Effect of Pesticide Use on Farmers' Health in Vietnam

Xuan Chen, Emory University, xuan.chen@emory.edu
Nguyen Vuong, University of Maine, tuan.vuong@maine.edu

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Effect of Pesticide Use on Farmers’ Health in Vietnam

Xuan Chen† & Nguyen Vuong‡
† Rollins School of Public Health, Emory University § School of Economics, University of Maine

Abstract

Though pesticide does increase productivity in the agricultural sector, it has an adverse effect on human health. There have been many pieces of evidence for a large amount of pesticide residue in Vietnam. However, how pesticide residue affects health condition of farmers is still unknown. This study aims partly answer this question by investigating the effect of household pesticide consumption on every member of the farm households in Vietnam. The results show that for every million VND (approximately US $55) spending on pesticide two years before, the number of hospital visits increases by 2.3%. This figure for rice crop, non-rice food crop and fruit crop are 4.1%, 1% and 13.1%, respectively. Besides, a million VND increase in lagged pesticide leads to 9% increase in healthcare costs. For rice, fruit and industrial crops, it is 11.3%, 16.2%, and 46.6%, respectively. We also try to estimation with unlagged pesticide consumption. It confirms the harmful effect of pesticide consumption on farm households.

Introduction

• Even though pesticides increase the productivity in the agricultural sector, there are potentially adverse health effects in both farmers and non-farmers.
• Pesticides poisoning could be a severe problem in Vietnam since 50% of the Vietnamese workforce is in agricultural sectors (CIA, 2015).
• Even though the economic cost of pesticide application is large in Vietnam, there is still a huge gap in the literature about the effect of pesticide on the health condition of Vietnamese farmers.
• This is one of the first studies in Vietnam considering the health impact of pesticide use.
• By using data from Vietnam Household Living Standard Surveys from 2004 to 2014, we are able to quantify the impact of pesticide use on health expenditure and the number of hospital visits.

Econometric models

Estimating the number of hospital visits

Since the number of hospital visits is a count variable, negative binomial regression is employed. Even though the large number of individuals who do not visit hospital in a year, thus we used zero-inflated negative binomial regression. Additionally, we use pesticide use 2 years before to avoid endogeneity issue causing by reverse causation. Below is the model specification:

\[ P(y_{ijt} = k) = \beta_0 + \beta_1 y_{ijt} (1 - \alpha) \log(\lambda_{ijt} + 1) \]

\[ g(y_{ijt}) = \log(\lambda_{ijt} + 1) = \sum_{k=0}^{\infty} \alpha^k \frac{1}{k!} [\lambda_{ijt}]^k \]

where \( y_{ijt} \) is the number of hospital visits that person \( j \) of household \( i \) made at year \( t \), \( g(y_{ijt}) \) is the pdf function of negative binomial distribution that \( g(y_{ijt}) = P[Y = y_{ijt}] = \frac{\Gamma(y_{ijt} + 1)}{\Gamma(\lambda_{ijt} + 1) \lambda_{ijt}^y} \frac{1}{y_{ijt}!} \sum_{k=0}^{\infty} \alpha^k \frac{\lambda_{ijt}^k}{k!} \)

In equation (2), \( p_{ijt} = \beta_0 + \beta_1 y_{ijt} - \sum_{k=0}^{\infty} \alpha^k \frac{\lambda_{ijt}^k}{k!} \)

\[ \log(\lambda_{ijt}) = \beta_0 + \beta_1 y_{ijt} - \sum_{k=0}^{\infty} \alpha^k \frac{\lambda_{ijt}^k}{k!} \]

In the above model, \( p_{ijt} \) is the amount of money spent on pesticide of household \( i \) at the year \( t - 2 \), and \( y_{ijt} \) is the value of control variables of person \( j \) of household \( i \) at year \( t \).

To see whether negative binomial distribution is more suitable than Poisson distribution with this sample, we test whether \( \alpha = 1 \) or \( \alpha = 0 \). The result of this test is provided in the Result section.

Health expenditure estimations

We use OLS model to estimate the impact of pesticide use on health expenditure of household \( i \) at year \( t \):

\[ \log(h_{ijt}) = \beta_0 + \beta_1 p_{ijt} + \gamma_{ijt} t + \sum_{j=0}^{\infty} \alpha^j \lambda_{ijt}^j + \sum_{k=0}^{\infty} \beta_k t + e_{ijt} \]

(4)

Result

Table 1 The Zero-Inflated Negative Binomial Regression For The Number Of Hospital Visits Estimations with Total Lagged Pesticide Consumption

<table>
<thead>
<tr>
<th></th>
<th>Pesticide</th>
<th>Young</th>
<th>Mid-age</th>
<th>Old</th>
</tr>
</thead>
<tbody>
<tr>
<td>NBREG</td>
<td>Inflated</td>
<td>Inflated</td>
<td>Inflated</td>
<td>Inflated</td>
</tr>
<tr>
<td>Total lagged</td>
<td>0.023**</td>
<td>0.335***</td>
<td>0.021***</td>
<td>0.742**</td>
</tr>
<tr>
<td>p_{ijt}</td>
<td>(0.086)</td>
<td>(0.079)</td>
<td>(0.073)</td>
<td>(0.313)</td>
</tr>
<tr>
<td>Vuong test</td>
<td>12.95**</td>
<td>7.69**</td>
<td>7.22**</td>
<td>5.53***</td>
</tr>
<tr>
<td>Obs</td>
<td>28,845</td>
<td>28,845</td>
<td>11,334</td>
<td>11,334</td>
</tr>
</tbody>
</table>

From table 1:

• Using Zero-inflated NB regression is more appropriate than standard NB regression and Zero-inflated Poisson regression.
• For every 1 million VND spent on pesticide, the number of hospital visits increases by 2.3%.
• In the sample of senior household members, this figure is 4.2%.

Table 2 The Zero-Inflated Negative Binomial Regression For The Number of Hospital Visits Estimations with Lagged Pesticide Consumption for Different Crops

<table>
<thead>
<tr>
<th></th>
<th>NBREG</th>
<th>Inflated</th>
<th>Inflated</th>
<th>Inflated</th>
<th>Inflated</th>
<th>Inflated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total lagged</td>
<td>0.041***</td>
<td>-0.385***</td>
<td>0.071***</td>
<td>0.248***</td>
<td>0.035***</td>
<td>-0.614***</td>
</tr>
<tr>
<td>p_{ijt}</td>
<td>(0.099)</td>
<td>(0.093)</td>
<td>(0.017)</td>
<td>(0.108)</td>
<td>(0.013)</td>
<td>(0.165)</td>
</tr>
<tr>
<td>Vuong test</td>
<td>12.95**</td>
<td>7.69**</td>
<td>7.22**</td>
<td>5.53***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obs</td>
<td>28,845</td>
<td>28,845</td>
<td>11,334</td>
<td>11,334</td>
<td>12,250</td>
<td>12,250</td>
</tr>
</tbody>
</table>

From table 2:

• Using Zero-inflated NB regression is more appropriate

Conclusions

• This is one of the first studies in Vietnam providing the empirical evidence for the negative impact on farmers of pesticide use.
• For every million VND pesticide use, the number of hospital visits and health expenditure increase, on average, by 2.3% and 9%.
• Our results suggest Vietnamese policymakers to promote less toxic insecticide and herbicide to reduce adverse impact from pesticide use.
• The available data are unable to treat the adverse impact of pesticide use on households living near farmland. Evidence from Lamers et al. (2011) shows that households living next to rice field are exposed to pesticide because of polluted groundwater and air. Our future works on this topic requires a field trip to collect more comprehensive data.

References


• Lagged pesticide for rice crop has a strong effect on farmers’ health. For every 1 million VND spending on pesticide for rice, the number of hospital visits increases by 4.1%.
• This figure for fruit crop is 13.1%.

Table 3 Health Expenditure Estimations with Lagged Pesticide Spending

<table>
<thead>
<tr>
<th></th>
<th>Pesticide</th>
<th>Young</th>
<th>Mid-age</th>
<th>Old</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total lagged</td>
<td>0.121***</td>
<td>0.091***</td>
<td>0.129***</td>
<td>0.152***</td>
</tr>
<tr>
<td>p_{ijt}</td>
<td>(0.022)</td>
<td>(0.031)</td>
<td>(0.035)</td>
<td>(0.050)</td>
</tr>
<tr>
<td>Vuong test</td>
<td>12.95**</td>
<td>7.69**</td>
<td>7.22**</td>
<td>5.53***</td>
</tr>
<tr>
<td>Obs</td>
<td>28,845</td>
<td>28,845</td>
<td>11,334</td>
<td>11,334</td>
</tr>
</tbody>
</table>

From table 3:

• For each million VND spent on pesticide, health expenditure, on average, increases by 9%.
• Health costs raises by 12.1% for each million VND spent on rice-crop pesticide.
• With industrial crops, this figure is 61.2%.