

Structural Transformation and Intertemporal Evolution of Real Wages, Machine Use, and Farm-Size-Productivity Relationships in Vietnam

Yanyan Liu*, William Violette, Christopher B. Barrett

*Senior Research Fellow, IFPRI
Adjunct Associate Professor, Cornell University

Acknowledgement: Financial support from Gates Foundation

February 2, 2017

Motivation

- Small farmers are more productive per unit area cultivated than larger ones in developing countries.
- Policy implications: to support small landholders and deter farm size expansion.
- Why? Multiple market failures lead to factor (shadow) price varying across farms. (Small farms have higher labor-land ratio than large farms.)
 - Labor market - supervision cost of hired labor (Feder 1985), off-farm labor market rationing (Benjamin 1992).
 - Inactive land rental and sale markets due to tenure insecurity, land reform regulations, high transaction costs.

Hypothesis of Otsuka (2013)

- Low income (wage) economy: High dependence on family labor \Rightarrow Small farm size with labor intensive production methods is optimum. \Rightarrow Inverse relationship between farm size and productivity tends to arise.
- High income (wage) economy: High dependence on non-labor inputs \Rightarrow Large farm size with capital and land intensive production methods is optimum. \Rightarrow Inverse relationship between farm size and productivity tends to diminish.
 - High wage leads to substitution of capital (machinery) for labor.
 - Machinery can be used more efficiently in large farms.
 - Large farms tend to have easier access to credit to purchase or rent machinery.
 - Machine use tends to reduce supervision costs of hired labor.

Research Question

Does the inverse relationship between farm size and crop yield change during the dramatic structural transformation in 1990s and 2000s in Vietnam

- The period: 1992-2008 (rapid transformation with 4-8 % annual GDP growth)
- Contribution: the first study to look at intertemporal change in the inverse relationship over such a long period.
- The evolution of this relationship has powerful implications for policy.

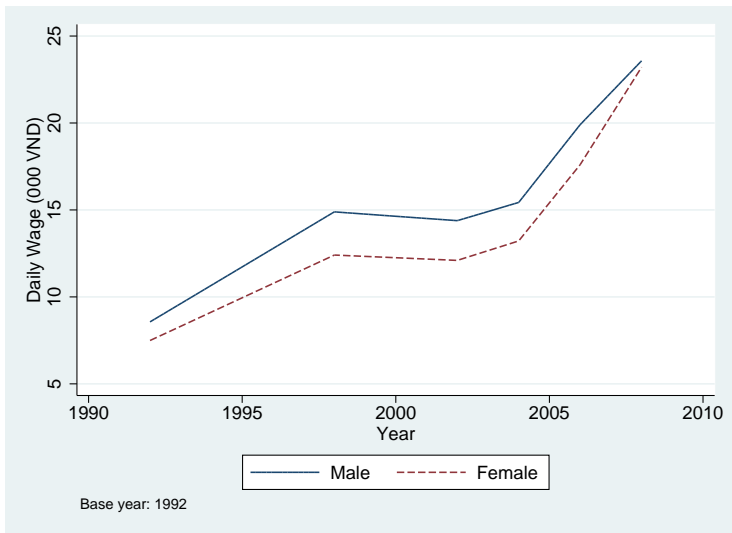
Data - Sample

- Vietnam Living Standard Survey (VLSS): 1992, 1998, and Vietnam Household Living Standard Survey (VHLSS): 2002, 2004, 2006, 2008
- VLSS 1992/1998 is a panel of 3,034 households from 103 rural communes.
- VHLSS 2002 is based off a new sample. The following rounds re-interviewed some households sampled in the previous round and added some newly sampled households.
- VHLSS 2002/2004 panel: 2,303 households from 794 rural communes
- VHLSS 2006/2008 panel: 2,346 households from 956 rural communes

Data - Survey Instruments

- Household and commune instruments
- Household: demographics, landholding, rice planting area and output, machine ownership and rental, labor hire (no data on labor use)
- Commune: local agricultural wage by gender and by task.

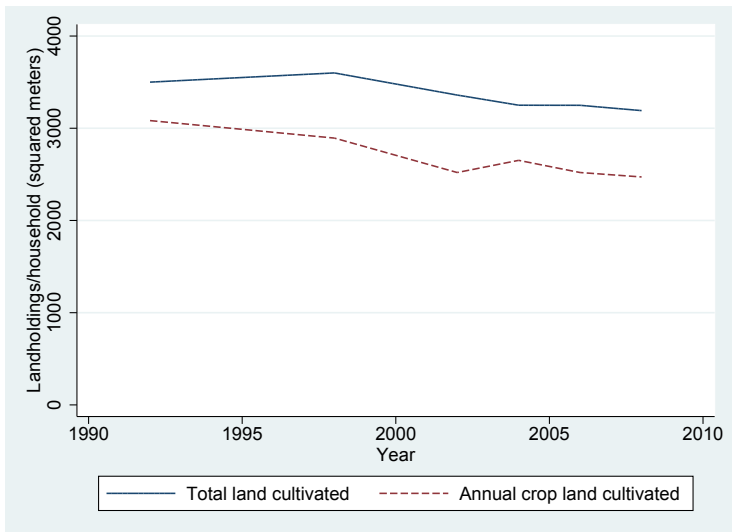
Daily Real Agricultural Wages, 1992-2008



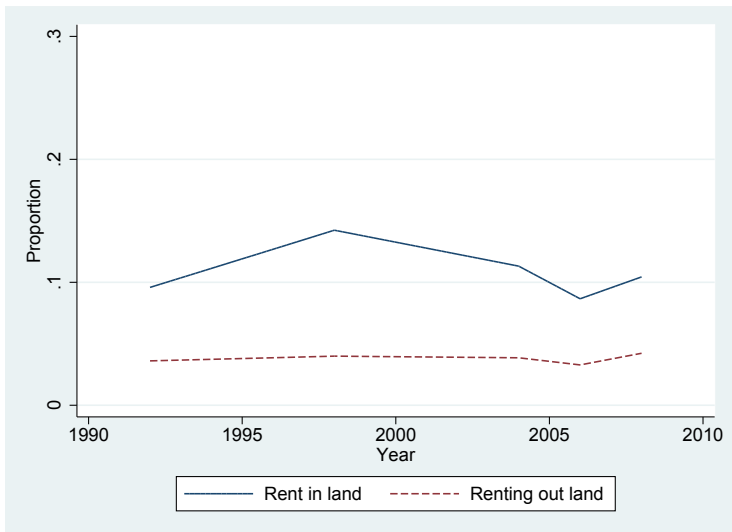
Daily real wage of male agriculture labor by region (000 VND)

Region	1992	1998	2002	2004	2006	2008
Red river delta	7.5	14.4	13.6	15.3	19.9	28.1
North East	5.2	11.2	11.0	13.0	15.8	22.2
North West	7.0	9.1	9.3	9.4	14.5	18.7
North Central Coast	7.7	12.1	13.0	13.2	20.0	23.6
South Central Coast	7.3	15.6	14.4	16.2	17.6	23.5
Central Highlands	9.2	13.4	13.4	13.9	18.5	26.5
South East	11.4	15.7	17.3	17.1	21.6	25.6
Mekong river delta	15.0	18.7	17.5	19.0	22.4	25.5

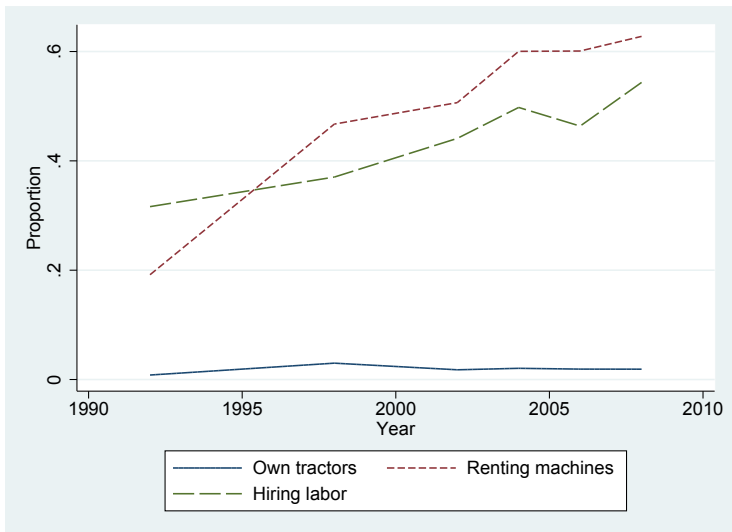
Median area of land cultivated per household, 1992-2008



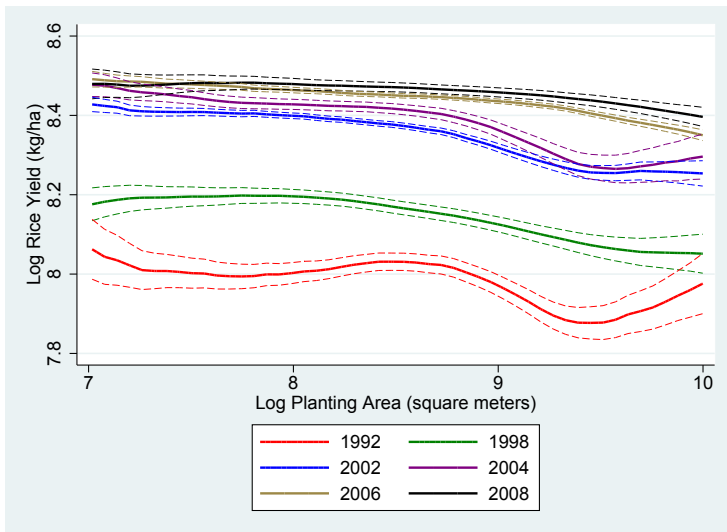
Proportion of households participating in land rental market, 1992-2008



Trend of tractor ownership, machine renting, and labor hiring



Rice yield versus planting area, 1992-2008



Empirical Strategy

- Estimate rice production equation using three panels (1992/98, 2002/04, 2006/08) respectively to look at the evolution of farm size - productivity relationship over time.
- Does inverse relationship change over time?

$$\ln y_{ict} = \beta_i + \beta_1 \ln h_{ict} + \beta_3 z_{ict} + \beta_4 D_t + \epsilon_{ict}$$

i , c , and t index farm/household, commune, and year, respectively;

y_{ict} is rice yield;

h_{ict} is planting area;

z_{ict} is household demographics.

- $\beta_1 < 0 \iff$ presence of inverse relationship
- $|\beta_1|$ decreases \iff inverse relationship attenuates over time

Empirical Strategy

- Does higher wage attenuate the inverse relationship?

$$\ln y_{ict} = \delta_i + \delta_1 \ln h_{ict} + \delta_2 \ln h_{ict} \times \ln w_{ct} + \delta_3 \ln w_{ct} + \delta_4 z_{ict} + \delta_5 D_t + v_{ict}$$

w_{ict} is daily wage for male agricultural labor

- $\delta_1 < 0$ & $\delta_2 > 0 \iff$ inverse relationship is attenuated by higher wage

Empirical Strategy - machine use

- Is higher wage associated with higher machine use?

$$dm_{ict} = \alpha_i + \alpha_1 \ln h_{ict} + \alpha_2 \ln w_{ct} + \alpha_3 z_{ict} + \delta_4 D_t + e_{ict}$$

dm_{ict} indicates machine use (either own or rent machine)

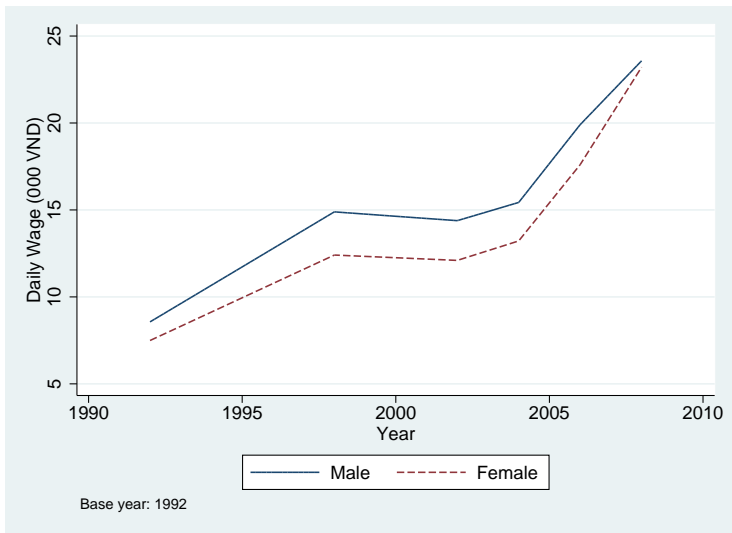
Results - Does inverse relationship change over time?

$$\ln y_{ict} = \beta_i + \beta_1 \ln h_{ict} + \beta_3 z_{ict} + \beta_4 D_t + \epsilon_{ict}$$

Dependent: Log yield	(1) 92/98	(2) 02/04	(3) 06/08	(2)-(1)	(3)-(2)	(3)-(1)
Log total area of rice (all varieties)	-0.149*** (0.0293)	-0.156*** (0.0305)	-0.0609*** (0.0159)	-0.00788 (0.0422)	0.0956*** (0.0343)	0.0877*** (0.0332)
male household head	0.00550 (0.0299)	0.0309 (0.0391)	0.00568 (0.00921)			
age of household head	0.000858 (0.00117)	0.0000337 (0.00132)	0.000202 (0.000303)			
highest education of household members	0.0232** (0.00958)	0.000856 (0.00568)	0.000375 (0.00402)			
number of male members	0.0150 (0.0159)	-0.0184 (0.0172)	-0.00281 (0.00453)			
household size	0.00897 (0.00847)	0.0200* (0.0120)	0.00493 (0.00589)			
Household FE & year dummy	Yes	Yes	Yes			
Observations	4944	3037	3864			

- Inverse relationship existed over the period 1992-2008 but it is lessened over time.

Daily Real Agricultural Wages, 1992-2008



Results - Does higher wage attenuate the inverse relationship?

$$\ln y_{ict} = \delta_i + \delta_1 \ln h_{ict} + \delta_2 \ln h_{ict} \times \ln w_{ct} + \delta_3 \ln w_{ct} + \delta_4 z_{ict} + \delta_5 D_t + v_{ict}$$

Dependent: Log yield	(1) 92/98	(2) 02/04	(3) 06/08
Log total area of rice (all varieties)	-0.150*** (0.0296)	-0.119*** (0.0309)	-0.0607*** (0.0152)
Log total area of rice x x log male real agricultural wage	0.00554 (0.0355)	0.00384 (0.0365)	0.0758*** (0.0212)
Log male real agricultural wage (Vietnamese dong in 1992)	0.0235 (0.0793)	0.0218 (0.0225)	0.0223 (0.0248)
Household demographics	Yes	Yes	Yes
Household FE & year dummy	Yes	Yes	Yes

The inverse relationship attenuates most quickly in areas where the real wage rate is higher, creating greater incentives to substitute machinery for labor.

Results - Robustness check

- In the above regressions, the dependent variable is land productivity of rice aggregated over all rice varieties.
- These results may be biased if the choice of rice varieties is correlated with farm size and if the productivity differs across rice varieties.
- We run the same regressions for spring ordinary rice and autumn ordinary rice separately as a robustness check.
- The results are qualitatively consistent.

Results - Machine use

$$dm_{ict} = \alpha_i + \alpha_1 \ln h_{ict} + \alpha_2 \ln w_{ct} + \alpha_3 z_{ict} + \delta_4 D_t + e_{ict}$$

Dependent: If use machine	1992/98	2002/04	2006/08
Log total land cultivated	0.0786*** (0.0234)	0.0884*** (0.0207)	0.0652*** (0.0191)
Log male real ag wage (VND in 1992)	-0.0586 (0.0929)	0.0712 (0.0530)	0.104** (0.0409)
Household demographics	Yes	Yes	Yes
Household FE & year dummy	Yes	Yes	Yes
Observations	5241	3378	4431

- Pointing to improvement of rural factor markets.

Conclusion

- The inverse relation attenuated considerably over the course of 1990s and 2000s. This change is associated with rising real wages and increasingly active machine rental and agricultural labor markets in rural Vietnam.
- The inverse relation attenuated most in areas with higher agricultural real wages in late 2000s, as real wages reached levels sufficiently high enough to induce some substitution of machinery for labor.
- The long-standing productivity advantage assumed to exist among smaller farmers appears to have diminished or disappeared by late 2000s.
- Rural factor market failures are receding in importance. So increased land concentration is unlikely to have adverse effects on aggregate food production or prices.

A related study on India

“Can labor-market imperfections explain changes in the inverse farm size productivity relationship? Longitudinal evidence from rural India”

by Klaus Deininger, Songqing Jin, Yanyan Liu, Sudhir K Singh.

- Additional Rural Incomes Survey and Rural Economic & Demographic Survey (ARIS/REDS): 1982, 1999, 2008
- The inverse relationship weakened significantly over the period 1982-1999.
- Better labor market functioning can explain gradual disappearance of the inverse relationship overall.
 - Family labor was more efficient than hired labor in the 1982-1999 period, but not during the 1999-2008 period.
 - Separability of labor supply and demand decisions can be rejected in the 1982-1999 period but cannot be rejected in the 1999-2008 period.