TAXES AND UNMARRIED FATHERS' PARTICIPATION IN THE UNDERGROUND ECONOMY

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Abstract

In this paper we employ data from the Fragile Families and Child Well-Being Study in order to estimate a model of underground labor supply developed by Lemieux et al. (1994). We focus specifically on the underground labor supply of unmarried fathers, a group that is likely to have significant involvement in the underground economy. We also extend the empirical analysis of Lemieux et al. by taking into account exogenous state and local variation in marginal tax rates, as well as sociodemographic variables related to the likelihood of participation in the underground.

In accordance with expectations, we find that a significant proportion of unmarried fathers report participation in the underground. However, although the theoretical model predicts a positive relationship between the tax rate and underground hours of work (under certain conditions), we find that the effect of the tax rate on hours is statistically indistinguishable from zero, even after including exogenous variation in tax rates. We also fail to find a positive and statistically significant effect of the tax rate on participation in the underground. Within the context of the model, these results have specific implications for the magnitudes of the probability of detection and the penalty on evaded tax. Therefore, we conclude that additional empirical information is needed regarding these parameters. Future research might also employ other datasets in the estimation of the theoretical model outlined by Lemieux et al., as well as investigate the applicability of other models of underground labor supply.

This paper considers whether marginal tax rates influence the likelihood that unmarried fathers participate in the underground economy. Although it does not directly consider the effect of the imposition of child support payments, a primary motivation for examining the effect of marginal tax rates stems from the possibility that such payments may cause unmarried fathers to face high implicit tax rates on their earnings.[1] To the extent these tax rates drive fathers underground, it may be harder for state authorities to obtain child support payments. In this way, enforcement of child support may be counter-productive. In addition, fathers who increase their hours of work in the underground may be less likely to build human capital that is useful in the mainstream economy, thus further compromising their ability to contribute to the material well-being of their children.

Theoretical work on tax evasion has shown that, consistent with intuition, an individual may be induced, under certain circumstances, to work in the underground sector in order to reduce his or her tax burden (Sandmo 1981; Cowell 1985; Kesselman 1989). In the models employed in these analyses, individuals must simultaneously decide how many hours to supply to the labor market, and how to allocate those hours between the regular and underground sectors. However, because these models must account for decisions across two margins (i.e. the labor-leisure choice, and the regular-underground sector choice), they have not resulted in unambiguous predictions concerning the effect of higher marginal tax rates on hours of work in the underground sector. Thus,

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[1] Existing analyses of the effects of child support enforcement on the labor market behavior of non-custodial fathers treat the imposition of child support orders as analogous to the imposition of taxes on wage income (Klawitter, 1994; Freeman and Waldfogel, 1995). However, these studies have focused on the potential effects of child support enforcement on the labor force participation and total earnings of non-custodial fathers, without discerning whether earnings arise from the regular sector, the underground sector, or both.

researchers interested in tax evasion have begun to look to empirical work to clarify this effect.

To date there have been few empirical studies of the effects of income taxes on participation in the underground economy, in part because of the difficulty of collecting information on the number of hours worked by individuals who participate in the underground economy. However, two previous studies suggest that higher marginal tax rates may encourage greater participation in the underground economy among the general population. Specifically, Lacroix and Fortin (1992) utilized data from a survey of individuals in Quebec City, Canada, which was designed for the express purpose of eliciting information on the extent of work in the underground sector. A descriptive analysis of the data revealed that participation in the underground economy, as well as hours of work conditional on participation, were inversely related to disposable income. Furthermore, among individuals employed in both the regular and underground sectors, an increase in the marginal tax rate led to increased hours of work in the underground.

Lemieux et al. (1994) analyzed the effects of taxes on work in the underground sector using the same data set as Lacroix and Fortin (1992), but adopted a different underlying theoretical model. Their descriptive analysis revealed that not only were participation rates inversely related to disposable income, but that labor earnings in the underground sector were concentrated among workers with low earnings in the regular sector. In addition, a probit analysis of participation in the underground showed some evidence that marginal tax rates increased participation. However, the authors also found that, among workers who supplied labor to both sectors, higher marginal tax rates were associated with lower hours of work in the underground. Finally, their results indicated

that hours worked in the underground sector were quite responsive to changes in the gross wage in the regular sector. They concluded that, for the average worker, who is unlikely to work in the underground sector, taxes do not significantly distort the allocation of hours of work from the regular to the underground sector. They suggested, however, that the effects might be large for some groups, such as welfare recipients, who do work in the underground sector.

Overall, these results suggest that enforcement of child support orders may have an important effect on the extent to which low-income, non-custodial fathers participate in the underground economy--both because such fathers have low incomes and, thus, are more likely to work in the underground, and because they may face high marginal tax rates arising from the imposition of child support orders.

This paper utilizes data from the Fragile Families and Child Well-Being Study to examine the effect of marginal tax rates on unmarried fathers' participation in the underground. Similar to the data employed by Lacroix and Fortin (1992) and Lemieux et al. (1994), the Fragile Families study asks respondents specifically about work and earnings in the underground sector. In addition, an important obstacle to obtaining estimates of the effect of taxes on labor supply in the regular sector is the well-known fact that tax rates are endogenous (Triest 1998). While the problem is lessened in the case of underground labor supply, it still exists (Lemieux et al. 1994). However, an important advantage of the Fragile Families study is that it allows for estimation of the effects of taxes after taking into account exogenous state and local variation in income tax rates.

The remainder of the paper is organized as follows. In the next section we describe in greater detail the analysis of Lemieux et al. (1994) and Lacroix and Fortin (1992). In section II we describe the data and method of analysis. Section III presents the results of the analysis, and section IV concludes with suggestions for future research.

I. PREVIOUS RESEARCH

Lacroix and Fortin (1992) estimate a model in which it is assumed that an individual's regular sector income is taxed at the rate τ. In addition, the individual may work in the underground sector in order to reduce his tax burden. However, if he does so, he faces a fixed probability p of being detected, in which case he must pay a proportion $\phi > \tau$ of his underground income. Individuals are assumed to choose hours of work in the regular and/or underground sectors in order to maximize utility. In doing so, they face wages $w_0 = W_0(1 - \tau)$ and w_1 in the regular and underground sectors, respectively; W_0 is the gross regular sector wage and w_1 is given by:

$$w_1 = \begin{cases} W_1 \text{ with probability } (1 - p) \\ W_1(1 - \phi) \text{ with probability } p \end{cases}$$

where W_1 is the gross wage in the underground sector.

In the solution to the model, individuals fall into one of four different regimes: 1) regular and underground employment; 2) regular employment only; 3) underground employment only; and 4) employment in neither sector.[2] The model yields labor supply functions for each regime, the parameters of which the authors estimate through maximum likelihood. The finding of greatest relevance to this paper is that higher tax rates increase underground hours, but only among those workers employed in both the

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[2] Lacroix and Fortin also consider an extension to this model in which individuals' hours in the regular sector can be constrained; in this case individuals can fall into one of six regimes.

underground and regular sectors. In addition, the point estimate of the elasticity of underground hours with respect to the tax rate is reported by Lacroix and Fortin to be within the range estimated by Fortin et al. (1990), who estimate a model similar to the one later estimated by Lemieux et al. (1994).

Lemieux et al. (1994) develop a somewhat different model of underground labor supply. Based on the relationships between regular and underground earnings and hours uncovered in the data, they model underground earnings as a concave Cobb-Douglas function of underground hours, and regular earnings as a linear function of regular hours.[3] Also, unlike the model developed by Lacroix and Fortin (1992), their model implicitly assumes that hours of work in the regular and underground sectors are perfect substitutes.

The model yields the following equations for underground hours as a function of the regular wage and the tax rate, and underground earnings as a function of underground hours:

$$\ln(h_{1i}) = (1/1 - \theta) [\ln \theta + \beta_0 + a_0] \ - \ (1/1 - \theta) \ln(W_{0i}) \ - \ (1/1 - \theta) (1 - a_1)\ln(1 - \tau_i)$$
$$+ \ (1/1 - \theta)\mathbf{x'}_{1i}\boldsymbol{\beta}_1 \ + \ (1/1 - \theta)\varepsilon_{1i} \tag{1}$$

$$\ln(Y_{1i}) = \beta_0 \ + \ \theta \ln(h_{1i}) \ + \ \mathbf{x'}_{1i}\boldsymbol{\beta}_1 \ + \ \varepsilon_{1i} \tag{2}$$

where h_1 = hours of work in the underground, $\mathbf{x}_{1i}$ is a vector of explanatory variables, and Y_1 = earnings in the underground. In the earnings equation, the parameter θ determines the elasticity of underground earnings with respect to underground hours. In addition, this parameter also determines the elasticity of underground hours with respect to the

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[3] Examination of the data revealed that the coefficient on regular hours in a regression of regular earnings was not statistically different from one. Also, the coefficient on underground hours in a regression of underground earnings was significantly smaller than one. Hence, the authors conclude that regular

regular wage, which is calculated as $-1/(1 - \theta)$. As a result, this parameter can be estimated directly by fitting the underground earnings equation, or indirectly by fitting the underground hours equation.

Lemieux et al. extend the model by assuming that underground workers face a probability p of being detected by the authorities and a penalty rate λ on evaded tax (with $\lambda \geq 1$). Incorporating these assumptions results in the following first-order condition with respect to the effect of the tax rate on underground hours of work:

$$dh1/d\tau \; = \; h1(1 - p\lambda)/(1 - \tau)(1 - p\lambda)(1 - \theta) > 0 \tag{3}$$

Thus, under the condition that $p\lambda < 1$, the model predicts a negative effect of the marginal tax rate on underground hours of work.

In their empirical analysis, Lemieux et al. first estimate probit models for the likelihood of participation in the underground. The primary independent variables in these models are the log of the gross wage and the marginal tax rate, entered as $-\log(1 - \tau)$, where τ is the marginal tax rate associated with federal and provincial payroll and income taxes, as well as tax-back rates embodied in the social-transfer system. Additional variables included are age and its square, sex, labor market experience and its square, education, nonlabor income, and marital status. In addition, some specifications also include either industry of employment dummies or a measure of excess employment in an individual's industry.[4] Both simple and two-stage probit models are estimated. In the latter models, the wage is instrumented with the industry dummies and union status, while the tax rate is instrumented with a predicted tax rate. However, because the data

earnings are a linear function of regular hours, while underground earnings are a concave function of underground hours.

employed by the authors is drawn from a single city, they cannot exploit exogenous variation due to provincial and/or local differences in tax rates.

In the simple probit models, the gross wage has a statistically significant negative effect on the likelihood of underground participation, while the marginal tax rate has a statistically significant positive effect. In the two-stage probit models the magnitudes of the coefficients on the regular wage and the marginal tax rate increase. However, the estimated standard errors increase by even more, so that the estimated coefficients are no longer statistically significant. As a result, Hausman specification tests do not reject the simple probit specifications.

Lemieux et al. also estimate OLS and two-stage least squares (2SLS) regressions of underground hours and underground earnings for the sample of workers employed in both the regular and underground sectors. The estimated equations are corrected for sample selection bias through the inclusion of the inverse Mills' ratio constructed from the probit equation for underground participation. In the 2SLS models, the regular wage is instrumented with the industry dummies and union status, while the tax rate is instrumented with a predicted tax rate. In the OLS results the coefficient on the tax rate is unexpectedly negative but statistically insignificant. However, it is negative and significant in one of two specifications for the 2SLS equation.[5] In addition, the elasticity of underground hours with respect to the regular wage is negative and statistically significant in the OLS, but not the 2SLS, regressions.

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[4] The excess employment variable was not statistically significant in any of the models. In addition, the coefficients on the industry dummies were not reported. However, the authors did report that none of the estimated coefficients changed substantially when the industry dummies were included.
[5] In this specification, the regular wage is instrumented with industry dummies only. In the second specification, it is instrumented with both industry dummies and union status. In this case the coefficient on the tax rate is reduced somewhat and becomes statistically insignificant.

The authors present a final set of estimates in which the underground hours and earnings equations were fitted jointly. Similar to the 2SLS estimates of the hours equation, the results indicate a negative and statistically significant effect of the tax rate on underground hours.

In sum, Lemieux et al. find some evidence that the marginal tax rate increases the likelihood of participation in the underground. In contrast, they also find that the tax rate decreases hours of work in the underground among those workers who work in both sectors. Finally, they find a large elasticity of underground hours with respect to the gross regular sector wage.

II. METHODS

A. Data

The evidence presented in this paper is based on data from the Fragile Families and Child Wellbeing Study (hereafter referred to as FF).[6] This study is collecting data on approximately 4,700 births (3,600 nonmarital, 1,100 marital) in 75 hospitals in 20 U.S. cities.[7] The data is representative of non-marital births in each of the 20 cities, and is also representative of non-marital births in U.S. cities with populations over 200,000. At baseline, mothers were interviewed in the hospital within 24 hours after they had given birth. Fathers were interviewed either at the hospital or outside the hospital as soon as

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[6] The Fragile Families Study has been designed and pretested by the principal investigators, Sara McLanahan of Princeton University and Irwin Garkinkel of Columbia University. Jeanne Brooks-Gunn (Columbia University) and Marta Tienda (Princeton University) are co-investigators, along with a network of junior scholars including Lauren Rich (University of Pennsylvania), Sheila Ards (Benedict College), Waldo Johnson (University of Chicago), Mark Turner (Urban Institute), Maureen Waller (Public Policy Institute of California), and Melvin Wilson (University of Virginia).

[7] The cities are: Austin, Texas; Baltimore, Maryland; Birmingham, Alabama; Boston, Massachusetts; Chicago, Illinois; Corpus Christi, Texas; Detroit, Michigan; Indianapolis, Indiana; Jacksonville, Florida; Nashville, Tennessee; New York City; Newark, New Jersey; Oakland, California; Philadelphia, Pennsylvania; Pittsburgh, Pennsylvania; Richmond, Virginia; San Antonio, Texas; Santa Ana, California; Toledo, Ohio; and Virginia Beach/Norfolk, Virginia.

possible after the birth. Using this approach, the FF study has been able to interview 75% of the partners of the unmarried mothers.[8]

This paper is based on the first wave of data collected in the twenty cities. Data for the cities of Austin and Oakland were collected in the spring of 1998. Data for the cities of Baltimore, Detroit, Newark, Philadelphia and Richmond were collected in the fall of 1999. Data for the remaining cities were collected in the fall of 2000.

FF is unique in that it asks fathers (and mothers) specifically about informal economic activity, and any earnings arising from such activity.[9] At baseline, fathers were asked the following question: "We are interested in finding out about some ways, other than regular work, in which people make a living. Please indicate whether, in the last twelve months, you engaged in any of the following activities in order to generate income or in exchange for meals, clothing, a place to live, or other basic necessities: a) Off-the-books or under-the-table work, such as household maintenance/repairs, providing transportation or other personal services, or selling personal property, b) Work in your own business (excluding activity already reported in a)), c) Selling stolen goods, selling or delivering drugs, or other hustles, or d) other." Finally, respondents who indicated they engaged in any of these activities were asked to report the number of weeks in the past twelve months they engaged in the activity, the number of hours per week they spent on the activity, and the amount they earned from each activity.

For comparison, the study employed by Lemieux et al. (1994) asks respondents to identify those jobs for which they report the proceeds in their income tax statements. Then, underground jobs are characterized as jobs from which the proceeds are not

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[8] For additional details on the sample and study design see Reichman et al. (2001).

reported. Although the questions used to determine underground activity differ between the surveys, it is expected that there is a significant amount of overlap in the activities characterized as underground activities. For example, it is probably unlikely that individuals engaging in off-the-books work (76% of the fathers in FF who report underground work report this activity) report the income from such work in their income tax statements. Still, it is possible that some of the work reported as underground work in the FF study is work that would not be reported in the QC study.

B. Analysis

In this paper, we base our analysis on the theoretical model developed by Lemieux et al. (1994).[10] Because there have been so few analyses of microdata on underground employment, we first compare the sociodemographic characteristics of and extent of underground employment among the respondents in the Fragile Families (FF) and Quebec City (QC) data.[11] We then replicate the exploratory analysis of Lemieux et al. in order to determine whether the FF data exhibit the same "empirical regularities" as those found in the QC data (see footnote #3).

Next, we estimate probit models of participation in the underground. Initially, we employ the specification adopted by Lemieux et al.[12] For this specification, we calculate each father's federal marginal tax rate according to the earnings he reports in the FF survey. We assume that each father files as a single individual and takes the standard

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[9] Mothers are not questioned about their own informal economic activity until round two of the survey. Hence, women are not included in the analysis in this paper.

[10] In future analyses, we will employ the Fragile Families data to estimate the model proposed by Lacroix and Fortin.

[11] We restrict the sample to unmarried fathers. However, results including the married fathers are qualitatively similar to those presented in the paper.

[12] Our specification does not include a variable for excess employment in an individual's industry. In addition, due to data limitations, we control for occupation instead of industry.

deduction for an individual. We also assume that fathers claim zero dependents.[13] Then, we extend the analysis of Lemieux et al. by including state and city taxes in the calculation of the overall marginal tax rate. We do this in order to take advantage of exogenous variation across states and locales in tax rates. In addition, we estimate a specification in which we include demographic and individual characteristic variables found in previous work to be important determinants of participation in the underground (Rich, 2001).

Finally, we estimate Lemieux et al.'s equations for underground hours and earnings. For these equations we begin with the marginal federal tax rate as the primary independent variable, and then investigate the effect of taxes when state and city tax rates are included. We also estimate specifications in which we control for sample selection bias through inclusion of the inverse Mills' ratio calculated from the probit analysis of participation in the underground.

III. RESULTS

A. Comparison of FF and QC Samples

Table 1 compares the demographic characteristics of, as well as the extent of underground employment among, the respondents in the FF and QC surveys.

As noted previously, the FF sample in this analysis consists entirely of men, while the QC sample is split evenly between men and women. Compared to the men in the QC study, a much higher proportion of the men in the FF sample reported participating in the underground sector (33.6 versus 9.9 percent). In addition, among those men who reported participating in the underground, hours worked in this sector were 40 percent

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[13] A small percentage of the fathers report children living in their household. Thus, our calculation may overstate the marginal tax rate for these fathers.

higher on average in the FF sample. There was not a substantial difference between the underground participation rates of the men and women in the QC sample (9.9 versus 7.1 percent).

The samples also differ on other dimensions. Specifically, the respondents in the FF sample are more likely to be aged 18-24, less likely to be over the age of 40, more likely to be single, cohabiting, or in an "other" living arrangement, less likely to have more than a high school education, more likely to be either employed or unemployed, less likely to be enrolled or otherwise out of the labor force, more likely to be receiving social assistance, more likely to have worked 2,000 or more hours in the past year, and less likely to have worked zero hours.[14] In addition, respondents in the FF sample are more likely to have an annual income between 16,000 and 33,000, and less likely to have an income between 33,000 and 66,000.[15]

However, the differences in demographic characteristics between the two samples do not appear to account for much of the difference in the observed underground participation rates. Respondents in the QC sample who are younger, unmarried, in school or unemployed, receiving public assistance, or working between 1-500 annual hours are significantly more likely to participate in the underground. In particular, QC respondents who are receiving public assistance, attending school, or unemployed, report underground participation rates similar to the average rate for the FF sample. This suggests that, if respondents in the FF sample are more likely to fall into these categories (and if a similar relationship exists between these characteristics and underground

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[14] For the FF sample, the 18-24 category includes 40 respondents under the age of 18. The majority of the FF respondents in the single/cohabiting/other category are cohabiting with a female partner, usually the mother of the focal child in the study.

participation), the demographic differences between the samples might explain a portion of the higher underground participation rate.

Individuals in the FF sample are more likely to be unemployed, and the underground participation rate is higher than average for this group. However, while the underground participation rate is higher than average among students in both samples, FF respondents are much less likely than QC respondents to be enrolled. Also, while the FF sample is younger and more likely to receive public assistance, underground participation rates do not vary much by age or assistance receipt in this sample. On the other hand, underground participation rates in the FF study do vary somewhat according to marital status; 23.7 percent of married FF fathers reported participating in the underground, versus 33.6 percent of all unmarried FF fathers. However, the participation rate for married men in the FF sample is significantly higher than the rate for married individuals in the QC sample. Finally, while the participation rate is higher than average for FF individuals working 1-500 hours in the regular sector, FF respondents are about as likely as QC respondents to fall into this category.

As noted previously, the differences between the questions used to identify underground employment in the two surveys may also account for some of the difference in the proportions reported to participate in the underground. In the QC study only jobs that are not reported in the individual's income tax statement are recorded as underground employment. In contrast, the FF study asks specifically about underground employment but does not attempt to ascertain whether the proceeds from such employment are reported as income.

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[15] In the Lemieux et al. (1994) study the income categories were 0-10,000, 10,000-20,000, 20,000-30,000, 30,000-40,000,and over 40,000 (in 1986 Canadian dollars). The beginning and end points for these

Table 2 shows the correlations of log hours, log wages, and log earnings in both sectors. Similar to Lemieux et al., we found a positive correlation between hours and wages in the regular sector, and a negative correlation between hours and wages in the underground sector. The degree of correlation between underground hours and wages in the FF data is significantly higher than that in the QC data, perhaps reflecting the fact that the underground wage for the FF sample was constructed using annual hours and annual earnings in the underground. Also, unlike the QC data, where underground hours and the regular wage were negatively correlated, the correlation between underground hours and the regular wage in the FF data is somewhat positive.[16]

In Table 3A we regress regular and underground hours on wages in the two sectors. The equations also include age, age squared and education as regressors. The results of these regressions confirm that the regular sector wage is positively related to hours in both sectors. This conclusion is strengthened when the regular wage is instrumented with annual earnings divided by annual hours.

In Table 3B we report OLS regressions of regular sector earnings on regular hours, and of underground earnings on underground hours. In both sectors, the elasticity of earnings with respect to hours is significantly smaller than one. Thus, similar to the results reported by Lemieux et al, we find that earnings in the underground sector are a concave function of underground hours, suggesting that wages in the underground sector decrease as hours increase. However, in contrast to the results reported by Lemieux et al, we also find that regular sector earnings are a concave function of regular sector hours.

B. Probit Analysis of Participation in the Underground

categories were converted to 1999 U.S. dollars.

Table 4 presents probit estimates of the decision to participate in the underground sector. The specification in this table is similar to that employed by Lemieux et al, except that the models do not include a measure of excess employment in the individual's industry.

In contrast to the results obtained by Lemieux et al., neither the regular wage nor the marginal tax rate has a statistically significant effect on the likelihood of fathers' participation in the underground sector. In addition, none of the other variables in the model attain statistical significance. In column 2, the effect of occupation is found to be statistically significant. Specifically, individuals employed in sales, clerical, machinery, transportation, labor, and service occupations are significantly less likely than those employed in craft or repair occupations to participate in the underground.

Table 5 presents additional probit estimates of the decision to participate in the underground sector. In column 1, based on previous analyses of the determinants of participation in the underground, the square of age and experience are excluded from the model. In column 2, state taxes are included in the calculation of the marginal tax rate faced by individuals. In column 3, city taxes are included in the calculation. Finally, the model in column 4 includes additional demographic and individual characteristic variables found in previous work to be related to the decision to participate in the underground.

The results in column 1 indicate that the federal marginal tax rate has a negative but statistically insignificant effect on the likelihood of fathers' participation in the underground. The same is true of the regular wage. The only variable with a statistically

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[16] The correlations between underground hours and regular hours and earnings are not estimated with much precision.

significant effect in this model is age, the coefficient of which indicates that older fathers are less likely to participate in the underground sector. In addition, although not shown, the occupational dummies continue to be statistically significant and to follow the pattern shown in Table 4.

When state taxes are used to compute the marginal tax rate the effect of the tax rate is measured more precisely. However, the coefficient on the tax rate becomes somewhat less negative and the effect of this variable remains statistically insignificant. In column 3, when city taxes are added to the computation of the marginal tax rate, the estimated standard error of the tax variable falls further still, and the estimated coefficient becomes more negative. As a result, the effect of the marginal tax rate becomes statistically significant at the 5 percent level.

However, the inclusion of additional variables in the model (column 4) reduces the tax coefficient somewhat, and the effect again becomes statistically insignificant. All of the additional included variables are statistically significant. They indicate that the likelihood that unmarried fathers participate in the underground increases with the number of children and the amount of reported alcohol and drug use. In addition, fathers born in the U.S. are more likely than those born outside of the U.S. to participate in the underground are, and blacks are less likely than fathers of other race/ethnicity groups to participate are.

In sum, there is some evidence that, in contrast to the results obtained by Lemieux et al., higher marginal tax rates reduce rather than increase the likelihood of participation in the underground sector. However, this effect disappears when demographic and

individual characteristic variables not considered by Lemieux et al. are included in the regression model.

C. Estimates of the Underground Hours and Earnings Equations

Columns one through four of Table 6 present estimates of the underground hours equation (1) derived by Lemieux et al. In column 1, the marginal tax rate is calculated based on federal taxes only. In column 2, exogenous variation in state taxes is taken into account, while in column 3 city taxes are included. The model in column 4 includes the additional demographic and individual characteristic variables found to be significant in the analysis of participation in the underground. Initially, these equations were corrected for selectivity bias through the inclusion of the inverse Mills' ratio constructed from the probit equation for underground participation. However, because the coefficient on the Mills' ratio was statistically insignificant, only the uncorrected results are presented here.[17]

The effect of the federal marginal tax rate on underground hours is found to be negative but statistically insignificant. Taking exogenous variation in state and city taxes into account causes the effect of the tax rate to become less negative. In addition, the effect is measured with greater precision. However, it remains statistically indistinguishable from zero. Thus, within the context of the model developed by Lemieux et al., this results leads to the unlikely conclusion that $p\lambda = 1$.

Also in contrast to the results obtained by Lemieux et al., the effect of the regular wage on underground hours is positive and significant in three of the four specifications of the model. However, the implied elasticity of hours with respect to the wage obtained from the earnings regression is -1.5 (i.e. $-1/(1 - \theta) = -1/(1 - .343)$). A Wald test rejects

the null hypothesis that this estimate is equal to the direct estimate of the elasticity obtained from the hours equation. A Wald test also rejects the hypothesis that the value of θ implied by the elasticity estimate in the hours equation is equal to the estimate of θ in the earnings equation. Thus, the data does not support the estimation of a unique θ through the joint fitting of the underground hours and earnings equations.

IV. CONCLUSION

Overall, we do not find any evidence that higher marginal tax rates encourage unmarried fathers' participation in the underground. On the contrary, we find some evidence that higher tax rates decrease participation. However, once we control for other factors related to participation in the underground, the statistically significant negative effect of taxes disappears. In addition, in a regression analysis of earnings among workers employed in the regular and underground sectors, we find that the coefficient on the marginal tax rate is statistically indistinguishable from zero. Employing the theoretical model developed by Lemieux et al., this result implies that the product of the probability of detection by the authorities and the penalty rate on evaded tax is equal to one.

In light of these findings, future empirical work on underground labor supply should seek to clarify the likely size of the probability that underground workers are detected by the authorities, as well as the penalty rate on evaded tax. Clarification of the size of these parameters will yield additional information useful in assessing the applicability of the Lemieux et al. model. In addition, as additional microdata on underground employment becomes available, further tests of the model proposed by Lemieux et al. might be conducted. Finally, existing microdata such as the Fragile

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[17] The results of the selectivity-corrected equations are available from the authors.

Families study might be used to explore the applicability of other models of underground

labor supply.

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Table 1. Comparison of Fragile Families and Quebec City data: Proportion Participating in Underground and Hours/Earnings of Underground Participants, by Demographic Characteristics

	Fragile Families Sample (Unmarried Fathers)				Quebec City Sample			
		Participation in the Underground				Participation in the Underground		
	Percent of Total Sample	Percent	Hours (H>0)	Earnings (US$) (Y>0)	Percent of Total Sample	Percent	Hours (H>0)	Earnings (US$) (Y>0)
Sex:								
Male	100.0	33.6	463	3,663	48.7	9.9	331	2,798
Female	0.0	---	---	---	51.3	7.1	391	1,986
Age:								
18-24	49.4	35.0	420	2,776	15.3	23.3	340	2,148
25-39	44.7	32.6	502	4,650	43.1	8.2	370	2,592
40-59	5.8	30.5	584	4,667	33.6	3.8	378	3,019
60 +	<1	0	---	---	8.0	1.2	120	598
Race:								
Black	55.0	33.3	501	3,705	---	---	---	---
Hispanic	29.4	30.8	360	3,036	---	---	---	---
White	15.5	40.1	511	4,529	---	---	---	---
Immigration Status:								
Born in U.S.	83.5	36.3	464	3,569	---	---	---	---
Born outside U.S.	16.5	20.2	457	4,536	---	---	---	---
Marital Status:								
Married	0.0	---	---	---	71.0	4.1	354	2,764
Head of one-parent Family	4.7	33.9	560	3,640	4.5	14.9	522	2,238
Living with parents	18.0	33.4	462	3,373	12.7	20.2	297	1,855
Single, Cohabiting or Other	77.2	33.7	458	3,729	11.8	19.7	382	2,763
Education:								
Less than high school	40.1	34.8	433	3,011	36.2	5.4	538	3,210
High school	35.8	32.8	511	3,267	31.7	8.8	363	2,420
Greater than high school	24.1	33.0	442	5,228	32.1	11.6	273	2,109
Labor market status:								
Employed	77.4	32.2	461	3,910	61.9	4.8	451	2,481
Student	2.8	41.9	244	1,745	11.4	28.2	332	2,410
Unemployed	13.8	40.1	452	2,059	4.0	27.4	369	2,322
Out of LF/other	5.9	32.3	658	5,995	22.7	5.2	478	2,265
Receives social assistance:								
Yes	14.2	39.4	332	2,195	4.8	32.4	451	3,035
No	85.8	32.6	492	3,975	---	---	---	---
Regular sector income:								
0-16,000	49.8	39.5	411	2,737	51.4	12.9	400	2,420
16,000-33,000	32.4	27.5	395	4,032	17.2	7.0	286	2,808
33,000-49,000	6.0	30.8	652	6,710	15.5	3.9	190	2,370
49,000-66,000	2.1	30.9	986	8,706	9.9	2.0	58	1,745
66,000 +	9.6	25.9	945	7,801	11.0	2.3	104	2,183
Hours of work in regular sector:								
0	6.2	41.6	593	5,740	31.7	11.4	507	3,049
1-500	8.4	40.6	504	2,376	6.8	18.9	247	1,333
500-1,000	7.8	39.9	380	2,175	8.6	12.7	269	2,065
1,000-1,500	10.7	41.1	348	2,937	10.1	7.1	178	2,006
1,500-2,000	19.1	32.5	409	3,934	33.7	4.1	199	2,204
2,000 +	47.9	29.1	513	4,165	9.1	4.2	522	3,286

Table 1. Comparison of Fragile Families and Quebec City data: Proportion Participating in Underground and Hours/Earnings of Underground Participants, by Demographic Characteristics (continued)

Characteristics	Percent of Total Sample	Fragile Families Sample (Unmarried Fathers) Participation in the Underground			Percent of Total Sample	Quebec City Sample Participation in the Underground		
		Percent	Hours (H>0)	Earnings (US$) (Y>0)		Percent	Hours (H>0)	Earnings (US$) (Y>0)
Industry in the regular sector:								
Primary	---	---	---	---	1.4	17.2	572	4,441
Manufacturing	---	---	---	---	5.6	7.6	262	3,858
Construction	---	---	---	---	3.0	9.4	220	3,878
Transportation	---	---	---	---	4.9	6.8	44	1,091
Trade	---	---	---	---	9.8	8.2	243	2,696
Finance, Insurance	---	---	---	---	7.2	2.0	217	4,041
Services	---	---	---	---	21.6	8.4	249	2,227
Public Administration	---	---	---	---	14.8	5.5	154	2,900
No regular job	---	---	---	---	31.7	11.4	518	4,029
Occupation in the regular sector:								
Prof/Administrative	7.7	33.7	772	5,844	---	---	---	---
Sales/Clerical	15.0	28.8	344	2,092	---	---	---	---
Craft/Repair	26.5	41.1	472	4,306	---	---	---	---
Machinery/Transport	11.0	31.1	369	2,404	---	---	---	---
Laborer	16.5	33.2	496	3,367	---	---	---	---
Services	20.6	30.0	384	2,984	---	---	---	---
Miscellaneous	2.6	31.8	786	9,532	---	---	---	---
No regular job	1.0	40.7	414	4,883	---	---	---	---

Table 2. Correlation Matrix for Wages, Earnings and Hours Worked for Workers Holding Jobs in Both Sectors (p values in parentheses)

Variable	Regular Sector			Underground Sector		
	Hours	**Wage**	**Earnings**	**Hours**	**Wage**	**Earnings**
Regular hours	1.000					
Regular wage	0.237	1.000				
	(0.000)					
Regular earnings	0.551	0.518	1.000			
	(0.000)	(0.000)				
Underground hours	0.005	0.119	0.032	1.000		
	(0.913)	(0.006)	(0.468)			
Underground wage	0.078	0.113	0.140	-0.712	1.000	
	(0.076)	(0.009)	(0.001)	(0.000)		
Underground earnings	0.092	0.292	0.199	0.642	0.081	1.000
	(0.035)	(0.000)	(0.000)	(0.000)	(0.065)	

Table 3. Ordinary Least Squares and Two-Stage Least-Squares Estimates of Hours and Earnings Equations for Workers Holding Jobs in Both Sectors

A. Hours Equations

Independent Variable	Regular Sector		Underground Sector	
	OLS	2SLS	OLS	2SLS
1. Regular sector wage	0.305*** (0.073)	0.490** (0.155)	0.389* (0.168)	0.627* (0.283)
2. Underground sector wage	.040 (.025)	---	-0.927*** (0.039)	---
3. Regular sector wage	0.295*** (0.074)	---	0.689*** (0.114)	---
Underground sector wage	0.030 (0.025)	---	-0.952*** (0.038)	---

B. Earnings Equations

Regular sector hours	0.620*** (0.045)	---	---	---
Underground sector hours	---	---	0.443*** (0.024)	

*** $p \le .001$, ** $p \le .01$, * $p \le .05$

Note: Regressions also include age, age squared and education.

Table 4. Model of Participation in the Underground Sector

Independent variable	Model 1	Model 2
Age	-0.029	-0.033
	(0.026)	(0.026)
Age squared	0.032	0.037
	(0.042)	(0.042)
Education:		
Less than high school	-0.021	-0.064
	(0.076)	(0.079)
High school	-0.067	-0.090
	(0.074)	(0.076)
Greater than high school	---	---
Nonwage income	0.003	0.004
	(0.004)	(0.004)
Regular wage	0.018	-0.045
	(0.069)	(0.071)
Marginal tax rate	-0.497	-0.469
$[-\ln(1 - \tau)]$	(0.352)	(0.355)
Occupational dummies:		
Professional/Administration	---	-0.189
		(0.115)
Sales/Clerical	---	-0.428***
		(0.093)
Craft/Repair	---	---
Machinery/Transportation	---	-0.257**
		(0.098)
Laborer	---	-0.219**
		(0.087)
Service	---	-0.308***
		(0.085)
Miscellaneous	---	-0.309
		(0.295)
Log-likelihood	-1,363.7	-1,350.5
N	2,145	2,145

*** $p \le .001$, ** $p \le .01$, * $p \le .05$

Table 5. Model of Participation in the Underground Sector—Extensions

Independent Variable	Model 1	Model 2	Model 3	Model 4
Age	-0.010*	-0.010*	-0.010*	-0.011*
	(0.004)	(0.004)	(0.004)	(0.005)
Education:				
< HS	-0.058	-0.058	-0.064	-0.008
	(0.078)	(0.078)	(0.078)	(0.081)
HS	-0.088	-0.087	-0.088	-0.079
	(0.076)	(0.076)	(0.076)	(0.077)
> HS	---	---	---	---
Nonwage income	0.004	0.004	0.004	0.004
	(0.004)	(0.004)	(0.004)	(0.004)
Regular wage	-0.046	-0.040	-0.025	-0.019
	(0.071)	(0.072)	(0.072)	(0.073)
Marginal tax rate (federal)	-0.495	---	---	---
	(0.354)			
Marginal tax rate (federal + state)	---	-0.435	---	---
		(0.293)		
Marginal tax rate (federal + state + city)	---	---	-0.586*	-0.514
			(0.284)	(0.291)
Race/Ethnicity:				
Black	---	---	---	-0.236**
				(0.081)
Hispanic	---	---	---	-0.161
				(0.091)
Other	---	---	---	---
Number of Children	---	---	---	0.049*
				(0.023)
Born in U.S.	---	---	---	0.472***
				(0.093)

Table 5. Model of Participation in the Underground Sector—Extensions (continued)

Independent Variable	Model 1	Model 2	Model 3	Model 4
Alcohol use:				
Never	---	---	---	---
< once a month	---	---	---	0.240**
				(0.079)
Several times/month	---	---	---	0.171*
				(0.080)
Several times/week	---	---	---	0.292**
				(0.097)
Every day	---	---	---	0.326*
				(0.152)
Drug use:				
Never	---	---	---	---
< once a month	---	---	---	0.170
				(0.106)
Several times/month	---	---	---	0.425**
				(0.137)
Several times/week	---	---	---	0.425**
				(0.162)
Every day	---	---	---	0.425*
				(0.180)
Log-likelihood	-1,350.8	-1,350.7	-1,349.7	-1,303.4
N	2,145	2,145	2,145	2,145

*** $p \leq .001$, ** $p \leq .01$, * $p \leq .05$
Note: All specifications include occupational dummies.

Table 6. Equations for Hours of Work and Earnings in the Underground Sector

Independent Variable	Hours				Earnings	
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2
Underground Hours	---	---	---	---	0.349***	0.343***
					(0.022)	(0.022)
Age	0.023*	0.023*	0.023*	0.015	0.016**	0.017**
	(0.012)	(0.012)	(0.012)	(0.014)	(0.006)	(0.007)
Education:						
< HS	0.032	0.035	0.042	0.149	-0.294**	-0.255**
	(0.201)	(0.201)	(0.201)	(0.207)	(0.104)	(0.108)
HS	0.138	0.143	0.143	0.169	-0.154	-0.127
	(0.197)	(0.197)	(0.197)	(0.199)	(0.104)	(0.106)
> HS	---	---	---	---	---	---
Nonwage income	0.005	0.005	0.005	0.004	0.000	0.000
	(0.009)	(0.009)	(0.009)	(0.009)	(0.005)	(0.005)
Regular wage	0.373*	0.368*	0.342	0.415*	---	---
	(0.187)	(0.189)	(0.189)	(0.191)		
Marginal tax rate (federal)	-1.486	---	---	---	---	---
	(0.933)					
Marginal tax rate (fed + state)	---	-1.114	---	---	---	---
		(0.784)				
Marginal tax rate (fed + state + city)	---	---	-0.815	-0.841	---	---
			(0.763)	(0.763)		
Race/Ethnicity:						
Black	---	---	---	0.015	---	-0.113
				(0.202)		(0.108)
Hispanic	---	---	---	-0.558**	---	-0.228
				(0.225)		(0.122)
Other	---	---	---	---	---	---
Number of Children	---	---	---	0.042	---	-0.038
				(0.061)		(0.033)
Born in U.S.	---	---	---	-0.290	---	-0.259
				(0.266)		(0.144)
Alcohol use:						
Never	---	---	---	---	---	---
< once a month	---	---	---	0.192	---	-0.081
				(0.217)		(0.117)
Several times/month	---	---	---	0.344	---	0.001
				(0.217)		(0.118)
Several times/week	---	---	---	0.279	---	0.051
				(0.251)		(0.136)
Every day	---	---	---	0.096	---	-0.009
				(0.378)		(0.204)

Table 6. Equations for Hours of Work and Earnings in the Underground Sector (continued)

Independent Variable	Hours				Earnings	
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2
Drug use:						
Never	---	---	---	---	---	---
< once a month	---	---	---	-0.179	---	-0.055
				(0.255)		(0.138)
Several times/month	---	---	---	0.079	---	0.124
				(0.335)		(0.181)
Several times/week	---	---	---	0.591	---	0.066
				(0.368)		(0.199)
Every day	---	---	---	0.447	---	0.019
				(0.408)		(0.221)
R^2	0.017	0.016	0.015	0.046	0.322	0.333
Adjusted R^2	0.007	0.006	0.005	0.017	0.316	0.313
N	592	592	592	592	592	592

*** $p \leq .001$, ** $p \leq .01$, * $p \leq .05$