On-Line Appendix for

The Effects of China's Sloping Land Conversion Program
on Agricultural Households

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Additional notes

The information given below was removed from the manuscript due to space limitations.

Second-order impacts of PES

Generally, payments for environmental services could provide additional incomes to the participating households. On the other hand, the conservation set-aside program indirectly induces structural changes in household livelihood strategies by reducing the demand for labor for cultivating crops. However, the reallocation of the freed-up labor time is highly dependent on the individuals' resources and other factors (Engel et al., 2008, Uchida et al., 2009).

Conversion of farmland with slopes above 25 degrees

Out of the 14.67 million hectares of farmland that were intended to be converted to forest, 4.4 million hectares has slopes above 25 degrees.

Static agricultural household models

Most agricultural household models are defined as static models that maximize current utility instead of a discounted future stream of expected utility (Taylor and Adelman, 2003).

Ignoring output price uncertainty and financial constraints in the agricultural household model

Output price uncertainty may be less relevant for agricultural households that consume a high proportion of their own products, which is also observed in our sample, so that the behavior of the agricultural households in our sample can be approximately modeled by assuming risk neutrality. In addition, financial constraints can be relaxed by internal saving, borrowing, and microcredit, which was available for the households from the Chinese Rural Credit Cooperative and the Postal Saving Bank and which specifically targets purchases of agricultural inputs and services.

Taking into account the SLCP in the multi-input, multi-output transformation production function

The multi-input, multi-output transformation production function $G(.)$ not only depends on the size of the flat and sloping land that is used for agricultural production (R_f and R_{sa}), but also on the size of the(sloping) land that is in the SLCP (R_{sp}), because land in the SLCP requires some labor for maintenance and may contribute a little to the agricultural output through agroforestry. Our model specification, where $G(.)$ depends on R_f, R_s, and R_{sp} is equivalent to a more intuitive model specification, where $G(.)$ depends on R_f, R_{sa}, and R_{sp}, because $R_s = R_{sa} + R_{sp}$. We chose our model specification because it simplifies the comparative static analysis, because only one variable (R_{sp}) is affected by the SLCP in our specification, while two variables (R_{sa} and R_{sp}) are affected by the SLCP in the alternative specification.

Land transfers

China began experimenting with land transfer in selected rural areas in 2003, but this system was not officially launched nationwide until 2009. Therefore, land transfers were virtually absent in our dataset (from 1995 to 2010). Moreover, the land transfer procedures are not standardized, which makes land rentals difficult to achieve. Therefore, land rentals are also uncommon within the SLCP areas in 2009 and later.

Hired on-farm labor

Generally, the pervasive situation in rural China is that most households are involved in off-farm work, but only very few, if any, households hire labor for farming in the peak season. Furthermore, for the few households that hire farm labor, the proportion of hired labor in total farm labor is negligible. Therefore, we do not take hired farm labor into account.

Shortfall of the compensation payment

The central government set the standard compensation payment rate for land in the SLCP program to 2100 CNY /ha/year in the Yellow River basin and to 3150 CNY/ha/year in the Yangtze River basin. However, in practice, some households that participated in the SLCP program received lower compensation payments. Xu et al. (2010) elaborated two plausible reasons for this shortfall in receiving payment, either because the local government had reduced the compensation payment, or because the converted sloping land had not yet been fully approved by the program monitoring department. We observed the same situation in our study, and therefore, the compensation rate not only varies between the different river basins, but also between townships and counties within the same river basin. As only a fraction of the households fell short of the official compensation level (Xu et al., 2006), we assume in the comparative static analysis that the SLCP positively affects full income and thus, also leisure time; otherwise this program would not be a (typical) PES program because the compensation

payment would not exceed the opportunity cost of setting aside cultivated land for conservation (Pagiola et al., 2005; Wunder, 2008).

Reduction of the compensation payment rate after eight years

The compensation payment rates received by the households that were in the second phase of the SLCP were on average 26% lower than the compensation payment rates received by households in the first phase of the SLCP in our sample. The compensation payment rates were reduced by less than 50% for two reasons. First, the reduction did not include the cash subsidy for managing and protecting the planted trees. Second, as discussed above, some local governments kept some funds to cover the cost of the seedlings in the first phase of the program.

Grain subsidy

The grain subsidy was introduced in 2004 in order to motivate rural households to produce grain. The subsidy rate (S_a) has changed over time and differs between townships due to different levels of financial support from townships, counties, and provincial governments. In our theoretical model, we assume that the area payment is paid for all types of crop production, but in our empirical application, the area payment is only paid for grain production. Our data set does not include information on the area that is used for grain production. However, the data on production values indicate that grain production comprises on average 93% of crop production so that the total cultivated area is a suitable proxy for the area that is used for grain production.

Alternative representation of full income

In the comparative static analysis, we derive the effect of participating in the SLCP on the full income based on the following representation of use the full income:

$$y^* = \Pi\big(p^p, R_f, R_s, R_{sp}, z^p\big) + P_l^*(T_l - X_l^s) + f(X_l^s, z^s) + R_{sp}S_p + \big(R_f + R_s - R_{sp}\big)S_a + E.$$

Dependence of the shadow price of labor on P_c^*, P_c, and T_c

In the empirical model specification, we write that the shadow price of labor depends the market price of crop products P_c and the tax rate on crop products T_c. Alternatively, we could write that the shadow price of labor depends on the effective producer price of crop products P_c^* and the effective consumer price of crop products P_c, where the latter is identical to the market price of crop products and the former is $P_c^* = (1 - T_c)P_c$. We find it more straightforward to write that the shadow price of labor depends on the market price of crop products P_c and the tax rate on crop products T_c. As one of the three variables P_c^*, P_c, and T_c can be obtained from the other two variables, both approaches are equivalent (particularly as we do not assume a specific functional form).

Assigning provinces to River basins

In terms of geography, Guangxi is not located in the Yangtze River basin while Hebei is not located in the Yellow River basin. However, the SLCP program only distinguishes two different compensation payment levels; one for the Yangtze River basin and one for the Yellow River basin, where the compensation payment level for the Yangtze also applies to the Guangxi province while the compensation payment level for the Yellow River basin also applies to the Hebei province.

Data collection through household surveys

The EDRC designed the questionnaire and conducted the household surveys. The surveys were conducted by experienced interviewers from the respective regions, and as far as possible, the same interviewers were used in each year in order to ensure high consistency and quality of the data. These surveys were sponsored and supported by the Asian Development Bank and China's Ministry of Finance. They were conducted in cooperation with local governments, which provided some basic information that was used in the surveys to check the plausibility of the answers from the farmers, e.g. average crop yield, which increased the reliability of the data. These surveys collected detailed household data from 16 consecutive years and generated a large longitudinal socio-economic data set, which is rarely found in developing countries.

Use of household-level price data

It would have been problematic to use household-level price data, because the market prices vary at different places on different days, and even from hour to hour (Gibson and Rozelle, 2005), while using unit values (values divided by quantities) is usually a poor approximation of the market price due to quality differences.

Seasonal pattern

As we have annual data, we have no information on seasonal patterns, e.g. labor allocation. Potential changes in seasonal patterns over the years in z^p, z^c, and z^s are accounted for by a linear and quadratic time trend (t and t^2).

Missing observations

Some variables in the data set have a few missing values. It seems that the missing values are randomly distributed and are not missing for some special reason. Hence, we can remove observations with missing values from our sample without introducing a bias, because the random sampling assumption still holds (Wooldridge, 2009).

Fixed-effects vector decomposition (FEVD)

The so-called "fixed-effects vector decomposition" (FEVD) procedure (Plümper and Troeger, 2011) is an extension of the FE estimator that can identify the effects of time-invariant variables.

Breusch et al. (2011) show that this estimator is a special case of the Hausman-Taylor (HT) estimator and Greene (2011) shows that the FEVD estimator may be biased in the case of slowly changing explanatory variables.

Chow tests

In order to test for regional heterogeneity, we added interaction terms between all explanatory variables (including the constant) in equation (25) and dummy variables for the river basin or the provinces. In a simple FE regression, this specification would be equivalent to estimating separate models. However, in our HT estimation, the estimated coefficients of this specification and of the estimated coefficients of separate estimations for different regions are slightly different because the joint estimation with dummy variables still assumes that the variance components are the same for all the regions, while the separate estimations do not have this restriction.

Identification strategy

In order to isolate the treatment effect from other confounding effects, we apply the following strategy: (a) we use a data set with both participating and non-participating households at all survey sites and with observations for the pre-implementation period and the post-implementation period for all participating and non-participating households. (b) We use a combination of a "before-and-after" approach and a "with-and-without" approach, whereas variable R_{sp}^*, i.e. the proportion of the household's land in the SLCP, indicates (the degree of) participation. This approach can be seen as a "before-and-after" approach that uses data from non-participants to control for unobserved confounding effects that change over time, or it can be seen as a "with-and-without" approach that uses data from the pre-participation period to control for unobserved differences between farm households that already existed before the SLCP was adopted by the participating farmers. (c) Finally, we include several explanatory variables in our empirical analysis that control for structural shifts over time and for differences between participating and non-participating households. Using the same data set, Liu and Lan (2015) conducted an identification condition test and found that the participating households and the non-participating households followed rather similar patterns during the pre-intervention period. This indicates that our approach is suitable for isolating the treatment effect from other confounding factors.

Software used in the econometric analysis

The empirical analysis has been conducted in STATA, e.g. using the routines "xthtaylor," "Pantob" (Honoré, 1992), "ivregress," and "nlcom."

Additional assumptions used in the theoretical analysis presented in Table 1

1. concavity of $e(\cdot)$ in p^c;

2. convexity of $\Pi(\cdot)$ in p^p;

3. concavity of $f(\cdot)$ in X_l^s;

4. C_c, C_a, C_m and C_l are normal goods;

5. the SLCP increases full income;

6. the increase in leisure due to the SLCP is smaller than the decrease in farm labor due to the SLCP, i.e. $\partial C_l / \partial R_{sp} + \partial X_l / \partial R_{sp} < 0$;

7. the sloping land is partly used for crop production and partly used for animal production (e.g. grazing, fodder production);

8. labor and intermediate inputs are complements to (sloping) land;

9. the direct effect is larger (in absolute terms) than the indirect effect.

Glauben et al. (2012) assume that labor and intermediate inputs are complements, i.e. $\partial^2 \Pi(.)/(\partial P_l^* \, \partial P_v) = -\partial X_l(.)/\partial P_v = -\partial X_v(.)/\partial P_l^* > 0$, and that all (physical) consumption goods are net-substitutes of leisure, i.e. $\partial^2 e(.)/(\partial P_l^* \, \partial P_i) = \partial C_l(.)/\partial P_i = \partial C_i(.)/\partial P_l^* > 0$, but we think that these assumptions are unrealistic in our case, e.g. because a higher (shadow) price of labor could encourage farmers to do less hand-weeding and instead use more pesticides (i.e. more intermediate inputs) and/or a higher (shadow) price of leisure (with full income remaining constant) may not only decrease leisure time, but also decrease the expenditure on leisure activities (i.e. less market-purchased consumption goods).

Additional Tables

Table A1 presents descriptive statistics of the variables used in our empirical analysis.

Tables A2-A6 provide detailed estimation results for the five provinces.

Table A1: *Descriptive statistics of the variables in our empirical model*

Variable	Descriptions	Sichuan		Jiangxi		Hebei		Shaanxi		Guangxi	
		Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
$X_c + X_a$	Total agricultural outputs (CNY 1994)	3354.5	3363.8	3210.1	3095.2	2575.9	3104.4	1855.2	3350.3	5140.4	5520.5
X_c	Crop production (CNY 1994)	1050.8	1629.4	1943.2	1919.7	2032.2	2877.4	1227.0	1216.4	2313.	2845.6
X_v	Intermediate inputs (CNY 1994)	1115.2	1362.2	968.6	2384.2	867.9	2337.3	799.4	3670.4	1664.1	2525.5
X_l	Working days on the farm	280.1	177.7	183.3	129.2	121.6	121.9	160.9	115.7	356.8	210.2
X_l^s	Working days on non-farm jobs	191.1	214.5	309.5	287.9	145.5	150.3	165.8	179.7	200.7	217.9
$C_c + C_a + C_m$	Total consumption (CNY 1994)	5196.9	5611.3	6231.2	5646.0	4444.4	4425.0	4789.7	4915.7	5192.9	3754.3
$C_c + C_a$	Consumption of self-produced agricultural products (CNY 1994)	1990.8	2126.7	2261.2	3226.9	815.5	862.1	844.7	2126.7	2177.4	1482.3
P_c/P_m	Province-level price index of crop products (1994 = 1)	0.53	0.09	0.60	0.11	0.65	0.16	0.65	0.07	0.60	0.10
P_a/P_m	Province-level price index of animal products (1994 = 1)	0.73	0.07	0.68	0.10	0.90	0.14	0.76	0.07	0.67	0.13
P_v/P_m	Province-level Price index of intermediate inputs (1994 = 1)	0.95	0.09	0.97	0.13	1.01	0.07	0.99	0.12	1.05	0.12
R_f	Total flat land (mu = 0.067 hectare)	8.24	8.40	6.55	4.49	7.49	7.76	12.4	12.5	9.89	7.88
R_s	Total sloping land (mu = 0.067 hectare)	3.91	5.89	1.13	4.12	5.13	7.57	24.4	23.8	1.98	4.34
$R_f + R_s$	Total cultivated land (mu = 0.067 hectare)	12.15	10.54	7.68	5.78	12.61	13.68	36.8	30.4	11.87	8.35
$R_s^* = R_s/(R_f + R_s)$	Share of sloping land	0.28	0.26	0.10	0.19	0.35	0.23	0.63	0.20	0.15	0.24
$R_{sp}^* = R_{sp}/(R_f + R_s)$	Share of land in the SLCP program	0.12	0.20	0.12	0.10	0.13	0.19	0.28	0.26	0.05	0.14
	-- only for observations with $R_{sp}^* > 0$	0.43	0.21	0.32	0.22	0.41	0.19	0.62	0.21	0.42	0.21
$R_{sp}S_p/P_m$	SLCP compensation payments (CNY 1994)	274.4	671.9	43.4	242.0	214.6	509.9	1054.2	1584.2	94.20	342.5
	-- only for observations with $R_{sp}^* > 0$	756.3	938.3	328.8	591.8	501.1	681.0	1515.9	1705.6	729.6	668.1
$(R_f + R_s - R_{sp})S_a/P_m$	Grain subsidy (CNY 1994)	33.92	97.85	39.8	90.2	47.04	68.11	32.85	134.0	33.29	113.3
	-- only years 2004−2010	110.9	144.2	150.0	118.9	152.3	169.5	131.7	243.0	130.9	194.2
T_c	Agricultural tax rate on crop production	0.01	0.03	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.02
	-- only years 1995−2002	0.02	0.04	0.01	0.02	0.01	0.02	0.02	0.03	0.02	0.02
E/P_m	Exogenous income (mainly remittance) (CNY 1994)	183.1	1473.9	278.6	1553.1	143.3	1058.7	266.0	1494.4	102.1	1042.4
E^*/P_m	Total exogenous income (CNY 1994)	571.2	1718.9	417.1	1675.2	407.3	1267.6	1434.2	2424.1	231.1	1144.7
T	Time trend variable for 1995 (t=1) to 2010 (t=16)	8.18	4.48	8.22	4.53	8.10	4.49	8.37	4.58	8.28	4.47
SEX	Gender of household head (0 = female, 1 = male)	0.92	0.27	0.95	0.22	0.98	0.15	0.98	0.15	0.92	0.27
AGE	The age of household head in years	44.98	12.19	46.41	11.06	45.95	11.97	44.21	10.44	43.75	11.53
EDU	Education years of household head	5.53	2.84	6.78	2.04	6.97	2.65	6.56	3.14	6.79	2.77
NO	Number of persons living in the household	3.89	1.36	4.27	1.43	3.45	1.15	3.89	1.27	4.63	1.31
ROAD	Type of road to the household (0=soft surface, 1=hard surface)	0.21	0.38	0.64	0.42	0.61	0.44	0.27	0.37	0.15	0.36
DIS	Distance to the center of township (km)	7.04	8.46	6.95	4.76	7.54	4.63	11.2	6.58	12.6	7.53
$\bar{P}_l/P_m$	County-level wage rate of off-farm labor (CNY 1994/day)	17.4	4.89	15.7	4.78	21.9	5.32	17.2	5.42	17.4	3.82
CADRE	A household member working at the government (0=no, 1=yes)	0.08	0.27	0.08	0.28	0.07	0.26	0.12	0.32	0.58	0.35

Note: all the household data information is from surveys by the Economics and Development Research Centre (EDRC), State Forestry Administration (SFA) in China, while all price indices are from the national statistics yearbook. All monetary variables are deflated by the Consumer Price Index (P_m).

Table A2: *Estimation results of Sichuan Province*

Coefficient	(1) $X_a + X_c$	(2) X_c	(3) X_v	(4) X_l	(5) X_l^s	(6) $C_a + C_c + C_m$	(7) $C_a + C_c$
β_{Pc}	0.096	0.296	-0.580**	0.330*	-17.817	-0.380***	0.103
	(0.157)	(0.169)	(0.177)	(0.156)	(38.277)	(0.111)	(0.136)
β_{Pa}	0.559***	0.251*	-0.860***	0.059	154.196**	-0.040	-0.161
	(0.102)	(0.110)	(0.116)	(0.102)	(52.987)	(0.072)	(0.089)
β_{Pv}	-1.149***	-1.106***	-1.253***	-0.465**	-208.083***	-0.658***	-1.408**
	(0.193)	(0.209)	(0.219)	(0.193)	(62.122)	(0.137)	(0.168)
β_{Rsp}	-0.305***	-0.624***	-0.288***	-0.420***	103.896**	-0.192***	-0.300***
	(0.048)	(0.053)	(0.054)	(0.048)	(38.232)	(0.034)	(0.042)
β_{Tc}	0.209	-2.710***	-0.318	-0.685*	-615.519*	0.393	0.367
	(0.289)	(0.321)	(0.322)	(0.294)	(309.796)	(0.212)	(0.260)
β_{t}	-0.027	-0.001	-0.135***	0.018	-26.128*	-0.125***	-0.017
	(0.027)	(0.049)	(0.025)	(0.037)	(11.090)	(0.045)	(0.059)
β_{t2}	0.002	-0.003*	0.010***	-0.002	-0.858***	0.009***	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.143)	(0.001)	(0.001)
β_{ROAD}	0.048	-0.182***	0.041	0.064	91.550*	0.336***	0.177***
	(0.033)	(0.040)	(0.036)	(0.036)	(36.044)	(0.025)	(0.033)
β_{Pl}	-0.215**	-0.248	-0.151**	-0.113**	76.478*	-0.033	-0.143***
	(0.043)	(0.047)	(0.048)	(0.043)	(31.328)	(0.030)	(0.037)
β_{E} (10^3)	-0.012**	0.004	0.020***	-0.014**	-3.879	0.016***	0.0001
	(0.005)	(0.005)	(0.005)	(0.005)	(2.763)	(0.003)	(0.004)
β_{NO}	0.212***	0.318***	0.331***	0.140**	232.095***	0.379***	0.291***
	(0.033)	(0.036)	(0.037)	(0.032)	(32.521)	(0.022)	(0.029)
β_{R}	0.150***	0.132	0.109**	0.131***	-33.053**	0.068	0.201
	(0.039)	(0.091)	(0.037)	(0.076)	(12.665)	(0.076)	(0.117)
β_{Rs}	-0.265	0.075	-0.021	-0.269	113.694***	0.078	-0.128
	(0.117)	(0.271)	(0.109)	(0.222)	(34.879)	(0.223)	(0.346)
β_{SEX}	0.020	0.042	0.019	0.180	-35.736	0.048	0.076
	(0.105)	(0.254)	(0.101)	(0.214)	(22.796)	(0.200)	(0.328)
β_{Birth}	-0.027	-0.038	-0.033	0.008	-38.614***	-0.030	-0.024
	(0.021)	(0.045)	(0.017)	(0.033)	(11.090)	(0.043)	(0.057)
$\beta_{Birth2}(10^3)$	-0.310	-0.440	-0.330	0.134	466.919***	-0.406	0.302
	(0.278)	(0.597)	(0.223)	(0.435)	(143.021)	(0.566)	(0.753)
β_{EDU}	0.023	0.026	0.046***	-0.013	21.493**	0.042	0.012
	(0.013)	(0.028)	(0.011)	(0.022)	(5.313)	(0.025)	(0.036)
β_{DIS}	0.057*	0.075	0.025	0.061	15.900*	0.051	0.094
	(0.028)	(0.066)	(0.026)	(0.056)	(6.647)	(0.053)	(0.085)
β_{CADRE}	-0.033	-0.942	-1.252*	0.580	-1784.990**	-1.062	-1.130
	(1.005)	(1.839)	(0.622)	(0.876)	(673.872)	(2.069)	(2.266)
Marginal Effect							
$\partial Z / \partial R_{sp}^*$ phase 1	-0.328***	-0.618***	-0.323***	-0.443***	97.066*	-0.163***	-0.300***
	(0.047)	(0.052)	(0.053)	(0.047)	(37.588)	(0.033)	(0.041)
$\partial Z / \partial R_{sp}^*$ phase 2	-0.316***	-0.621***	-0.303***	-0.431***	100.761**	-0.179***	-0.300***
	(0.048)	(0.052)	(0.054)	(0.048)	(37.861)	(0.034)	(0.041)
$\partial Z / \partial S_p$	-0.009**	0.003	-0.015***	-0.010**	-2.934	0.012***	0.00004
	(0.003)	(0.004)	(0.004)	(0.003)	(2.090)	(0.002)	(0.003)
Observ.	6729	6543	6702	6668	7272	6935	6647

Note: ***, ** and * denote significance at 0.1%, 1% and 5%, respectively.

Table A3: *Estimation results of Jiangxi Province*

Coefficient	(1) $X_a + X_c$	(2) X_c	(3) X_v	(4) X_l	(5) X_l^s	(6) $C_a + C_c + C_m$	(7) $C_a + C_c$
β_{Pc}	1.823***	1.558***	-0.836***	0.965***	17.858	0.233	1.786***
	(0.198)	(0.178)	(0.173)	(0.186)	(81.585)	(0.140)	(0.173)
β_{Pa}	2.582***	2.715***	-2.393***	0.471	389.052***	0.508**	2.510***
	(0.266)	(0.237)	(0.233)	(0.253)	(117.181)	(0.190)	(0.231)
β_{Pv}	-1.936***	-1.513***	-0.480**	-1.338***	74.031	-0.567***	-1.550***
	(0.201)	(0.182)	(0.175)	(0.187)	(84.868)	(0.140)	(0.176)
β_{Rsp}	-0.542***	-0.717***	-0.114	-0.260*	43.823	0.105	-0.205*
	(0.110)	(0.099)	(0.096)	(0.102)	(99.155)	(0.077)	(0.098)
β_{Tc}	-3.316***	-2.598***	-0.777	-3.027***	1716.754	0.862	-3.421***
	(0.675)	(0.605)	(0.584)	(0.651)	(847.275)	(0.481)	(0.594)
β_t	0.151**	-0.203***	-0.234***	-0.076*	72.485***	-0.015	0.245***
	(0.050)	(0.045)	(0.035)	(0.053)	(2.626)	(0.037)	(0.037)
β_{t2}	-0.010***	-0.011***	0.009***	-0.002	-2.543***	0.003***	-0.010***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.032)	(0.001)	(0.001)
β_{ROAD}	-0.100**	0.037	0.048	-0.008	37.627	-0.172***	-0.095**
	(0.036)	(0.033)	(0.031)	(0.034)	(41.429)	(0.025)	(0.032)
β_{Pl}	-0.126**	0.181***	-0.359***	-0.277***	-17.938	-0.096*	-0.214***
	(0.053)	(0.047)	(0.046)	(0.051)	(59.393)	(0.038)	(0.046)
$\beta_E(10^3)$	0.021***	-.0280***	0.016***	0.007	-9.748	0.009*	0.022***
	(0.006)	(0.005)	(0.005)	(0.005)	(8.055)	(0.004)	(0.005)
β_{NO}	0.189***	0.230***	0.062	0.147***	298.885***	0.316***	0.146***
	(0.043)	(0.039)	(0.038)	(0.041)	(49.203)	(0.030)	(0.039)
β_R	0.407*	0.393**	0.314**	0.353*	-40.765***	0.254*	0.343**
	(0.164)	(0.148)	(0.104)	(0.169)	(10.072)	(0.117)	(0.119)
β_{Rs}	-0.134	-0.037	-0.468*	-0.060	74.964***	-0.134	-0.325
	(0.310)	(0.280)	(0.205)	(0.351)	(14.609)	(0.230)	(0.215)
β_{SEX}	0.075	0.028	0.023	0.096	-118.187***	-0.088	-0.021
	(0.259)	(0.234)	(0.170)	(0.290)	(13.282)	(0.192)	(0.180)
β_{Birth}	-0.099*	-0.058	-0.060*	-0.103*	-5.458*	0.036	-0.063*
	(0.045)	(0.041)	(0.030)	(0.049)	(2.626)	(0.033)	(0.031)
$\beta_{Birth2}(10^3)$	1.141*	-0.638	-0.694	1.210*	32.945	0.494	0.701
	(0.562)	(0.507)	(0.368)	(0.610)	(32.428)	(0.413)	(0.392)
β_{EDU}	0.050	0.041	0.051	0.070	-4.903	0.062	0.046
	(0.058)	(0.052)	(0.037)	(0.060)	(3.938)	(0.042)	(0.042)
β_{DIS}	-0.029	-0.055	-0.033	0.001	3.879	-0.047	-0.018
	(0.055)	(0.050)	(0.036)	(0.063)	(2.590)	(0.041)	(0.038)
β_{CADRE}	-1.486	-1.155	-0.588	-1.634	316.272**	-1.015	-0.791
	(1.615)	(1.467)	(1.005)	(1.592)	(116.154)	(1.133)	(1.204)
Marginal Effect							
$\partial Z/\partial R_{sp}^*$ phase 1	-0.565***	-0.748***	-0.096	-0.252*	32.751	0.095	-0.230*
	(0.110)	(0.098)	(0.096)	(0.102)	(97.930)	(0.077)	(0.097)
$\partial Z/\partial R_{sp}^*$ phase 2	-0.554***	-0.734***	-0.104	-0.256*	37.894	0.099	-0.218*
	(0.110)	(0.098)	(0.096)	(0.102)	(98.396)	(0.077)	(0.097)
$\partial Z/\partial S_p$	-0.007***	-0.009***	0.005***	0.002	-3.205	-0.003*	-0.007***
	(0.002)	(0.002)	(0.002)	(0.002)	(2.648)	(0.001)	(0.002)
Observ.	4769	4702	4675	4642	4863	4863	4680

Note: ***, ** and * denote significance at 0.1%, 1% and 5%, respectively.

Table A4: *Estimation results of Hebei Province*

Coefficient	(1) $X_a + X_c$	(2) X_c	(3) X_v	(4) X_l	(5) X_l^s	(6) $C_a + C_c + C_m$	(7) $C_a + C_c$
β_{Pc}	1.400***	1.565***	-0.063	0.584**	18.696	-0.290	0.537
	(0.283)	(0.275)	(0.250)	(0.237)	(52.852)	(0.189)	(0.291)
β_{Pa}	1.733***	1.699***	0.548***	-0.204	-19.461	0.183	1.413***
	(0.183)	(0.180)	(0.160)	(0.152)	(74.442)	(0.121)	(0.192)
β_{Pv}	-1.159***	-1.078***	-1.931***	0.528	-129.755	-1.375***	-1.072**
	(0.349)	(0.340)	(0.307)	(0.291)	(67.358)	(0.232)	(0.356)
β_{Rsp}	-0.404***	-0.578***	-0.188*	-0.580***	-23.105	0.144*	-0.081
	(0.093)	(0.091)	(0.081)	(0.078)	(30.523)	(0.061)	(0.096)
β_{Tc}	-0.597	3.016**	0.349	0.315	1203.300**	0.400	-7.707***
	(1.101)	(1.081)	(0. 962)	(0.919)	(448.767)	(0.730)	(1.124)
β_{t}	0.230***	0.260***	-0.059**	0.097	-72.485***	-0.122***	0.253***
	(0.058)	(0.076)	(0.047)	(0.046)	(2.626)	(0.036)	(0.064)
β_{t2}	-0.019***	-0.023***	0.003***	-0.006	-2.543***	0.007***	-0.019***
	(0.003)	(0.003)	(0.002)	(0.002)	(0.032)	(0.002)	(0.003)
β_{ROAD}	-0.030	0.097	0.144***	0.152***	38.804	0.010	-0.038
	(0.049)	(0.050)	(0.040)	(0.040)	(29.170)	(0.031)	(0.055)
β_{Pl}	0.833***	1.580	0.607***	-0.267*	-14.078	0.553***	-0.033
	(0.165)	(0.175)	(0.136)	(0.132)	(56.613)	(0.105)	(0.174)
$\beta_{E}(10^3)$	0.003	0.007	-0.013	0.013	7.188	0.032***	-0.018
	(0.010)	(0.010)	(0.009)	(0.009)	(7.871)	(0.007)	(0.013)
β_{NO}	0.235***	0.228***	0.330***	0.127**	168.298***	0.497***	0.267***
	(0.062)	(0.061)	(0.054)	(0.052)	(37.092)	(0.041)	(0.072)
β_{R}	0.625***	0.768***	0.522***	0.485***	-42.952***	0.227***	0.144
	(0.092)	(0.154)	(0.067)	(0.067)	(2.838)	(0.054)	(0.115)
β_{Rs}	-0.291	-0.304	-0.249	-0.523**	58.265***	-0.154	-0.230
	(0.253)	(0.480)	(0.166)	(0.179)	(7.154)	(0.137)	(0.332)
β_{SEX}	0.056	0.410	-0.463*	-0.195	-64.592***	-0.426*	-0.655
	(0.327)	(0.621)	(0.214)	(0.230)	(10.1121)	(0.177)	(0.431)
β_{Birth}	-0.039	-0.045	-0.031	-0.025	-3.838***	0.034	-0.019
	(0.032)	(0.061)	(0.021)	(0.022)	(0.994)	(0.017)	(0.042)
$\beta_{Birth2}(10^3)$	-0.539	-0.636	-0.362	-0.257	54.664	0.443*	-0.163
	(0.390)	(0.743)	(0.255)	(0.273)	(11.951)	(0.212)	(0.519)
β_{EDU}	-0.019	-0.013	0.026	-0.009	-0.039***	0.036**	-0.014
	(0.023)	(0.045)	(0.015)	(0.016)	(0.715)	(0.013)	(0.031)
β_{DIS}	-0.093	-0.099	-0.056	-0.020	24.034***	-0.023	-0.067
	(0.063)	(0.120)	(0.041)	(0.044)	(1.852)	(0.034)	(0.083)
β_{CADRE}	-1.391	-2.710	-1.084	-0.255	21.744	0.124	1.549
	(0.073)	(1.394)	(0.557)	(0.509)	(39.223)	(0.458)	(1.068)
Marginal Effect							
$\partial Z/\partial R^*_{sp}$ phase 1	-0.401***	-0.570***	-0.205***	-0.563***	-13.733	0.186**	-0.104
	(0.093)	(0.091)	(0.081)	(0.078)	(31.185)	(0.061)	(0.096)
$\partial Z/\partial R^*_{sp}$ phase 2	-0.402***	-0.574***	-0.196***	-0.572***	-18.627	0.164**	-0.092
	(0.093)	(0.091)	(0.081)	(0.078)	(30.412)	(0.061)	(0.095)
$\partial Z/\partial S_p$	0.001	0.003	-0.007	0.006	3.602	0.016***	-0.009
	(0.005)	(0.005)	(0.005)	(0.004)	(3.944)	(0.003)	(0.007)
Observ.	3314	3303	3323	3228	3345	3345	3114

Note: ***, ** and * denote significance at 0.1%, 1% and 5%, respectively.

Table A5: *Estimation results of Shaanxi Province*

Coefficient	(1) $X_a + X_c$	(2) X_c	(3) X_v	(4) X_l	(5) X_l^s	(6) $C_a + C_c + C_m$	(7) $C_a + C_c$
β_{Pc}	0.868*	0.634	0.198	0.308	-179.324	1.147***	0.015
	(0.436)	(0.419)	(0.371)	(0.320)	(110.641)	(0.249)	(0.436)
β_{Pa}	0.397	0.191	-1.312***	-0.458*	-199.826***	0.114	0.636**
	(0.249)	(0.235)	(0.224)	(0.189)	(45.558)	(0.153)	(0.232)
β_{Pv}	-0.466	-0.267	-1.162***	0.355	-125.214*	-0.364*	-0.747***
	(0.297)	(0.282)	(0.264)	(0.224)	(52.336)	(0.180)	(0.283)
β_{Rsp}	-0.674***	-0.431***	-0.538***	-0.676***	140.757***	-0.073	-0.564***
	(0.107)	(0.104)	(0.094)	(0.079)	(42.723)	(0.064)	(0.107)
β_{Tc}	-2.631***	-1.141***	-0.349**	-0.204	101.233	-1.625	-4.023***
	(0.822)	(0.777)	(0.733)	(0.609)	(280.476)	(0.506)	(0.805)
β_t	0.218***	0.136**	-0.130*	-0.025	-72.051***	0.065	0.227
	(0.064)	(0.051)	(0.064)	(0.038)	(2.261)	(0.075)	(0.177)
β_{t2}	-0.013***	-0.011***	0.015***	-0.002	5.230***	0.001	-0.008*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.030)	(0.002)	(0.003)
β_{ROAD}	0.028	0.035	0.112*	-0.061	22.647	0.071	-0.056
	(0.062)	(0.058)	(0.054)	(0.043)	(32.247)	(0.038)	(0.066)
β_{Pl}	0.666***	0.465***	-0.538***	0.555	-226.451***	-0.356***	0.176
	(0.102)	(0.098)	(0.089)	(0.073)	(39.764)	(0.061)	(0.098)
$\beta_E(10^3)$	0.003	-0.008	0.014	0.012	-2.010	0.024***	0.014
	(0.083)	(0.008)	(0.007)	(0.006)	(3.119)	(0.005)	(0.009)
β_{NO}	0.055	0.031	0.061	0.095	304.388***	0.459***	0.247**
	(0.086)	(0.084)	(0.074)	(0.062)	(69.918)	(0.050)	(0.090)
β_R	0.172	0.417***	0.014	0.236***	-87.348***	-0.209	-0.424
	(0.110)	(0.078)	(0.117)	(0.055)	(4.928)	(0.152)	(0.358)
β_{Rs}	0.103	0.290	-0.219	-0.402	51.100***	0.111	0.970
	(0.397)	(0.280)	(0.427)	(0.198)	(16.540)	(0.567)	(1.317)
β_{SEX}	-0.382	-0.164	-0.670	-0.264	12.009	-0.440	-1.178
	(0.508)	(0.360)	(0.548)	(0.255)	(21.538)	(0.736)	(1.707)
β_{Birth}	0.018	-0.016	0.012	-0.011	-7.968***	-0.005	0.088
	(0.052)	(0.036)	(0.055)	(0.025)	(2.261)	(0.072)	(0.172)
$\beta_{Birth2}(10^3)$	0.317	-0.146	0.141	-0.060	-95.341***	-0.165	1.183
	(0.661)	(0.463)	(0.698)	(0.320)	(29.696)	(0.912)	(2.201)
β_{EDU}	-0.009	0.028	-0.025	-0.003	-8.912***	0.005	-0.088
	(0.038)	(0.026)	(0.039)	(0.016)	(2.242)	(0.046)	(0.122)
β_{DIS}	0.121	0.125	0.263*	0.319***	-30.160***	-0.004	0.374
	(0.117)	(0.083)	(0.127)	(0.060)	(4.757)	(0.172)	(0.398)
β_{CADRE}	1.917	-0.100	1.753	0.116	321.368**	1.572	5.212
	(1.452)	(0.941)	(1.399)	(0.480)	(99.251)	(1.328)	(4.191)
Marginal Effect							
$\partial Z/\partial R_{sp}^*$ phase 1	-0.673***	-0.467***	-0.477***	-0.625***	131.979***	0.032	-0.625***
	(0.102)	(0.099)	(0.090)	(0.076)	(40.032)	(0.061)	(0.101)
$\partial Z/\partial R_{sp}^*$ phase 2	-0.673***	-0.453***	-0.500***	-0.645***	135.329***	-0.008	-0.601***
	(0.102)	(0.099)	(0.090)	(0.076)	(40.543)	(0.061)	(0.102)
$\partial Z/\partial S_p$	0.001	-0.012	0.021	0.018	-3.046	0.037***	-0.021
	(0.013)	(0.012)	(0.011)	(0.009)	(4.728)	(0.007)	(0.013)
Observ.	2345	2291	2443	2382	2502	2502	2145

Note: ***, ** and * denote significance at 0.1%, 1% and 5%, respectively.

Table A6: *Estimation results of Guangxi Province*

Coefficient	(1) $X_a + X_c$	(2) X_c	(3) X_v	(4) X_l	(5) X_l^s	(6) $C_a + C_c + C_m$	(7) $C_a + C_c$
β_{Pc}	0.639*	1.147***	-1.507***	1.582***	83.425	-0.310*	2.048***
	(0.252)	(0.263)	(0.233)	(0.202)	(109.663)	(0.153)	(0.175)
β_{Pa}	2.428***	3.175***	-1.753***	1.240***	323.145*	-0.134	1.007***
	(0.343)	(0.359)	(0.316)	(0.274)	(149.371)	(0.207)	(0.237)
β_{Pv}	1.283***	1.658***	-1.715***	-0.529***	248.028*	0.031	1.094***
	(0.193)	(0.202)	(0.179)	(0.155)	(123.038)	(0.116)	(0.136)
β_{Rsp}	-0.057	0.059	0.204	-0.023	82.979	0.397***	0.225**
	(0.118)	(0.126)	(0.109)	(0.094)	(95.565)	(0.071)	(0.083)
β_{Tc}	-1.508	-0.542	-0.671	-2.411*	-2517.044*	-3.568***	-3.262***
	(1.408)	(1.498)	(1.328)	(1.147)	(1109.275)	(0.856)	(0.982)
β_{t}	0.287***	0.386***	-0.229***	0.258***	66.484***	-0.013	0.521***
	(0.045)	(0.073)	(0.065)	(0.046)	(1.728)	(0.028)	(0.034)
β_{t2}	-0.012***	-0.019***	0.013***	-0.010***	-2.052***	0.0004	-0.025***
	(0.002)	(0.002)	(0.002)	(0.001)	(0.023)	(0.001)	(0.001)
β_{ROAD}	-0.138	-0.001	-0.400	-0.560**	37.060	-0.001	-0.025
	(0.146)	(0.351)	(0.316)	(0.203)	(41.428)	(0.094)	(0.133)
β_{Pl}	0.072	-0.394***	0.056	0.229***	-48.434	0.315**	0.216***
	(0.076)	(0.080)	(0.070)	(0.061)	(56.341)	(0.045)	(0.053)
$\beta_{E}(10^3)$	-0.019	-0.008	-0.013	-0.002	0.225	0.036***	0.051***
	(0.012)	(0.013)	(0.011)	(0.010)	(12.229)	(0.007)	(0.008)
β_{NO}	0.284***	0.261***	0.095	0.262***	328.940***	0.430***	0.393***
	(0.066)	(0.070)	(0.062)	(0.053)	(64.457)	(0.040)	(0.046)
β_{R}	0.323***	0.339*	0.491***	0.096	-46.571***	0.071	0.053
	(0.062)	(0.152)	(0.133)	(0.086)	(3.874)	(0.040)	(0.055)
β_{Rs}	-0.466**	-0.345	-1.180**	-0.526	-27.949*	-0.219	-0.147
	(0.197)	(0.469)	(0.417)	(0.270)	(12.088)	(0.126)	(0.177)
β_{SEX}	0.128	-0.159	0.163	0.166	-13.817	-0.223*	-0.031
	(0.155)	(0.379)	(0.332)	(0.215)	(10.271)	(0.099)	(0.137)
β_{Birth}	-0.035	-0.086	0.017	0.050	-3.708*	-0.034*	0.003
	(0.026)	(0.063)	(0.055)	(0.036)	(1.728)	(0.017)	(0.023)
$\beta_{Birth2}(10^3)$	-0.455	-1.015	0.211	0.726	32.095	0.424	0.091
	(0.342)	(0.830)	(0.732)	(0.472)	(22.669)	(0.219)	(0.306)
β_{EDU}	0.005	0.030	-0.007	-0.013	4.681***	0.022	0.012
	(0.018)	(0.043)	(0.038)	(0.025)	(1.244)	(0.011)	(0.016)
β_{DIS}	-0.266***	-0.311	-0.076	-0.085	17.779***	0.089*	-0.117
	(0.067)	(0.162)	(0.142)	(0.092)	(4.337)	(0.043)	(0.059)
β_{CADRE}	-0.217	-1.850*	1.638	1.251*	126.956***	-0.287	-0.395
	(0.382)	(0.891)	(0.835)	(0.537)	(26.265)	(0.251)	(0.361)
Marginal Effect							
$\partial Z/\partial R_{sp}^*$ phase 1	-0.090	0.045	0.182	-0.027	83.365	0.335***	0.138
	(0.113)	(0.121)	(0.105)	(0.091)	(90.558)	(0.068)	(0.080)
$\partial Z/\partial R_{sp}^*$ phase 2	-0.077*	0.051	0.191	-0.025	83.205	0.360***	0.174*
	(0.115)	(0.123)	(0.106)	(0.092)	(92.090)	(0.069)	(0.081)
$\partial Z/\partial S_p$	-0.014	-0.006	-0.009	-0.002	0.164	-0.027***	-0.037***
	(0.009)	(0.009)	(0.008)	(0.007)	(8.922)	(0.005)	(0.006)
Observ.	2265	2253	2264	2265	2277	2277	2243

Note: ***, ** and * denote significance at 0.1%, 1% and 5%, respectively.

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