Non-labor Income and Agricultural Investment in Peru

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***Abstract**: What is the effect of marginal increases in non-labor income on agricultural investment of fixed and working capital? This paper examines this question using income and agricultural data from the 1994 LSMS Peruvian survey. Findings indicate that non-labor income has substantive increases on fixed capital, and significant and substantive effects on working capital. For both forms of capital, investment of non-labor income is far greater than that of labor income. Further analysis evaluates the presence of children in households on investment of non-labor income, and disaggregates working capital to analyze the individual components.*

1. Introduction

Different forms of household income are allocated differently. Studying the use of auxiliary incomes has provided economists insight into credit constraints, personal motivations and investment decisions. Many studies have analyzed the effect of cash transfers, particularly social assistance transfers and pension disbursements, on agricultural investment and production.

This study attempts to provide further insight into how auxiliary income is invested in agriculture. Specifically, we will consider how marginal increases in non-labor income, vis-à-vis labor income, affect agricultural investment in fixed and working capital. Fixed capital investment is quantified by the value of agricultural equipment owned by a household, and working capital investment is derived from the yearly expenditure of agricultural inputs (e.g. seeds, fertilizer, hired labor). The analysis is conducted using the LSMS 1994 survey of Peru, which contains personal and household information on demographics, economic conditions, education, food consumption, small business and agriculture. Results suggest that non-labor income has substantive but insignificant effect on fixed capital, and both significant and substantive effects on working capital. For both forms of capital, marginal investment of non-labor income is far greater than that of labor income. This analysis also evaluates how the presence of children within a household affects investment, and breaks down working capital to indicate which components are most affected. We then turn to potential theoretical explanations for our findings, and contemplate policy implications for Peru and the body of work at large.

Section 2 of the paper provides background information on Peru and previous literature on cash transfers and agricultural investment. Section 3 introduces the data and basic information on the specific study. Section 4 presents the empirical methodology underlying the study, and Section 5 discusses the results. Section 6 brings the results into a theoretical context, and Section 7 discusses policy implications of the study and concludes the work.

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5.2. Working Capital

Results from Table 5 show both significant and substantive increases in working capital due to marginal increases in incomes. Model 1 derives a marginal investment of non-labor income equal to .544. That is, an additional solar in non-labor income results in a 54 centavo increase in agricultural input expenditure on average, compared to an 8 centavo marginal increase from labor income. This finding evidences that non-labor income has a far greater marginal effect on agricultural investment than permanent income, and that agriculture takes high priority in budgetary decisions regarding auxiliary income. We must remember that this large difference in coefficients between labor and non-labor income does not translate to greater non-labor income allocation at the absolute level, since the regressions test marginal effects.

Table 5: Agricultural Investments, Working Capital

Dependent variable: Value of Agricultural Inputs (*100 solares*)

	Model 1	Model 2	Model 3	Model 4	Model 5		
	Non-labor & Labor Income	Household Breakdown	Non-labor Income	Labor Income	Rural	No Instruments	Log on Dependent & Income Variables

Non-labor Income (100 solares)	.544** (.247)	.558** (.247)	.530*** (.251)	-	.044 (.155)	1.09*** (.242)	.086 (.061)
Salary (100 solares)	.0788*** (.016)	.078*** (.016)	-	.053*** (.013)	.033*** (.010)	.060*** (.013)	.093** (.042)
Rural (dummy)	-9.73** (3.81)	-8.36 (3.90)	-10.60 (3.85)	-8.73*** (2.96)	-	-	-.263 (.311)
Household Size	-.210 (.499)	-	-.183 (.507)	-.073 (.403)	-.041 (.304)	-	-.045 (.042)
Number of males	-	.371 (1.00)	-	-	-	-	-
Number of females	-	1.694 (.999)	-	-	-	-	-
Number of children	-	-2.296 (1.061)	-	-	-	-	-
Household head gender (dummy)	-4.00 (4.31)	-4.84 (4.40)	-4.79 (4.36)	-8.74** (3.77)	-6.71 (5.48)	-	-.323 (346)
Household head education IV	Yes	Yes	Yes	Yes	Yes	No	Yes
Land ownership (area)	.000 (.000)	.000 (.000)	.000 (.000)	.000 (.000)	.000 (.000)	-	.000 (.000)
Land rights IV	Yes	Yes	Yes	Yes	Yes	No	Yes
Occupation IV	Yes	Yes	Yes	Yes	Yes	No	Yes

Model 2 in Table 5 provides important insight into investment preferences between investment in agricultural versus children. Each child reduces yearly working capital expenditure by 230 solares.

5.3. Components of Working Capital

Disaggregating input expenditure allows us to determine which types of working capital are of greatest importance. Note that this table must be interpreted differently from the previous tables, as the coefficient for the labor income variable indicates the primary budget allocation to that good. Since labor income is far greater that non-labor income, and permanent income must also go towards the purchase of staple goods and services, greater marginal increases in labor income signify a greater overall budgetary importance of a specified good.

Under this interpretive context, we see that land rental is most important agricultural input. Interpreting its coefficients indicates that, for individuals who allocate

money towards land rental, every additional solar of labor income will increase land rent expenditure by 35 centavos. Though this is a flawed interpretation, as land rental is a diminishing marginal cost, it still allows us to understand the importance of land rental. This importance is logical, since it is needed for both cultivation and inhabitance, and since land costs are far greater than they are for other input forms. Processing expenditure is second highest, again likely due to the high costs. Income allocation towards transportation is substantial as well, however this may contain a positive bias resulting from households reporting transport costs not associated with agricultural production. The high degree of marginal investment in machine rental for both non-labor and permanent incomes corroborates the belief that fixed capital rental markets exist. The main shortcoming in these models is that they restrict the sample to households who spend money on the specified input, thereby reducing the sample size and forcing each variable to be interpreted exclusively from the other variables.

Reviewing Tables 4 to 6 corroborates our prior belief that non-labor income should have a greater effect on agricultural investment that permanent labor income, in terms of both fixed and working capital. In addition to this primary finding, we discover that the effect of non-labor income on fixed capital (other than land) may be partially mitigated due to an equipment rental market, a theory corroborated by substantial marginal increases in machine rental due to non-labor income (as seen in Table 6). We also find that the presence of children greatly reduces agricultural investment.

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6. Theoretical Reasoning

In Section 5, we use empirical analysis to reveal that marginal agricultural investment is far greater for non-labor income than it is for permanent, labor income. Yet this research cannot explain why we find this occurrence. We will therefore refer to three theoretical explanations for qualitative reasoning: credit constraints, permanent versus transitory income allocation, and mental accounts.

Martinez ascribes increases in food production to the reduction of liquidity constraints in farming communities.

> Especially for poor households with untapped productive and income generating potential, cash transfers may boost output through household investments in activities such as farming and micro-enterprise. With positive returns on these investments, poor households can increase consumption by more than the value of the initial transfer amount through multiplier effects on the transfer (Martinez, 1).

Since there is no evidence of multiplier effects in agricultural production, it is difficult to test this hypothesis with our data. We can, however, look at differences in permanent versus transitory income allocations at the margin.

The 'residual funds hypothesis' posits that household farmers will carry out investment desires with transitory income, especially when farmer incomes are unstable (Girão et al). By comparing the coefficients on non-labor income and labor income in 5.1 – 5.3, we can draw some interesting inferences. The large magnitude of marginal non-labor income expenditure, relative to that of permanent income, corroborate this theory, especially when the primary sources of rural non-labor income, non-profit assistance and non-family remittances, are transient in nature.

Table 6: Agricultural Input Expenditure by Category										
Dependent Variable: Yearly Input Expenditure										
	Model 1 Plants	Model 2 Fertilizer	Model 3 Pesticides	Model 4 Canisters, Containers	Model 5 Transportation	Model 6 Storage Costs	Model 7 Hired Labor	Model 8 Rent for Land	Model 9 Processing Costs	Model 10 Machinery Rental, Other
Non-labor Income	0.351	0.397	0.279	1.27**	0.406	1.606	1.97***	1.55	1.601	0.991
(100 solares)	(.402)	(.318)	(.344)	(.623)	(.460)	(1.007)	(.641)	(1.103)	(1.06)	(.929)
Salary	0.161***	0.095***	.108***	0.118***	0.187***	0.149***	.115***	.350***	0.214***	.176***
(100 solares)	(.034)	(.024)	(.028)	(.034)	(.043)	(.046)	(.028)	(.065)	(.061)	(.047)
Rural (dummy)	-12.58	-8.14	-9.43	-10.1	-6.04	-11.59	-9.36	-7.85	-10.3	-8.43
	(9.79)	(9.01)	(8.23)	(9.13)	(13.66)	(10.33)	(8.58)	(5.49)	(12.3)	(9.22)
Number of males	1.90	1.38	-.986	-1.33	-1.01	-.874	-.158	1.56	1.39	1.94
	(2.19)	(1.70)	(1.97)	(2.61)	(1.81)	(2.33)	(1.96)	(4.52)	(4.48)	(3.53)
Number of females	0.894	1.91	2.73	2.56	1.98	2.93	2.41	0.731	2.89	4.57
	(2.06)	(1.67)	(1.94)	(2.63)	(2.36)	(2.02)	(1.91)	(4.57)	(5.07)	(3.47)
Number of children	-3.47	-2.5	-3.02	-3.32	-2.75	-2.96	-3.45	-5.24	-8.1	-5.14
	(2.12)	(1.75)	(2.00)	(2.56)	(2.43)	(2.66)	(1.94)	(4.27)	(4.69)	(3.40)
Head education IV	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Land ownership	-.031	-.010	-.033	-.027	-.001	-.063	-.068	-.083	-.043	-.039
	(.017)	.000	.000	.000	.000	.000	.000	.000	.000	.000
Land ownership rights IV	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State rights IV	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Occupation IV	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

The high coefficient gaps in hired labor and storage costs suggests that these are 'luxury' investments; that is, when receiving income beyond what is expected, this auxiliary income is disproportionately invested in these inputs. We can easily understand this finding in regard to hired labor – households will only hire more workers 'if extra cash is available'.

Lastly, Case and Deaton explain their findings using behavioral effects, also known as mental accounts. Mental accounts examines how individuals decide to allocate different forms in income. In reference to our analysis, if non-labor income is simply added to household resources, we should expect it to show up in additional purchases of agricultural input. If the coefficients for labor and non-labor income are the same, it would seem that non-labor income is treated like other income. However, since the coefficient on non-labor income is larger, households favor agricultural investment over other expenditures. Along with the residual fund hypothesis, the behavioral effects premise provides a plausible explanation for our data.

7. Conclusion

This study provides evidence that non-labor income is an important source of liquidity for rural farms. We notice a greater marginal propensity to invest non-labor income in agriculture for both fixed and working capital. Disaggregating working capital shows that marginal investment varies in accordance to the cost and relative potential returns of each component. We then place our empirical findings into a theoretical context. According to the behavioral effects premise, the differences in marginal investment of non-labor and labor income prove that agricultural investment precedence over other (but not all) budgetary allocations. If the residual funds hypothesis is valid,

then farmers' non-labor income is transitory, indicated by their relatively higher marginal investment.

Along with the limitations found in individual models, we encounter overarching shortcomings in this study. First, as mentioned earlier, the econometric method employed does not analyze the effect of changes in non-labor income over time, and comparison is made between households as opposed to comparison within households, over time. Secondly, there may be biases present, especially those resulting from equipment valuation differences. Thirdly, due to the fact that nearly all urban observations are omitted, the number of subjects in each regression is lower than desirable. In some regressions, as few as 650 observations are included. Therefore, multiple forms of regressions are used as robustness checks for tests in Section 5.1 and 5.2.

Due to its apparent importance, the provision of non-labor income has weighty policy implications. Non-profit assistance is currently the primary source of non-labor income in rural areas. Extending the pension program, which suffers from poor coverage (especially in rural areas), will provide farmers with necessary residual capital and allow social assistance to go towards other improvements such as education or public spending. Additionally, improving Peru's subsistence farming market will lead to positive externalities, most notably the reduction of coca production – a problem that has stoked Peru's civil unrest for decades.