smaller than self-employment income, I conclude that theoretically progressivity has an adverse effect on the decision to become self-employed.

In order to look at the effects of p on choosing self-employment, I rewrite (6) as

$$\begin{aligned} U(y_e - \tau(y_e)) \leq p[q((&U(\overline{y_s} - \tau(\overline{k}\overline{y_s}) - B(\overline{y_s}(1-\overline{k}))- \\ &U(\overline{y_s} - \tau(\overline{k}\overline{y_s}))) \\ &(1-q)(U(\underline{y_s} - \tau(\underline{k}\underline{y_s}) - B(\underline{y_s}(1-\underline{k})))- \\ &U(\underline{y_s} - \tau(\underline{k}\underline{y_s}))]+ \\ &qU(\overline{y_s} - \tau(\overline{k}\overline{y_s})) + (1-q)U(\underline{y_s} - \tau(\underline{k}\underline{y_s})). \end{aligned} \tag{7}$$

(7) implies that an increase in probability p leads to less self-employment[1]. If all people in self-employment are tax evading and the probability of being caught increases, then self-employment becomes less attractive compared to wage employment where there is no tax evasion and no bribes are paid.

Also, for the cases in which progressivity negatively affects self-employment, the effects of taxes are higher for higher p's. If an increase in progressivity increases the amount of taxes paid in self-employment and also increases the amount evaded, and thus also the amount of the bribe, then the effects of taxes are higher when it is more likely to pay these high bribes in addition to paying the high taxes.

In conclusion, the major predictions of the model, and the ones that are going to be tested later, are: First, an increase in progressivity makes people more likely to choose unofficial self-employment over official self-employment, second, an increase in progressivity makes people less likely to choose any

[1] p's coefficient is always negative. Thus, if p increases, the right hand side of the inequality decreases, and thus self-employment becomes less attractive.

form of self-employment over wage employment, and third, the effects of progressivity are larger in countries with more common bribes than in countries with less common bribes.

3 Analysis of Russian Longitudinal Data

In this section, I explore the effects of taxes on individual decisions regarding official self-employment. I also try to estimate the effects of taxes on self-employed individuals that operate in the unofficial economy. I exploit a large decrease in income tax progressivity in Russia during the 2001 tax reform.

In 2000, personal income was taxed at 4 marginal tax rates, ranging from 0% to 30%. In 2001, the income tax schedule became flat: all income above 4,800 rubles was taxed at 13%. To offset the revenue loss, corporate tax rates increased from 30% to 35% and the tax on dividends doubled from 15% to 30%. At the same time, interest and capital gains tax decreased from 15% to 13%, and VAT and social contributions taxes stayed almost constant.

During this period, GDP/capita increased every year from 49,934 constant rubles in 2000 to 64,282 constant rubles in 2004. That is, GDP/capita was 1,775 constant US$ in 2000 and 2,285 constant US$ in 2004. Inflation decreased every year from 37% in 2000 to 13% in 2003 and then increased the following year to 20%. Unemployment was on a downward trend during this period, decreasing from 9.8% in 2000 to 7.9% in 2004.

I analyze the impact of these tax changes on self-employment using longitudinal data from the Russia Longitudinal Monitoring Survey, RLMS. RLMS is a series of nationally representative surveys that collect data on demographic characteristics, income, occupation, expenditure and health status of its respondents. The survey has been administered 13 times from 1992. I use survey data from 2000 (round 9), 2001(round 10), 2002 (round 11), 2003 (round 12) and 2004 (round 13).

I use data only on heads of households who are between 18 and 60 years old and who are not employed in agriculture. Some information is available only at household level and I include only one person per household in the analysis. I chose the person who has the largest earned income[2] in the household and I call that person head of household. People who work in agriculture

[2] Other types of income are not reported at individual level, only at household level.

and sell/barter the agricultural goods they produce are eliminated. Out of the whole sample, I use approximately 24000 observations.

Using this data, I define 3 occupational dummies. The first one is official self-employment that takes value 1 if the head declares he owns a business or works as a self-employed professional. The second is wage employment that takes value 1 if the head says he works for an employer. The third dummy, other, takes value 1 if the head declares he is out of labor force or unemployed. It is likely that the unofficially self-employed individuals are in this other category. If an individual is unofficially self-employed, then he probably doesn't declare his business in the survey, so he is not in the self-employed category. Also, if this unofficial business is his full time occupation, then he is not working for an employer either. In my sample, 7% of heads are officially self-employed, 10% are in the other category and 82% are wage employed. TABLE 2 shows descriptive statistics for the Russian data.

I also consider personal characteristics of the head of household in the analysis: Age, age squared, male, homeowner, married, family size, and 4 educational dummies, 4 years or less of education, 5-8 years of education, 9-12 years of education and 13 years or more of education. The average age is 38, 80% of heads of household are homeowners, 67% are married, they have an average family size of 3, 47% of them have some high-school education and 46% have some college.

I exploit the 2001 tax reform in a differences-in-differences approach and estimate the effects of decreases in income tax progressivity on choosing an occupation. First, I look at heads of households interviewed in 2000, one year before the change, and then again, in 2001, the year of the change. I control for a different group of heads that were interviewed in 2001 and later in 2002, 2003 and 2004 when the tax system remained unchanged. I estimate a multinomial logit model of the form

$$\ln \frac{\Pr(y_{i,t} = o)}{\Pr(y_{i,t} = b)} = \alpha_{0,o|b} + \alpha_{1,o|b} 2nd\ period_{i,t} + \alpha_{2,o|b} cohort_{i,t} + \alpha_{3,o|b} tax\ change_{i,t} + \sum_{j=4}^{9} \alpha_{j,o|b} personal\ characteristics_{j,i,t} + \epsilon_{i,t} \tag{8}$$

where i is the index for individuals, t is the index for year, $y_{i,t}$ is one of the occupational dummies, $o \neq b$, b is the baseline occupation, $2nd\ period$ dummy

takes value 1 if the year t is 2001, 2002, 2003 or 2004 and the individual i was interviewed in both t and $(t-1)$. It takes value 0 if year t is 2000, 2001, 2002 or 2003 and i was also interviewed in $(t+1)$. The *cohort* dummy takes value 1 if year t is 2000 or 2001 and i was interviewed in both 2000 and 2001, and value 0 if year t is 2001, 2002, 2003 or 2004 and i was interviewed in two consecutive years. The tax change dummy is the interaction between the *2nd period* effect and the *cohort* effect.

TABLE 3 presents the results from estimating equation (8). The table presents the marginal effects from the multinominal logit model and the robust standard errors clustered by individual. Column (1) shows the effects of the 2001 tax change on the probability of being officially self-employed, column (2) shows the effects on the probability of being wage employed and finally, column (3) shows the effects on the probability of being in the other category. The effects on official self-employed are positive and significant at the 5% level, the effects on wage employment are negative and significant at the 10% level, and the effects on other are positive and insignificant. It seems that the 2001 tax change made people move from wage employment to official self-employment while the unofficial self-employment stayed unaffected.

These results are based on time series analysis; next I use panel and cross-section data for other countries to investigate the effects of progressivity on self-employment.

4 Cross-Country Analysis

The rest of the paper investigates cross-country effects of progressivity. First, I estimate the effects of income tax progressivity at the aggregate level on the number of micro enterprises.

I collect data on personal income taxes from PriceWaterhouseCooper's annual summaries of personal income taxes, *Individual taxes, a worldwide summary* and from the *AEI International Tax Database*. The data set contains information on all marginal tax rates, all income tax brackets, and on special self-employment income tax rates and exemptions. The marginal tax rates are reported for single individuals who are residents of the country[3]. Some countries have one personal income tax schedule for wage income and

[3]Few countries impose taxes at household level, thus I choose the rates for single individuals to be consistent across countries.

another for other types of personal income. For such countries, I report the income tax schedule for types of incomes other than wage incomes.

The data set consists of 95 countries over 20 years. There is a good deal of variation in income tax schedules across countries. Out of the 95 countries, 12 have flat income tax systems at least in one of the surveyed year. Countries like Denmark and Latvia have the least progressive systems, with one single marginal tax rate. Countries like Brazil, Egypt, Hungary, and Indonesia, have slightly more progressive tax systems with 2 or 3 marginal tax rates and top rates as low as 25%. Finally, countries like Belgium, Chile, France are among the most progressive in the data set with at least 7 marginal tax rates and top rates as high as 55%.

There is some time variation as well; the data captures some tax changes in various countries like Slovak Republic, Slovenia and South Korea. Developing countries seem to have more frequent tax reforms than developed countries.

Using this data, I construct a measure of progressivity. Progressivity is the difference between the top marginal tax rate paid on an income x times the GDP/capita of that country and the top marginal tax rate paid on an income 1/x times the GDP/capita,

$$progressivity\ meas. = MTR(x \cdot GDP/cap) - MTR((1/x)) \cdot GDP/cap) \quad (9)$$

where $x = 2, 3, 4, 5$,or 10. In the analysis, I use mostly $x = 4$ because it captures the best the curvature of most tax schedules. TABLE 4 shows the summary statistics for $progressivity = MTR(4 \cdot GDP/cap) - MTR(.25 \cdot GDP/cap)$, $progressivity2 = MTR(2 \cdot GDP/cap) - MTR(.5 \cdot GDP/cap)$ and for $progre- ssivity3 = MTR(10 \cdot GDP/cap) - MTR(.1 \cdot GDP/cap)$. It seems that high income per capita countries tend to also have more progressive tax schedules. The correlation between GDP/capita and the above measure of progressivity is 11%.

I also use a mean income tax rate defined as the tax rate paid by an individual who earns an income=GDP/capita and a mean corporate rate defined as the marginal tax rate paid by a corporation earning an income=GDP/cap. I also include the VAT rate for each country.

The data on micro enterprises is taken from an International Finance Corporation[4] (IFC) data set. The IFC data set is compiled from multiple

[4]The International Finance Corporation is a member of the World Bank Group that

sources, mostly from various Census and other country level surveys. This variable is likely to capture small businesses that pay at least some taxes and that operate in the official economy. This section does not address tax evasion or unofficial economy problems.

A micro enterprise is a firm that has few employees. Micro enterprises have 1-4 employees for most countries, except for a small number of countries where micro enterprises can have up to 200 employees. Azerbaijan, Ukraine, Singapore and Hong Kong are the only countries with micro enterprises with more than 50 employees. The variable used in the analysis is number of micro enterprises per 1,000 inhabitants. The mean for the sample is 41 enterprises per 1,000 inhabitants., with some developing countries with extremely large numbers of firms; Czech Republic has 163.70 enterprises/1,000 inhabitants in 1998 and Indonesia has 183.01 firms/1,000 inhabitants the same year. Some African countries have extremely low numbers of enterprises; Botswana has the smallest number of the sample, .03 firms/1,000 inhabitants, and it is closely followed by Kenya with .09 enterprises/1,000 inhabitants.

I also use a bribe variable taken from Frasier Institute's *Economic Freedom of the World: 2006 Annual Report*. It measures how common it is for people to pay bribes in a country. The variable is measured from 0 to 10, where 0 means bribes are very common. This bribe measure originates from the *Executive Opinion Survey*, an annual survey administered to 11,000 executives from 131 countries by the World Economic Forum. The executives were asked to rank on a discrete scale how common bribes are in their country[5].

Other variables used in the analysis are gdp/capita expressed in 2000 US$, services/gdp, the net output of the service sector as percent of GDP, manufacturing/gdp, the net output of manufacturing sector as percent of GDP, inflation, the percentage change in the consumer price index, female

provides loans and advice to firms/individuals in private sectors in developing countries.

[5]The bribe data is missing for some of the countries of interest. Since I have data on bribes on a large number of other countries, I predict the missing values by estimating the following equation:

$bribe_{k,t} = a_0 + a_1 * democracy_{k,t} + a_2 * gdp/cap_{k,t} + a_3 * g/gdp_{k,t} + a_4 * legal\ origin_k + e_{k,t}$, where k is the country index, t is the year index, bribe is the bribe score, democracy is a measure of democracy, gdp/cap is GDP per capita in 2000 US $, g/gdp is government expenditures/GDP. The bribe data is taken from the Fraser Institute's *Economic Freedom of the World*, the democracy score is taken from the Polity IV dataset, the macroeconomic variables are taken from the World Development Indicators, and legal origin is taken from La Porta et al. (1999).

work force/total work force and unemployment rate, % of unemployed individuals out of the total labor force. The country characteristics data comes from the *World Development Indicators*.

Using this data, I estimate the effects of progressivity on the number of micro enterprises/1,000 inhabitants. Specifically, I estimate an ordinary least squares model of the form

$$\begin{aligned} micro\ enterprises_{k,t} = \beta_0 + \beta_1 progressivity_{k,t} + \sum_{i=2}^{3} \beta_i mtr_{i,k,t} + \\ \beta_4 bribe_{k,t} + \beta_5 bribe_{k,t}\ progressivity_{k,t} + \\ \sum_{m=6}^{11} \beta_m country\ characteristics_{m,k,t} + \beta_{12}\vartheta_t + \\ \epsilon_{k,t}. \end{aligned} \tag{10}$$

where k is the index for country, t is the index for year, i is the index for taxes. The number of enterprises depends on the progressivity of the tax system, mean income tax rate, mean corporate tax rate, value added tax rate, bribes, interaction between bribes and progressivity, other country characteristics including gdp/cap, services/gdp, manufacturing/gdp, female work force/total work force, unemployment, inflation, year fixed effects ϑ_t, and an error term $\epsilon_{k,t.}$

I control for mean marginal tax rate because I want to capture the effects of an increase in tax rate spread keeping constant for the mean rate. The corporate rates and VAT rates also affect the number of small firms in a country. I also control for bribes and the interaction of progressivity with bribes because I want to test whether the magnitude of the effects varies by bribe level. The above country characteristics are believed to affect the number of firms in a country; richer countries with higher GDP/capita tend to also have larger numbers of firms. Countries that have a large service sector have fewer micro enterprises and more larger enterprises, while countries with large manufacturing sectors have more micro enterprises than larger ones. Also, in places where it is common for women to work, it is also relatively common for them to become self-employed. Thus, in those places one is likely to observe more micro enterprises over all, as a larger segment of the population can start enterprises. Inflation might affect the number of micro firms positively, as people don't want to be wage employed when

inflation is high because wage income adjusts slower to inflation compared to self-employment income. Finally, high unemployment may lead people who cannot find jobs in wage employment to open small businesses instead.

Time fixed effects are also included because there is some time variation in the progressivity measure for each country.

TABLE 5 presents the results for equation (10). In column (1), I estimate the effect of progressivity on the number of micro enterprises, controlling for the tax rates, country characteristics and year fixed effects. I find that progressivity has a negative effect on the number of micro enterprises, although not statistically significant.

In column (2), I also control for how common bribes are in that country. The bribery index has a negative but not statistically significant coefficient, which means that as bribes become more common, the number of micro enterprises increases.

Next, in column (3), I also control for the interaction term between bribe and progressivity. The main effect of bribery is now statistically significant and negative at the 1% level. Also, results show that the progressivity effects are higher in countries in which bribes are more common, just as the theory predicted. The marginal effect of progressivity at a mean bribe score is -1.55, which means that a decrease of progressivity of 33% (like the one in Russia in 2001) leads to an increase 51 of micro enterprises per 1000 inhabitants; that is an increase of .72 standard deviations.

TABLE 6 presents some robustness checks. Column (1) and column (2) show the results for different measures of progressivity. Column (1) uses progressivity1, the difference between marginal tax paid at twice GDP/cap and half GDP/cap and column (2) uses progressivity2, the difference between marginal tax rates paid at ten times GDP/cap and 1/10th GDP/cap. The effects are still negative and significant at 5% level. Next, I change the measure for small firms. I use medium, small and micro firms per 1000 inhabitants. This measure includes also larger firms that might have up to 500 employees. The mean number of employee for these firms is 214. The effects of progressivity are similar to the ones obtained for the micro firms. Finally, I use a corruption measure instead of bribes. The corruption measure is taken from PRS Group's countrydata and larger values mean less corruption in the country. For missing variables I predicted corruption in the same way I predicted the bribe variable. Progressivity stays negative and significant, but the corruption measure is still negative, but insignificant.

But aggregate data cannot show the split between official self-employment

and unofficial self-employment. To investigate the effects of taxes on unofficial self-employment, I use individual level data from several countries where employment status can be ascertained.

Individual level data comes from the Living Standards Measurement Study, LSMS. LSMS is a World Bank research project that collects data on personal characteristics, income, employment, expenditure and health in developing countries. My study uses LSMS surveys from Azerbaijan, Brazil, Bulgaria, China, India, Russia, South Africa and Tanzania between 1991 and 2004[6]. I chose these particular countries because these were the only developing and transitional countries for which there is micro level data on personal characteristics, food consumption, income and occupation and for which I have personal income tax data.

I use only individuals who are heads of households[7], between 18 and 60 years old, and not employed in agriculture. Most surveys report some types of income only at household level, so in order to use the income variable, I had to choose one person per household. I chose the head of household. I chose a person between 18 and 60 because I wanted to analyze the occupation decisions of working age adults and the 18 to 60 age range was the most appropriate age range for all the countries in the sample. Finally, I leave out people who work and trade in agriculture because I estimate the amount of tax evasion based on food consumption and declared income. This estimation might be different for people who produce most of the food in the household and have little income besides the one from selling a part of the agricultural goods. In the end, I keep about 48,756 observations.

Using this data, I define three occupational dummies: Officially self-employed, other and wage employed. They are defined in the same way as in the previous section. The percentage of people who are in each group varies from country to country: India has the largest share of self-employed at 44% and Bulgaria has the smallest at 3%. Overall, 14% of the heads of household in my sample are officially self-employed.

I construct personal characteristics variables similar to the ones used in

[6] More specifically, the countries and years used are Azerbaijan 1995, Brazil 1996 and 1997, Bulgaria 2001, China 1994, India 1997 and 1998, Russia 1992, 1993, 1994, 1995, 1996, 1998, 1999, 2000, 2001, 2002, 2003 and 2004, South Africa 1993 and Tanzania 1991, 1992 and 1993.

[7] The head of household is the person designated as a head of household by the respondent in the survey. The head of household question is not asked in Russia and thus, in Russia, heads are determined the same way as in the previous section.

the Russian analysis. I use age, age squared, male, homeowner, married and educational dummies. On average, a head of household from this sample is 40 years old and has a family of 3.96 individuals. In my sample, 60% are males, 67% are homeowners and 68% are married. TABLE 7 reports the descriptive statistics for the cross country data.

In addition to occupation and demographic variables, I also use two macroeconomics indicators for the countries in the sample: GDP/capita and inflation between 1991 and 2004. Other macroeconomics variables like services/GDP, female labor force, etc. used in the aggregate analysis are not included in this analysis because some variables are missing for some of the 8 countries. These measures are taken from the *World Development Indicators.*

Tax rates and income tax brackets for wage and other incomes are used to calculate measures of progressivity and average tax rates for each individual. I proceed in several steps; First, I estimate k, a percentage of income that official and unofficial self-employed individuals declare to the tax authorities. Then, I estimate y_T, a true income adjusted for under-reporting. Next, I predict y_p, a self-employed income for all individuals based on their personal characteristics and the true income calculated before. I calculate $\overline{y_s}$, a successful income, twice the amount of the predicted self-employed income, and $\underline{y_s}$, an unsuccessful income, half the amount predicted. Then, I estimate $k\ \overline{y_s}$ and $k\underline{y_s}$, the amounts that are being declared from the successful and unsuccessful incomes. The next step is to calculate a progressivity measure that is the difference between the top marginal rate paid on the declared successful income and the top marginal rate paid on the declared unsuccessful income. Finally, the predicted declared income is used to calculate the average tax rate for an income equal to ky_p. Appendix 2 presents in more detail the method used to calculate these tax variables.

Next, I exploit the variation in progressivity at the individual level, the country level and over time to estimate the effects of progressivity on the probability that a head of household will choose one particular occupation. I estimate a multinomial logit model of the form

$$\ln \frac{\Pr(y_{i,k,t} = o)}{\Pr(y_{i,k,t} = b)} = \gamma_{0,o|b} + \gamma_{1,o|b} progressivity_{i,k,t} + \gamma_{2,o|b} atr_{i,k,t} + \sum_{l=3}^{8} \gamma_{l,o|b} personal\ characteristics_{l,i,k,t} + \sum_{j=9}^{10} \gamma_{j,o|b} country\ characteristics_{j,i,k,t} + \mu_{i,k,t} \tag{11}$$

where i is the index for head, k is the index for country, t is the index for year and o is an occupation (officially self-employed, wage employed or other), b is another occupation, $b \neq o$, atr is the average tax rate for ky_p. I control for bribery because the level of bribes in one country can affect the easiness of tax evading in one sector and thus, the decision to choose the easy to evade sector. As in the previous sections, I control for a set of personal characteristics — age, age squared, male, married, family size, education categories and homeowner— because personal characteristics play an important role in choosing an occupation, and for country characteristics like GDP/capita and inflation that can have an impact on the decision to become self-employed.

The data is weighted according to the survey weights (where they exist) and re-weighted to allow each country to weight equally in the analysis.

FIGURE 1 shows the relationship between progressivity and official self-employment. The scatter plot shows the mean progressivity for all individuals in one country year on the x axis and the mean official self-employment rate for the same country year on the y axis. The graph shows a negative correlation between the mean progressivity in one country and the self-employment ratio of the same country. The correlation between the two variables is -21%, but not statistically significant at the 10% level.

TABLE 8 presents the results from estimating (11). Column (1) shows the effects of progressivity, average tax rate, personal characteristics and country characteristics on the probability of being officially self-employed. Marginal effects and robust standard errors are reported for each variable. The progressivity estimate is negative and statistically significant at the 1% level, which means that an individual is less likely to choose official self-employment if the progressivity increases. An increase of 1 standard deviation in progressivity

leads to a decrease of .04 standard deviations in the probability of being officially self-employed. Also, for a decrease in progressivity of 33%, similar to the one in Russia in 2001, the probability of being officially self-employed increases by 6%, or .17 standard deviations. The results are larger than in Russia, but it is hard to draw a definitive conclusion about what is the effect of such a large change in progressivity on individual decisions because the cross-country results are estimated based on individual progressivity values much smaller than the aggregate progressivity values in Russia.

The average tax rate coefficient is negative, but statistically insignificant. Intuitively, a higher average tax rate on the self-employment income makes self-employment less attractive and thus decreases the probability of being officially self-employed.

Column (2) shows the effects of progressivity on the probability of choosing wage employment. The coefficient estimate is positive and statistically significant at the 1% level, which means that an increase in progressivity makes people more likely to choose wage employment. Also, the coefficient estimate on average tax rate is positive, but statistically insignificant. A higher average tax rate on the self-employment income makes the other alternatives more attractive than official self-employment, so it increases the probability of choosing wage employment.

The last column reports the effects of progressivity on the probability of being unofficially self-employed. Progressivity seems to have a negative and statistically significant effect and average tax rate has a positive but insignificant effect. It seems that an increase in progressivity leads people to move from all types of self-employment to wage employment. Also an increase in average tax rate on self-employment income makes people less likely to choose official self-employment and more likely to choose the other two categories, though this last conclusion is not definitive as it was drawn from insignificant results.

Finally, I perform a variety of robustness checks for these results. Some of the results are presented in TABLE 9. I estimate another progressivity measure, progressivity' and look at its effects on choosing an occupation. Progressivity' is the difference between the top marginal rate paid on an income 3 times the predicted one and the top marginal rate paid on an income .33 times the predicted one. Columns (1)-(3) show the results of progressivity' on occupational choice. These results are almost identical to the ones in the original specification. Allowing individuals to face slightly higher progressivity measures does not change the magnitudes and signs of

the results.

I also perform the same analysis under the assumption that people declare their income correctly in the survey. The income is not adjusted for under-reporting; I use the income reported in the survey to predict a self-employment income for all individuals and to estimate a personal progressivity measure for that predicted income. Columns (4)-(6) show these results. Progressivity continues to have a negative and statistically significant effect on official self-employment and a positive and statistically significant effect on wage employment. The magnitude of the effect of progressivity on official self-employment is higher when I assume no tax evasion because an increase in progressivity leads to higher tax burdens for people who declare all their income rather than for the ones who evade.

5 Conclusion

Using various data sets, I find that personal income tax progressivity affects self-employment even when people tax evade and pay bribes. First, a theoretical model suggests that high progressivity affects negatively the decision to become self-employed under certain conditions. Then, I look at tax changes in Russia and find that after large decreases in progressivity people became more likely to become officially self-employed and less likely to become wage employed. Next, aggregate data shows that the number of official micro businesses declines when progressivity increases and that the effects of progressivity are larger when bribes are more common in the economy. Finally, cross-country individual data shows that high progressivity makes individuals less likely to choose official self-employment, less likely to choose unofficial self-employment and more likely to choose wage employment.

How do these effects compare to the ones from US studies? The elasticity of entry into self-employment[8] with respect to progressivity is -1.8 in the US according to the results[9] in Gentry and Hubbard (2000). The elasticity of the probability of being officially self-employed with respect to progressivity for the countries in my sample is -.05. The elasticity of number of micro firms

[8] Gentry and Hubbard report the effects of progressivity on entry into entrepreneurship, where entrepreneurship is defined as self-employment of the head of the household.

[9] The elasticity is calculated at the reported mean self-employment of 3.1% and mean progressivity 9.06%.

with respect to progressivity varies by bribe level: It is -.22 in Indonesia, the country with the most common bribes and it is 0 in Luxemburg, the country with the least common bribes. It seems that self-employment is less responsive to tax progressivity in countries with high tax evasion than in the U.S. and that frequent bribes make people more responsive to changes in taxes because they also have to pay bribes in addition to paying some taxes.

These results have important policy implications for developing and transitional economies. If encouraging official self-employment and small businesses is the goal, then less progressive taxes are desirable. Although the effects of taxes are higher when bribes are more frequent, the highest response to taxes is achieved in countries like the US, where tax evasion is very low and there are no bribes. Thus, a policy of eliminating bribes and evasion should be pursued in addition to tax reform.

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Appendix 1

TABLE 1 - EFFECTS OF PROGRESSIVITY AND PROBABILITY OF SUCCESS ON OCCUPATION

prog	q	$y_e \leq \min(\overline{ky_s}, \underline{ky_s})$	$\underline{ky_s} \leq y_e \leq \overline{ky_s}$	$ky_s \leq y_e \leq \overline{\underline{ky_s}}$	$\max(\underline{ky_s}, \overline{ky_s}) \leq y_e$
high	high	wage employment	wage employment	self-employment	self-employment
high	low	wage employment	self-employment	wage employment	self-employment
low	high	self-employment	self-employment	wage employment	wage employment
low	low	self-employment	wage employment	self-employment	wage employment

The table describes the effects on occupational choice of all the combinations of wage employed, y_e, self-employed incomes $\underline{ky_s}$ and ky_s, progressivity and probability of success, q.

TABLE 2 - DESCRIPTIVE STATISTICS FOR RUSSIAN LOGITUDINAL DATA 1992-2004

variable	observations	mean	standard deviation
officially self-employed	22752	.07	.26
other	22752	.10	.30
wage employed	22752	.82	.38
age	24491	38.80	11.09
age squared	24491	1629.10	874.93
male	24491	.51	.49
homeowner	23477	.80	.39
married	24392	.67	.46
family size	24491	3.15	1.47
edu4-	24410	.002	.04
edu5-8	24410	.04	.20
edu9-12	24410	.47	.49
edu13+	24410	.46	.49

Data reported for heads of households between 18 and 60 not in agriculture between 2000-2004.

TABLE 3 - DIFFERENCES-IN-DIFFERENCES FOR RUSSIA

	(1) officially self-employed	(2) wage employed	(3) other
2nd period	-.01	.03	-.01
	(.003)***	(.004)***	(.003)***
cohort	.02	-.02	-.001
	(.005)***	(.007)***	(.006)
tax change	**.01**	**-.02**	**.006**
	(.008)**	**(.01)***	**(.009)**
age	.01	-.001	-.01
	(.002)***	(.002)	(.001)***
age squared	-.0001	-.000008	.0001
	(.00003)***	(.00003)	(.00002)***
male	.0003	.01	-.01
	(.005)	(.008)**	(.006)***
homeowner	.009	-.02	.01
	(.006)*	(.008)**	(.006)*
married	.02	.05	-.07
	(.006)***	(.01)***	(.008)***
family size	.001	.01	-.01
	(.002)	(.003)***	(.002)***
edu5-8	.01	-.04	.02
	(.02)	(.04)	(.03)
edu9-12	.01	-.02	.009
	(.02)	(.03)	(.02)
edu13+	.02	.01	-.03
	(.02)	(.03)	(.02)
predicted P	.06	.85	.08
observations		15587	
R^2		6.37%	

Multinomial logit models; marginal effects reported, robust standard errors in parentheses, clustered by individual. In (1) , the dependent variable is being officially self –employed, in (2) is being wage employed and in (3) is other. The omitted education category is edu4-. *** significant at 1%, ** significant at 5% and * significant at 10%.

TABLE 4 - DESCRIPTIVE STATISTICS FOR AGGREGATE DATA

variable	obs	mean	standard deviation
micro enterprises/1,000 inhabitants	207	41.97	70.65
micro, small and medium enterprises/ 1,000 inhabitants	241	44.48	69.15
progressivity (%)	230	13.31	11.21
pregressivity1 (%)	230	7.94	8.57
progressivity2 (%)	230	18.88	12.98
marginal income tax rate at GDP/capita (%)	230	17.95	12.04
marginal corporate tax rate at GDP/capita (%)	226	27.25	7.87
VAT rate (%)	203	14.53	7.44
bribe	221	6.61	1.81
corruption	230	5.45	2.48
gdp/cap (2000 US $)	234	12301.83	12524.05
services/gdp (%)	227	59.60	11.96
manufacturing/gdp (%)	218	18.79	6.66
inflation (%)	227	15.93	137.97
female work force/total work force (%)	235	42.87	5.32
unemployment (%)	206	7.96	4.31

TABLE 5 - IMPACT OF PROGRESSIVITY ON NUMBER OF MICRO ENTREPRISES

	(1) micro	(2) micro	(3) micro
progressivity	**-.69**	**-.70**	**-10.81**
	(.54)	**(.52)**	**(3.66)*** **
mean income tax rate	-.42	-.37	-.13
	(.71)	(.66)	(.56)
vat rate	1.95	1.80	2.89
	(1.26)	(1.29)	(1.30)**
mean corporate tax rate	-1.28	-1.21	-1.18
	(1.62)	(1.68)	(1.50)
bribe		-12.28	-30.47
		(9.24)	(11.32)***
progressivity*bribe			1.37
			(.47)***
gdp/cap	.0002	.001	.001
	(.0009)	(.001)	(.001)
services/gdp	-4.07	-3.59	-2.80
	(1.73)***	(1.52)**	(1.41)**
manufacturing/gdp	1.55	1.36	2.46
	(2.19)	(2.18)	(1.92)
inflation	-1.45	-1.49	-1.67
	(.70)**	(.75)**	(.80)**
female labor force	.16	.94	-.94
	(2.39)	(3.06)	(3.17)
unemployment	-4.79	-5.16	-2.23
	(3.05)	(3.27)	(3.05)
year dummies	yes	yes	yes
observations	126	121	121
R^2	.30	.31	.36

Ordinary least squares models; robust standard errors in parentheses, clustered by country. The level of observation is country year. The dependent variable is the number of micro enterprises/1,000 inhabitants. Bribe is a variable that measures how common bribes are in various sectors of the economy. It is measured on a scale from 0 to 10, where 0 means bribes are extremely common. *** significant at 1%, ** significant at 5% and * significant at 10%.

TABLE 6 - IMPACT OF PROGRESSIVITY ON NUMBER OF ENTREPRISES – ROBUSTNESS CHECKS

	(1) micro	(2) micro	(3) msme	(4) micro
progressivity			**-10.57**	**-4.38**
			(4.09)* **	**(1.83)** **
progressivity1	**-12.56**			
	(5.24) **			
progressivity2		**-9.16**		
		(3.93) **		
mean income tax rate	-.29	-.32	-.08	-.13
	(.56)	(.61)	(.51)	(.69)
vat rate	2.58	2.53	2.22	2.38
	(1.26)**	(1.31)**	(1.25)**	(1.25)*
mean corporate tax rate	-.95	-1.44	-1.94	-1.15
	(1.51)	(1.57)	(1.39)	(1.55)
bribe	-27.16	-32.77	-28.96	
	(9.60)***	(14.01)**	(12.22)**	
corruption				-9.67
				(6.11)
progressivity*bribe	1.66	1.09	1.36	
	(.63)***	(.47)**	(.53)**	
progressivity*corruption				.58
				(.25)**
gdp/cap	.001	.001	.001	.0007
	(.001)	(.001)	(.001)	(.001)
services/gdp	-2.88	-2.99	-1.57	-3.66
	(1.47)**	(1.40)**	(1.13)	(1.50)**
manufacturing/gdp	1.96	1.98	1.46	2.20
	(2.00)**	(1.95)	(1.80)	(1.89)
inflation	-1.59	-1.91	-1.26	-1.55
	(.76)**	(.91)**	(.70)**	(.76)**
female labor force	-.48	.12	-2.03	-.83
	(3.61)	(2.87)	(2.73)	(2.79)
unemployment	-3.75	-3.57	-1.82	-3.28
	(3.14)	(2.80)	(2.62)	(3.81)
year dummies	yes	yes	yes	yes
observations	121	121	133	126
R^2	.35	.38	.32	.32

Ordinary least squares models; robust standard errors in parentheses, clustered by country. The level of observation is country year. The dependent variable is the number of micro enterprises/1,000 inhabitants for (1), (2) and (4) and micro, small and medium enterprises for (3). Pogressivity1=MTR(2*GDP/cap)-MTR(0.5*GDP/cap) and progressivity2=MTR(10*GDP/cap-MTR(.1*GP/cap). Corruption is a variable that measures how corrupt various sectors of the economy are in one country. It is measured on a scale from 0 to 10, where 0 means the country is most corrupt.*** significant at 1%, ** significant at 5% and * significant at 10%.

TABLE 7 - DESCRIPTIVE STATISTICS FOR CROSS-COUNTRY INDIVIDUAL LEVEL DATA

variable	method	observations	mean	standard deviation
progressivity (%)	k≠1	45142	3.78	7.01
progressivity (%)	k=1	44258	4.78	7.99
progressivity' (%)	k≠1	45142	6.20	9.78
atr (%)	k≠1	45142	19.79	13.43
atr (%)	k=1	44258	19.23	13.00
officially self-employed		48756	.14	.35
other		48756	.16	.37
wage employed		48756	.68	.46
age		48756	40.03	10.93
age squared		48756	1722.82	888.25
male		47645	.60	.48
homeowner		48030	.67	.46
married		48681	.68	.46
edu4-		47605	.09	.29
edu5-8		47605	.14	.35
edu9-12		47605	.35	.47
edu13+		47605	.39	.48
family size		48754	3.96	2.65
gdp/cap (2000 US$)		48756	1997.03	721.91
inflation (%)		48756	252.59	464.61
bribe		32754	5.24	1.43
property rights		29988	3.63	1.00

Progressivity and atr (k≠1) are calculated the way described in Appendix 2, progressivity and atr (k=1) are calculated by predicting a self-employment income based on personal characteristics and the income reported in the survey (the income is not adjusted for evasion, evasion is assumed to be 0), progressivity' (k≠1) is the difference between the top MTR paid on an income 3 times the predicted income and .33 the predicted income (formula (15) from Appendix 2).

TABLE 8 - IMPACT OF PROGRESSIVITY ON SELECTING AN OCCUPATION OVER ANOTHER

	(1) officially self-employed	(2) wage employed	(3) other
progressivity	**-.002**	**.005**	**-.002**
	(.001)* **	**(.001)*** **	**(.0007)*** **
average tax rate	-.001	.0002	.0007
	(.001)	(.001)	(.001)
age	.01	.01	-.03
	(.003)***	(.003)***	(.002)***
age squared	-.0001	-.0002	.0004
	(.00004)***	(.00005)***	(.00003)***
male	.04	.007	-.05
	(.01)***	(.02)	(.01)***
edu5-8	-.02	-.004	.03
	(.02)	(.05)	(.07)
edu9-12	-.05	.06	-.008
	(.04)	(.03)*	(.07)
edu13+	-.03	.11	-.07
	(.04)	(.03)***	(.07)
homeowner	.03	-.08	.04
	(.01)***	(.02)***	(.02)*
family size	-.003	.003	-.0007
	(.004)	(.007)	(.003)
married	.02	.04	-.07
	(.007)***	(.008)***	(.008)***
gdp/cap	-.00002	.00005	-.00003
	(.00004)	(.00005)	(.00004)
inflation	-.0009	.001	-.0003
	(.00004)	(.0002)***	(.0002)
predicted P	.13	.72	.13
observations		44662	
pseudo-R^2		7.50%	

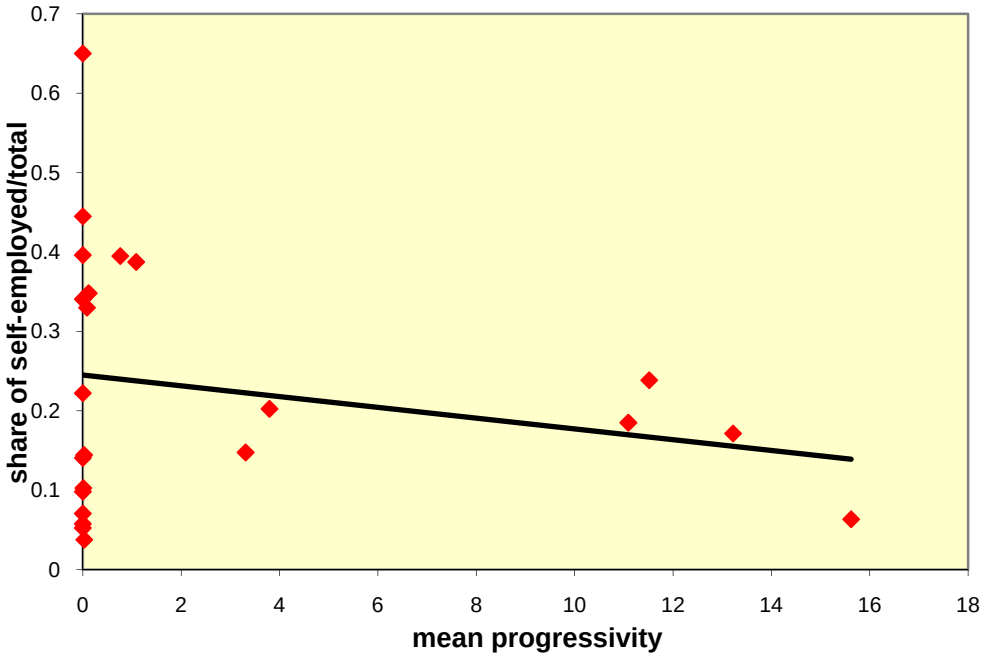
Multinomial logit models; marginal effects reported, robust standard errors in parentheses, clustered by country. In (1), the dependent variable is being officially self –employed, in (2), is being wage employed and in (3) is other. The omitted education category is edu4-. *** significant at 1%, ** significant at 5% and * significant at 10%.

TABLE 9 - ROBUSTNESS CHECKS

	(1) officially self - employed	(2) wage employed	(3) other	(4) officially self- employed k=1	(5) wage employed k=1	(6) other k=1
progressivity				**-.003**	**.003**	**-.00008**
				(.0009)***	**(.003)*****	**(.003)**
progressivity'	**-.002**	**.005**	**-.002**			
	(.0009)***	**(.001)*****	**(.0007)*****			
average tax rate	-.001	.0002	.0007	-.001	.00003	.0001
	(.001)	(.001)	(.001)	(.001)	(.002)	(.001)
age	.01	.01	-.03	.01	.01	-.03
	(.003)***	(.003)***	(.002)***	(.003)***	(.003)***	(.002)***
age squared	-.0001	-.0002	.0004	-.0002	-.0002	.0004
	(.00004)***	(.00005)***	(.00003)***	(.00004)***	(.00005)***	(.00003)***
male	.04	.007	-.05	.04	.01	-.05
	(.01)***	(.02)	(.01)***	(.01)***	(.02)	(.01)***
edu5-8	-.02	-.004	.03	-.02	.01	.007
	(.02)	(.05)	(.07)	(.02)	(.03)	(.05)
edu9-12	-.04	.06	-.008	-.05	.08	-.02
	(.03)	(.03)*	(.07)	(.03)	(.02)***	(.05)
edu13+	-.02	.11	-.07	-.03	.12	-.09
	(.03)	(.03)***	(.07)	(.03)	(.02)***	(.05)
homeowner	.03	-.08	.04	.02	-.08	.05
	(.01)***	(.02)***	(.02)*	(.01)***	(.02)***	(.01)*
family size	-.002	.003	-.0007	-.002	.004	-.001
	(.004)	(.007)	(.003)	(.004)	(.006)	(.003)
married	.03	.04	-.07	.02	.04	-.06
	(.008)***	(.008)***	(.008)***	(.005)***	(.009)***	(.009)***
gdp/cap	-.00002	.00005	-.00003	-.00002	.00005	-.00003
	(.00004)	(.00005)	(.00004)	(.00005)	(.00005)	(.00004)
inflation	-.001	.001	-.0003	-.001	.001	-.0002
	(.0001)***	(.0002)***	(.0002)	(.0001)***	(.0004)**	(.0004)
predicted P	.13	.72	.13	.13	.73	.13
observations		44662			43778	
pseudo-R^2		7.62%			8.04%	

Multinomial logit models; marginal effects are reported, robust standard errors in parentheses, clustered by country. (4)-(6) report results if we assume people declare all their income correctly. The omitted education category is edu4-. *** significant at 1%, ** significant at 5% and * significant at 10%.

FIGURE 1 - PROGRESSVITY VS OFFICIAL SELF-EMPLOYMENT



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One observation represents the mean progressivity in one country year and the share of officially self-employed out of the total sample in the same country year.

Appendix 2

Methodology for calculating tax measures at individual level

STEP 1. Calculate the share of income that is declared by an individual who is officially self-employed

I assume that wage employed individuals declare their income correctly. Most of the countries in this study have withholding tax which makes evasion harder. Even in countries without withholding tax, wage employed individuals have few opportunities to tax evade.

Then, I assume that officially and unofficially self-employed underreport their incomes. Tax evasion among self-employed individuals is common even in countries were tax evasion is not rampant. Johansson (2005) estimates that Finish self-employed individuals underreport 16%-40% of their incomes and Finland is considered to have good tax compliance. So, it is likely that individuals in the developing countries from my sample underreport a large share of their incomes.

Also, I assume that household food expenditure is reported correctly. For most countries in my sample, respondents are asked to tell how much of each food item they consumed in the previous 30 days. Since in most cases, respondents don't have to calculate actual expenditures, it is likely they report the consumption correctly.

Finally, the household food expenditure function is the same for all 3 occupations.

I use a method similar to the expenditure approach from Pissarides and Weber (1989) in order to estimate how much tax is evaded. First, I estimate the following equation,

$$\ln(food_i) = \delta_0 + \delta_1 \ln(income_i) + \delta_2 official\ se_i + \delta_3 other_i + \\ + \sum_{l=4}^{9} \delta_{j,i} personal\ characteristics_{l,i} + \psi_j, \tag{12}$$

where food is the food expenditure for the household, income is the declared household income, official se and other are occupational dummies for official self-employment and unofficial self-employment and the set of personal characteristics are: age, age squared, male, educational categories, size, married

and homeowner. The regression is run on heads of household between 18 and 60 not in agriculture. It is run separately for each country since there are reasons to believe that food expenditure functions might be different across countries.

Then, I estimate k, the share of income that is declared if the head of household is officially self-employed as

$$k = e^{-\frac{\delta_2}{\delta_1}}. \tag{13}$$

STEP 2. Estimate a potential self-employed income for all heads

Using the k calculated in (13) and the declared income, y, I derive the true income y_T for an officially self-employed head.

$$y_T = y/k \tag{14}$$

Next, I use the above true income y_T to estimate an equation for officially self-employed income based on demographic characteristics of the head. I estimate the equation,

$$y_{Ti,k,t} = \zeta_0 + \sum_{l=1}^{6} \zeta_j personal\ characteristics_{l,i,k,t} + \phi_{i,k,t}, \tag{15}$$

where the set of personal characteristics are age, age squared, male, homeowner, married, size and education categories, i is the index for a head, k is the index for country and t is the index for year. Then, using (15), I estimate a predicted self-employed income for all heads, y_p.

$$y_p = \widehat{\zeta_0} + \sum_{l=1}^{6} \widehat{\zeta_j} personal\ characteristics_{l,i,k,t}. \tag{16}$$

STEP 3. Calculate the progressivity measure & tax rates for all heads of households

First, I calculate a successful income, $\overline{y_s}$, and an unsuccessful income, $\underline{y_s}$,

$$\overline{y_s} = 2y_p \tag{17}$$

$$\underline{y_s} = 0.5y_p \tag{18}$$

And then, I estimate the amount that is reported from the successful income, $\overline{y_s}^r$ and from the unsuccessful income, $\underline{y_s}^r$using the k calculated in (13).

$$\overline{y_s}^r = k\overline{y_s} \tag{19}$$

$$\underline{y_s}^r = k\underline{y_s}. \tag{20}$$

The progressivity measure is the difference between the top marginal rate paid on Y_s^r and top marginal rate paid on Y_u^r,

$$progressivity = \tau(\overline{y_s}^r) - \tau(\underline{y_s}^r). \tag{21}$$

Other measure of progressivity are calculated for robustness checks. Progressivity' is the difference in top marginal paid if the heads earns 3 times the predicted income and if he earns 1/3 of the same income,

$$progressivity' = \tau(3 \cdot ky_p) - \tau(.33 \cdot ky_p). \tag{22}$$

Another tax measures used in the analysis is the average tax rate for the same income,

$$atr = 100 \cdot \frac{T(ky_p)}{ky_p}, \tag{23}$$

where $T(Y)$ is the total tax paid on the income Y.