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The Role of Income Diversification during the Global Financial Crisis: Evidence from Nine Villages in Cambodia

TONG Kimsun and PHAY Sokcheng

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Responsibility for ideas, facts and opinions presented in this research paper rests solely with the authors. Their opinions and interpretations do not necessarily reflect the views of the Cambodia Development Resource Institute.

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ACRONYMS AND ABBREVIATIONS

ADB	Asian Development Bank
CDRI	Cambodia Development Resource Institute
HHH	Household Head
IDRC	International Development Research Centre
MEF	Ministry of Economy and Finance
OLS	Ordinary Least Squares
RC	Red Cross
SNEC	Supreme National Economic Council

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ABSTRACT

This paper uses four-period panel data covering the years 2001, 2004, 2008 and 2011 to analyse the roles of rural income diversification during the global financial crisis. Income diversification is commonly defined as a proportion of income derived from non-farm activities or the number of income portfolios. However, the use of such measures is problematic because the income diversification variable is sensitive to assumptions about the thresholds used to assign households to different income categories. To address this concern, following Dimova and Sen (2010), we use the Herfindahl index constructed as the sum of squares of the shares of different income portfolios in the household: the smaller the index value, the higher the degree of income diversification.

Using both fixed- and random-effects models, we find that the number of male household members aged 15-64, household head primarily engaged in agriculture, durable assets, agricultural land endowment, health shock and crop failure are the key determinants of income diversification in rural Cambodia, where households' diversification behaviour is mainly motivated by the desire to accumulate rather than by survival concerns. This finding suggests that richer households are better able than poorer households to seize the advantages provided by a diversified income portfolio. It also implies that accumulation-led diversification has less impact on poverty, at least in the short run, than survival-led activity. Therefore policies that reduce constraints on diversification, such as risk reduction strategies, microcredit provision, rural services, rural non-farm enterprise development, infrastructure and education improvements are in general desirable.

Using the interaction of health shock and crop failure as an instrumental variable, we confirm that income diversification is strongly and positively associated with per capita consumption but is unlikely to help smooth consumption during a crisis. This result holds even if we use the poverty headcount ratio as the measure of household welfare outcomes. These findings strengthen the need for well-designed public safety nets as a risk-reducing and coping strategy.

1

INTRODUCTION

In the late 2000s Cambodia suffered two major economic shocks: oil and food price increases and the global economic-financial crisis. The food and oil prices rise to record highs in 2008 is one of the most severe external shocks to have rocked the country. In its wake, the global financial crisis hit Cambodia's economy in 2009, making an already difficult situation even worse, particularly for the poor and other vulnerable groups. The crises coincided with Cambodia's property market collapse and a border stand-off with Thailand, both of which possibly contributed to the sudden economic contraction. As a result, macroeconomic indicators changed dramatically during 2007–09: economic growth declined from 10.2 percent in 2007 to 6.7 percent in 2008 and 0.1 percent in 2009, while inflation registered a record high of 19.7 percent in 2008 before dropping to -0.7 percent in 2009 and 4.0 percent in 2010. The World Bank (2009) and ADB (2008) projected that as a direct consequence of the crises, 2.2 to 2.5 million more Cambodians would fall into poverty in addition to the 4.5 million already living below the poverty line.

A number of studies confirmed that the global economic and financial crisis hit the poor and vulnerable the hardest, largely due to weak formal ex-ante and ex-post coping strategies, informal social insurance and the lack of public response (e.g. Tong *et al.* 2009; Tong 2010; Chan & Ngo 2010). However, no study has used econometric techniques to investigate the role of income diversification during the crisis.

Morduch (1995) notes that if credit and insurance markets are incomplete and formal safety nets are missing, households will choose to diversify their income sources in order to smooth consumption. Households may opt to diversify income either ex-ante or ex-post to manage the risk of shocks (Reardon *et al.* 1992) in addition to resorting to common informal insurance mechanisms, for example selling livestock and assets. The literature identifies a wide range of factors that can explain income diversification, such as response to household shocks and risk reduction and asset accumulation strategies (Ellis 1998; Barrett *et al*. 2001b). Most of these factors can be divided into pull factors and push factors. Pull factors include benefits from complementarities between activities (Norman 1974), new income opportunities created by market development (Davis & Pearce 2001), infrastructure improvement (Jalan & Ravallion 1998) and diversification for asset accumulation (Hart 1994). Push factors include ex-ante risk management (Alderman & Paxson 1992), ex-post risk coping (Carter 1997), liquidity constraints and credit market failure (Reardon *et al.* 1994) and the seasonality of agricultural activity (Sahn 1989). In other words, one could delineate the former factors as a matter of accumulation or choice and the latter as necessity or survival. A strong implication of the "diversification as accumulation" view is that the relationship between household income diversification and household income is expected to be positive—richer households will likely diversify more than poorer households. Conversely, the relationship between household income diversification and household income is expected to be negative under the "diversification as survival" view—poor households will likely diversify more than richer households. Different policies have different implications for each of these two factors (Dimova & Sen 2010). Policies which facilitate the movement of the rural poor out of high-risk low-return agricultural activities into non-farm waged work and self-employment are important if income diversification is a question of necessity, whereas investments in agricultural activities and agricultural extension services

that help overcome entry barriers to new off-farm business activities will be critical if income diversification is a matter of choice.

Income diversification has been shown to be positively associated with wealth accumulation and reduced vulnerability—at least in terms of partial consumption smoothing (Barrett *et al.* 2001a; Kinsey *et al.* 1998). However, little is known about how income diversification could protect households against exogenous shocks, particularly in Cambodia. This paper intends to fill this gap. More specifically, informed by unique panel data on rural Cambodian households between 2001 and 2011, we examine the determinants of income diversification and the response of higher income households to adversity in the face of the global economic and financial crisis.

Section 2 reviews existing studies on the key factors of income diversification and its role in mitigating shocks. Section 3 illustrates available data for the study. Section 4 discusses the econometric approaches employed in the analysis. Section 5 presents empirical findings. Section 6 concludes.

2

LITERATURE REVIEW

The wealth of literature that discusses farm household diversification into rural non-farm activities can be loosely divided into two strands. Several studies have focused on the determinants of income diversification (Corral & Reardon 2001; de Janvry & Sadoulet 2001; Lanjouw & Shariff 2002; Woldenhanna & Oskam 2001; Barrett *et al.* 2001a, 2001b), while others examine the impact of income diversification on investment, poverty and inequality (Reardon *et al.* 2000; Mastumoto *et al.* 2006; Nargis & Hossain 2006; van den Berg & Kumbi 2006; Lay *et al.* 2009). These studies noted that factors which influence income diversification can be grouped into five categories: (1) individual and household characteristics (age, gender, education, marital status, household size); (2) farm characteristics (amount of cultivated land, number of crops grown, value of farm implements, membership in a farm organisation, access to agricultural extension services); (3) location (quality of roads, availability of electricity, distance from towns); (4) market barriers (inaccessibility of credit and market information); and (5) risk (variability of returns from various economic activities). Most of these studies also identified survival as a chief incentive for income diversification. Although some found that income diversification as accumulation could also be a driving factor, such motivation is more typical of the non-poor (Dercon & Krishnan 1996; Lanjouw 2001; Lay et al 2009). Empirical evidence also suggests that income diversification is associated with higher income and food consumption as well as more stable income and consumption over time (Reardon et al 1992; Dercon & Krishnan 1996; Reardon 1997; Barrett *et al.* 2001a; Block & Webb 2001; Canagarajah *et al.* 2001). Non-farm income sources are also effective in combating poverty and inequality (de Janvry & Sadoulet 2001). In addition, a few studies attempt to investigate the dynamics of household income diversification, such as factors associated with changes in income diversification over time (Bezu & Barrett 2011). They argue that access to savings and credit is an important factor for transition into high-return rural non-farm activities.

Despite the plethora of studies on various aspects of income diversification in developing countries, few deal with the significance of income diversification or its key determinants in Cambodia. The available studies are Chan and Acharya (2002), and Fitzgerald and So (2007). To the best of our knowledge, no study has yet examined the role of income diversification in protecting households during external shocks.

Using household data collected in 2001 from nine villages in rural Cambodia,[1] Chan and Acharya (2002) attempted to identify sources of household income by focusing on the absolute income derived from different sources, the extent to which rural households depended on common property resources, the difference between rich and poor households' dependence on common property resources and the availability of common property resources. They argued that villagers in the study area had begun to diversify their income generating activities into wage labour and trade due to the declining availability of common property resources. Fitzgerald and So (2007), using a similar household data set along with a follow-up survey in 2004/05, analysed the key factors in community well-being and household mobility and showed that the proportion of household income from agriculture and common property resources fell, while that from self-employment and wage labour rose between 2001 and 2004/05—implying that households in all study villages continued to diversify their income. They added that the most

[1] Three of these nine villages were surveyed in 1996–97 as part of a CDRI study (Murshid 1998).

successful households and communities were those that have been able to diversify. However, both studies relied heavily on descriptive statistics that do not control for other factors that also influence household income diversification.

This study uses econometric approaches, i.e. fixed- and random-effects modelling, to eliminate unobserved household attitudes to risk that may be correlated with household income diversification behaviour, and instrumental variable methods to address the endogeneity of household income diversification. Our study is distinct from previous studies in two critical aspects. First, we used unique survey data covering the years 2001, 2004/05, 2008 and 2011, i.e. before, during and after the dual crises hit, meaning that significant response is expected from households. Second, we investigate not only the determinants of income diversification but also its role during the twin shocks.

3

DATA SOURCES AND DESCRIPTIVE STATISTICS

This study is informed by four-period panel household data collected by CDRI in 2001, 2004/05, 2008 and 2011. The information includes household demographics, housing condition, land ownership and transactions, credit markets, food and non-food consumption, non-land assets, livestock ownership, household income, agricultural production, production expenditure, wages and self-employment were collected. A brief description of the sample villages' characteristics is given in Fitzgerald and So (2007).

Information on household income from various sources such as agricultural produce, livestock, common property resources and off-farm activities has been collected over 10 years. But income sources such as transfers from non-government organisations, political parties, the Red Cross and pagodas are not comparable across the study period because they were incorporated into the questionnaire only in 2008. For this reason, all incomparable income sources are excluded from the analysis. In addition, gross rather than net household income is used because some income sources were collected as gross income rather than net income. The gross income was converted to constant 2001 prices using updated village price indexes originally constructed by Albert (2009), and into adult equivalence.[2]

[2] The consumption of a child aged 14 or below is assumed to be half that of an adult aged 15 and above.

4

ECONOMETRIC APPROACH

4.1. Measurement of Household Income Diversification

Definitions and measures of household income diversification vary within the literature. Some studies measure it as the proportion of income derived from non-farm sources (Reardon *et al.* 1992; Davis *et al.* 2010), while others use several different types of income portfolios (e.g. one source of income will get a value of one [farming], two sources of income will get the value of two [farm and non-farm activities] and so on). Dimova and Sen (2010) note that the use of such measures is problematic because the income diversification variable is sensitive to assumptions about the income thresholds used to assign households to different income categories. Further, it is unclear whether a household that generates, for example, 90 percent of its income from farming is seen as being more diversified than a household which relies solely on farming. To address this concern, following Dimova and Sen (2010), we use the Herfindahl index constructed as the sum of squares of the shares of different income portfolios in the household: the smaller the index value, the higher the degree of income diversification. This measure is more appropriate than the above measures because it does not need additional assumptions for grouping households into different income diversification categories (Dimova & Sen 2010; Ellis 2000b).

4.2. Econometric Model

If C_{it} is per capita consumption for household i at time t, we define C_{it} as a function of income diversification index D_{it} and other explanatory variables X_{it}, which can be written as

$$C_{it} = \alpha D_{it} + \beta X_{it} + a_i + v_{it} \qquad (1)$$

where X_i represents household characteristics such as gender, age, education and main occupation of household head, household size, agricultural land, durable asset index, livestock index[3] and housing condition; a_i captures unobserved effects, v_i is a random error term; and a, β are the parameters we would like to estimate.

Income diversification index D_i is often viewed as an endogenous variable because household income diversification behaviour can be correlated with a household's ability or risk perception, which is not observed by equation (1) (Ersado 2005; Dimova & Sen 2010). If D_i is correlated with v_i, ordinary least squares (OLS) estimation of equation (1) generally generates inconsistent estimators of a and β (Wooldridge 2002). To address the problem of endogeneity, we employed the instrumental variables (IV) method. The IV approach with D_i endogenous variables requires an observable variable Z_i, not in equation (1), that satisfies two conditions: (a) Z_i must be uncorrelated with v_i; (b) Z_i must have a relationship with D_i. Wooldridge (2002) notes that the covariate between Z_i and v_i can never be checked or even tested. In practice, one must maintain this assumption by appealing to economic theory. The correlation between D_i and Z_i can be tested by estimating the simple regression as

$$D_{it} = \varphi X_{it} + \theta Z_{it} + b_i + u_{it} \qquad (2)$$

[3] Durable asset and livestock indexes are constructed using the principal component approach proposed by Filmer and Prichett (1998). The variables used to compile the durable asset index are radio, television, bicycle, motorcycle, animal-drawn cart, sewing machine, boat, plough/harrow and rice mill; those used to construct the livestock index are cows, buffalos, pigs, horses, chickens, ducks and fish.

The assumption holds only if $\theta \# 0$ at a small significance level (5 percent or 1 percent). Previous studies (e.g. Dimova & Sen 2010) use different types of village level shocks (e.g. refugee inflow, epidemic, natural disaster), rainfall variability over the past year,[4] education of household head and death of working member(s) of the household in the past year as instrumental variables for constructing the income diversification index, assuming that these variables will cause income shock and impact on income diversification but have no direct effect on current consumption. In our study, we use the interaction of two dummy variables reflecting sickness/injury/death of household member(s), and crop/other damage due to flood/drought as an instrumental variable. The best instrumental variable for D_i is the linear combination of X_i and Z_i , which is the fitted value of equation (2): $\hat{D}_i$. Once we have $\hat{D}_i$, we can plug it into equation (1):

$$C_{it} = \alpha \widehat{D_{it}} + \beta X_{it} + a_i + v_{it} \qquad (3)$$

Because we use $\hat{D}_i$ as the IV for D_i, the parameters of interest α and β of equation (3) can now be estimated by OLS.

Given our four period panel data, it is not appropriate to assume that the observations are independently distributed across time. For example, unobserved factors (such as ability) that affected a household's welfare in 2001 will also affect that household's welfare in 2011. Failing to take unobserved effects into account may lead to incorrect standard errors and inefficient estimations (Greene 2007; Wooldridge 2002). In this regard, various approaches have been introduced for estimating panel data models with unobserved effects, namely fixed-effects or random-effects modelling. In empirical work, one has to decide whether a fixed- or random-effects estimator is more efficient. This largely depends on the assumption of a_i (b_i). If a_i (b_i) is uncorrelated with the variables in X_{it} (X_i and Z_i), the random-effects model is appropriate. But if a_i (b_i) is correlated with the variables in X_{it} (X_i and Z_i), the fixed-effects model is the appropriate estimator. To verify this assumption, the Hausman specification test helps us decide whether fixed or random effects are the preferred specification for our data (Greene 2007; Wooldridge 2002).

Since per capita consumption C_{it} and income diversification index D_{it} are continuous variables, the most common OLS method is adopted. To examine the relationship between poverty headcount ratio and income diversification, we employed probit model.[5]

[4] Ersado (2005) uses only two seasonal (planting and harvesting) rainfall variables with a lag as instrumental variables.

[5] It is important to note that there is no Stata command for a conditional fixed-effects probit model, as it does not have sufficient statistics to allow fixed effects to be conditioned out of likelihood (StataCorp 2010). Instead of fixed-effects estimators, we report population-average estimators. Stata command of xtreg with fe and re option and xtprobit with re and pa option are used to examine the relationship between income diversification, per capita consumption and poverty headcount ratio.

5

EMPIRICAL FINDINGS

5.1. Descriptive Results

Rural household income is derived from many different sources. In this study, we categorise household income into three main sources: crops, livestock and off-farm. Table 1 shows that total income rose by 75 percent in 2001–04 and 52 percent in 2004–08 before dropping by 20 percent in 2008–11. This suggests that the effect of the economic and global financial crisis may have persisted for longer than one year. Crop income grew by 97 percent in 2001–04 and 79 percent in 2004–08 but declined by 10 percent in 2008–11, while livestock income and off-farm income decreased by 31 percent and 27 percent during the last period. The share of crop income in total income increased from 33 percent in 2001 to 50 percent in 2011, indicating its growing role in rural livelihoods. In contrast, the share of livestock income decreased from 23 percent in 2001 to 15 percent in 2011, while off-farm income declined from 43 percent in 2001 to 35 percent in 2011.

Table 1: Income per Capita per Year from Different Sources

	Per Capita Income at 2001 prices ('0000 riels)				Growth (%)		
	2001	2004	2008	2011	2004	2008	2011
Crop	15.59	30.67	55.01	49.66	96.73	79.36	-9.73
Livestock	11.04	14.38	22.22	15.32	30.25	54.52	-31.05
Off-farm	20.45	37.38	48.40	35.18	82.79	29.48	-27.31
Total income	47.08	82.43	125.64	100.16	75.08	52.42	-20.28
% crop	0.33	0.37	0.44	0.50			
% livestock	0.23	0.17	0.18	0.15			
% off-farm	0.43	0.45	0.39	0.35			

Source: Authors' calculation

The shares of income sources by income quintile (1 = lowest income) are presented in Table 2. The only clear picture of diversification behaviour is among households in the fifth quintile, whose share of crop income increases gradually from 30.8 percent in 2001 to 58.7 percent in 2011, and whose livestock and off-farm income declines. This suggests that the richest households were more likely to depend on crop production in 2011 than in 2001. Income diversification behaviour in other quintiles seems to be mixed.

Table 2: Shares of Household Income Source in Total Income, by Quintile (%)

Crops	1	2	3	4	5
2001	0.425	0.389	0.362	0.304	0.308
2004	0.610	0.492	0.414	0.413	0.313
2008	0.518	0.350	0.326	0.379	0.509
2011	0.523	0.409	0.346	0.411	0.587
Livestock					
2001	0.201	0.231	0.183	0.230	0.261
2004	0.176	0.183	0.213	0.197	0.155
2008	0.145	0.220	0.225	0.162	0.164
2011	0.166	0.182	0.185	0.177	0.128
Off-farm					
2001	0.375	0.380	0.455	0.465	0.431
2004	0.213	0.325	0.373	0.390	0.532
2008	0.337	0.430	0.449	0.459	0.326
2011	0.311	0.409	0.469	0.412	0.285

Source: Authors' calculation

In absolute terms, per capita income of the first quintile was one-ninth that of the fifth quintile in 2001 (Table 3); this income gap had widened to 16 times in 2011. Per capita consumption for the fifth quintile was 4.4 times that of the first quintile in 2001, and the gap between the two narrowed to 3.8 times in 2011 (Tong forthcoming). This result is not surprising on two counts: we employed per capita gross income, which is normally higher than net income; and, importantly, income is less reliable than consumption as a poverty indicator in most developing countries (Haughton & Khandker 2008). The richer households are more likely to have benefited the most from economic growth during 2001–04 and been the least affected by the global economic and financial crisis. The poorest group seems to have been hit the hardest by the crisis, as its per capita income declined by 27.6 percent between 2008 and 2011.

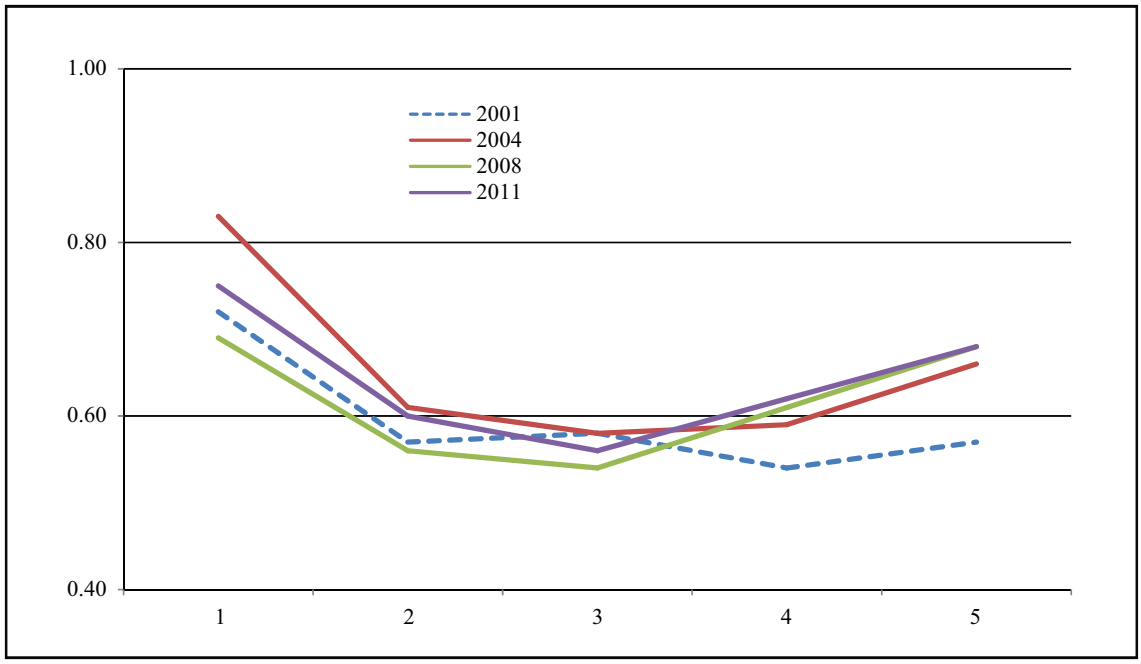
Table 3: Average Income per Capita per Year by Quintile ('0000 riels at 2001 prices)

	1	2	3	4	5
2001	11.56	26.68	38.78	55.37	103.32
2004	13.17	35.59	55.69	84.87	223.55
2008	22.51	56.84	93.67	145.07	311.06
2011	16.29	42.46	70.56	113.64	258.67
Growth rate (%)					
2004	13.92	33.39	43.60	53.27	116.36
2008	70.91	59.70	68.19	70.93	39.14
2011	-27.63	-25.29	-24.67	-21.66	-16.84

Source: Authors' calculation

To observe the pattern of income diversification, we plot the household diversification index for each year against income quintile in the initial period (Figure 1). We note that households in the first quintile tend to be less diversified than others. The literature suggests that, given insufficient assets, opportunities for diversification may be very limited at low income levels (Ersado 2005). Once a certain threshold is passed, however, diversification opportunities will be fully exploited. In line with previous studies, we observe that households in the second and third quintiles are more likely to diversify their income sources than those in the first quintile. Since households in the fourth and fifth quintiles are less diversified than those in the second and third quintiles, the relationship between income diversification and income is U-shaped, making it more difficult to conclude which hypothesis our evidence supports—diversification as accumulation or diversification as survival. Regardless of the starting point, households in the fourth and fifth quintiles become less diversified over time. The level of diversification was the lowest in 2008 for the three poorer income groups. Given this inconsistency, we attempt to control for various factors including year-specific shocks that may influence diversification behaviour on a year-to-year basis in our empirical analysis.

Figure 1: Income Diversification by Initial Income Quintiles



Source: Authors' calculation

Table 4 presents the Herfindahl index of household and geographical characteristics. It indicates that male-headed households and households whose head is mainly engaged in agriculture are likely to diversify their income sources more than female-headed households. The proportion of dependency in the family does not induce any significant differences in income diversification, although Dimova and Sen (2010) acknowledge that a higher dependent ratio drives the need to find better income sources. Household size,[6] educational level of household head and age of household head do not seem to affect income diversification either.

[6] Households with more members (including children) have more available labour for off-farm income earning activities such as collecting and selling firewood, management of livestock, daily waged labour or small trade (Block & Webb 2001).

We did not observe large differences in diversification across the study villages, but household incomes in Kompong Tnaot and Khsach Chi Ros are the most diversified.

Table 4: Income Diversification by Household and Geographical Characteristics

	2001	2004	2008	2011
HH size				
1-5	0.611	0.679	0.634	0.664
6-10	0.582	0.635	0.602	0.621
>10	0.625	0.594	0.590	0.629
HHH gender				
Female	0.641	0.716	0.650	0.676
Male	0.585	0.638	0.606	0.631
HHH age				
20-34	0.591	0.657	0.639	0.704
35-50	0.583	0.654	0.609	0.632
>50	0.620	0.655	0.620	0.643
HHH main occupation				
Non-agriculture	0.638	0.697	0.647	0.682
Agriculture	0.543	0.579	0.556	0.538
HHH education				
No school	0.579	0.661	0.618	0.650
Primary	0.588	0.642	0.609	0.629
Secondary	0.635	0.665	0.630	0.645
High school	0.642	0.722	0.668	0.694
Dependency ratio				
0	0.617	0.637	0.635	0.672
0-50%	0.594	0.653	0.614	0.630
>50%	0.594	0.663	0.612	0.651
Geographical area				
Andoung Trach	0.538	0.604	0.523	0.560
Ba Baong	0.708	0.807	0.766	0.758
Dang Kdar	0.533	0.633	0.595	0.620
Kanhchor	0.627	0.751	0.673	0.747
Khsach Chi Ros	0.517	0.563	0.513	0.525
Kompong Tnaot	0.483	0.581	0.485	0.520
Prek Kmeng	0.626	0.552	0.612	0.612
Trapeang Prei	0.549	0.668	0.680	0.681
Tuol Krasaing	0.739	0.705	0.680	0.731

Source: Authors' calculation

The descriptive statistics of dependent and explanatory variables illustrated in Table 5 indicate no significant change in household demographic variables. On average, the Herfindahl index tends to increase over time, indicating that households in the selected study villages are less diversified than they were 10 years ago. Household size shows a slight downward trend, as does the number of children aged 0-14. That household heads attained an average of only three years' education implies that a majority of household heads were unable to complete primary school. Average agricultural landholding per household increased from 1.50 hectares in 2001 to 2.19 hectares in 2008 before dropping back to 2.12 hectares in 2011, while at the same time agricultural landlessness showed a rising trend (see Tong [forthcoming] for an explanation of other explanatory variables).

Table 5: Descriptive Statistics, 2001–11

	2001	2004	2008	2011
Herfindahl index	0.60	0.66	0.62	0.64
HH size	5.81	5.81	5.76	5.57
Children aged 0-6	1.01	0.87	0.74	0.64
Children aged 7-14	1.44	1.37	1.16	0.99
Adult males aged 15-64	1.48	1.59	1.73	1.81
Adult females aged 15-64	1.65	1.72	1.83	1.80
Adults aged 64+	0.23	0.26	0.30	0.32
HHH gender (1=male)	0.81	0.78	0.77	0.76
HHH age (years)	43.84	46.70	47.82	51.36
HHH marital (1=married)	0.84	0.81	0.79	0.78
HHH education (years)	3.35	3.22	3.43	3.29
HHH occupation (1=agriculture)	0.42	0.36	0.33	0.28
Durable index	0.06	0.46	0.78	0.86
Agricultural land (ha)	1.50	1.58	2.19	2.13
House dummy (1=thatch house)	0.53	0.39	0.23	0.16
House dummy (1=wooden house)	0.47	0.60	0.76	0.84
House dummy (1=concrete house)	0.01	0.01	0.01	0.01
Shock dummy (1=health & crop shock)	0.33	0.09	0.04	0.02

Note: Sampling weight is applied.
Source: Authors' calculation

5.2. Econometric Results

The results of the fixed- and random-effects models (equation 2) for household income diversification strategies are presented in Table 6. Because the Hausman test suggests that fixed effects might be superior (Prob>chi2 is smaller than 0.05) to random effects, our interpretation is primarily based on the fixed-effects model. We find that the number of adult males increases the likelihood of household income diversification. Households whose head is mainly engaged in agriculture are more likely to participate in diversification. Wealth status, which is proxied by the durable asset index and agricultural land endowment, is positively associated with greater diversification. Households experiencing health problems or crop failure are positively linked to diversification strategies. In line with our descriptive analysis, households in rural Cambodia are now less likely to diversify their income sources than they were 10 years ago.

Table 6: Determinants of Income Diversification

	Random effects	Fixed effects
Children aged 0-6	-0.003	0.000
Children aged 7-14	-0.005	0.001
Adult males aged 15-64	-0.010***	-0.009*
Adult females aged 15-64	-0.005	0.000
Adults aged 64+	0.011	-0.011
HHH sex (1=male)	-0.021	0.009
HHH age (years)	-0.001	0.000
HHH marital status (1=married)	0.006	-0.024
HHH education (years)	0.003***	0.000
HHH occupation (1=agriculture)	-0.091***	-0.047***
Durable index	-0.002	-0.009**
Land dummy (1=<1ha)	-0.100***	-0.053***
Land dummy (1=1-2 ha)	-0.088***	-0.065***
Land dummy (1=2-3 ha)	-0.061***	-0.061***
Land dummy (1=3-4 ha)	-0.061***	-0.050**
Land dummy (1=>4 ha)	-0.071***	-0.042*
House dummy (1=wooden house)	0.007	-0.011
Shock dummy (1=health & crop shock)	-0.016	-0.026**
Credit dummy (1=access to MFI)	-0.011	-0.006
Year dummy (1=2004)	0.049***	0.055***
Year dummy (1=2008)	0.003	0.019*
Year dummy (1=2011)	0.024**	0.043***
Constant	0.771***	0.698***

Note: * significant at 10%, ** significant at 5%, *** significant at 1%.

Although some findings are consistent with expectations, a number of unexpected results also emerged. For instance, human capital measured by household head education is found to have no significant role in the diversification decision, which, though contrary to findings by Glewwe and Hall (1998) and Barrett *et al.* (2001a), is in line with Block and Webb's (2001). This may reflect the possibility that the low educational attainment of household heads is a constraint on the capacity to diversify income sources. The market barrier of poor access to microfinance is also found to have no significant influence on diversification. Other household characteristics such as the number of dependants, the number of adult females and household head gender, marital status and age are also found to be insignificant.

Table 7: Impact of Household Income on Diversification

	Random effects	Fixed effects	Random effects	Fixed effects
HH income (log)	-0.026***	-0.023***	-0.024***	-0.024***
Children aged 0-6			-0.005	-0.002
Children aged 7-14			-0.005	0.000
Adult males age 15-64			-0.011***	-0.011**
Adult females age 15-64			-0.008**	-0.004
Adults age 64+			0.008	-0.012
HHH sex (1=male)			-0.024	0.005
HHH age (years)			0.000	0.000
HHH marital status (1=married)			0.009	-0.027
HHH education (years)			0.004***	0.000
HHH occupation (1=agriculture)			-0.074***	-0.035***
Durable index			0.000	-0.007*
Land dummy (1=<1ha)			-0.079***	-0.038**
Land dummy (1=1-2 ha)			-0.063***	-0.047***
Land dummy (1=2-3 ha)			-0.032**	-0.043**
Land dummy (1=3-4 ha)			-0.029	-0.028
Land dummy (1=>4 ha)			-0.031*	-0.013
House dummy (1=wooden house)			0.011	-0.011
Shock dummy (1=health & crop shock)			-0.018	-0.030**
Credit dummy (1=access to MFI)			-0.013	-0.008
Year dummy (1=2004)			0.054***	0.060***
Year dummy (1=2008)			0.023**	0.040***
Year dummy (1=2011)			0.035***	0.053***
Constant	0.969***	0.935***	1.058***	1.006***

Note: * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 7 presents our estimates of equation (2), where the key independent variable, household income, is included. The coefficient of household income is negative and statistically significant at 1 percent level across the different specifications. In other words, higher income is associated with lower Herfindahl index values i.e. a higher degree of income diversification (see section 4.1). This finding seems to support the hypothesis that income diversification in rural Cambodia is used as a means of accumulation and not as a means of survival. Other explanatory variables are generally consistent with our previous estimates (see also Table 6).

To examine the effect of income diversification on welfare and poverty, we estimate equation (1) using the econometric methods explained in section 4.2. The results are presented in Table 8. Holding other factors constant, the coefficient of the Herfindahl index is negative and statistically significant at 1 percent regardless of the estimation methods i.e. random or fixed effects (columns 2 and 3). This strongly suggests that income diversification has a significant positive impact on per capita consumption. Education seems to play an important role in improving per capita consumption as well, but only if an individual attains at least eight years of schooling. Agricultural land has negative but increasing effects on per capita consumption since the linear term has negative and the quadratic term has positive and significant coefficients. Households whose head is mainly engaged in agriculture tend to have lower per capita consumption than those whose head is employed in non-agricultural activities. Other factors which negatively affect per capita consumption are the presence of persons any age except children 7-14. .

Columns (4) and (5) in Table 8 show that the Herfindahl index is positively associated with the poverty headcount ratio—its coefficient is statistically significant at the 1 percent level. This confirms that income diversification has a poverty reduction effect. In addition, our results reveal that only children aged 7-14 is unlikely to increase the likelihood of a household being poor. Households with a married head, with a head involved in agricultural activities or which depend on collecting firewood for cooking fuel are more likely to be poor.

To gain deeper insight into the extent to which income diversification helped rural people cope with the economic and financial crisis, we re-estimate equation (1) by reducing the four-period panel data to cross-sectional data in 2011. Our result illustrates that the coefficient of the Herfindahl index remains negative for the per capita consumption equation (Table 9, column 2) and positive for the poverty headcount ratio equation (Table 9, column 3), but is not statistically significant at the 10 percent level. This simply implies that income diversification is unlikely to play a role as an effective ex-ante risk coping strategy during an external shock such as the global economic and financial crisis.

Table 8: Impact of Income Diversification on per Capita Consumption and Poverty Headcount, 2001–11

	Consumption per capita (log)		Poverty headcount ratio	
	Random effects	Fixed effects	Random effects	Population Average
Herfindahl index	-0.012***	-0.025**	0.088***	0.079***
Lag consumption (log)	0.319***	-0.197***	-0.724***	-0.660***
Children aged 0-6	-0.053***	-0.037***	0.111***	0.102***
Children aged 7-14	0.001	-0.007	-0.005	-0.005
Adult males age 15-64	-0.039***	-0.073***	0.143***	0.129***
Adult females age 15-64	-0.026***	-0.028**	0.081**	0.073**
Adults age 64+	-0.084***	-0.097***	0.288***	0.263***
HHH sex (1=male)	0.117***	0.170***	-0.486***	-0.447***
HHH age (years)	-0.001	0.001	-0.000	-0.000
HHH marital status (1=married)	-0.070***	-0.087***	0.520***	0.477***
HHH education (years)	-0.006**	-0.033***	0.040	0.037
HHH education squared (years)	0.001	0.002**	-0.007**	-0.006**
HHH occupation (1=agriculture)	-0.019	-0.138**	0.340***	0.308***
Durable index	0.014	0.013	-0.019	-0.018
Livestock index	-0.017**	-0.011	0.099***	0.089***
Agricultural land (log)	-0.035**	-0.054***	0.168***	0.152***
Agricultural land squared (log)	0.025**	0.038**	-0.113***	-0.101***
Toilet dummy (1=yes)	0.104***	0.033	-0.404***	-0.371***
House dummy (1=wooden house)	0.120***	0.067	-0.292**	-0.269**
Fuel (1=self-collected firewood)	-0.178***	-0.024	0.521***	0.478***
Year dummy (1=2008)	0.224***	0.211***	-0.035	-0.033
Year dummy (1=2011)	-0.130***	0.058**	0.466***	0.422***
Constant	6.222***	10.965***	-1.974	-1.783

Note: * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 9: Impact of Income Diversification on Per Capita Consumption and Poverty Headcount, 2011

	Per capita consumption (log)	Poverty headcount ratio
Herfindahl index	-0.011	0.042
Lag consumption (log)	0.275***	-0.892***
Children aged 0-6	-0.015	0.110
Children aged 7-14	-0.006	0.046
Adult males aged 15-64	-0.080***	0.189**
Adult females aged 15-64	-0.019	0.042
Adults aged 64+	-0.129***	0.371***
HHH sex (1=male)	0.118*	-0.518**
HHH age (years)	-0.000	-0.002
HHH marital status (1=married)	-0.020	0.401
HHH education (years)	-0.005	-0.050
HHH education squared (years)	0.000	0.006
HHH occupation (1=agriculture)	-0.077	0.203
Durable index	0.015	-0.067
Livestock index	0.018	-0.064
Agricultural land (log)	-0.075***	0.171*
Agricultural land squared (log)	0.069***	-0.145*
Toilet dummy (1=yes)	0.105***	-0.296*
House dummy (1=wooden house)	0.077*	-0.325*
Fuel (1=self-collected firewood)	-0.191***	0.571**
Constant	6.652***	2.196

Note: * significant at 10%, ** significant at 5%, *** significant at 1%. HHH: Household Head. Village dummies are also included.

6

CONCLUSION

Crop income was the least affected by the global economic and financial crisis and has become the main income source for rural households. Using both fixed- and random-effects models, we find that the number of male household members aged 15-64, household head primarily engaged in agriculture, durable assets, agricultural land endowment, health shock and crop failure are the key determinants of income diversification in rural Cambodia, where household diversification behaviour is mainly motivated by accumulation rather than by survival. This suggests that richer households are better able to seize the advantages provided by a diversified income portfolio than are poorer households. It also implies that accumulation-led diversification has less impact on poverty, at least in the short run, than survival-led activity. Therefore policies that reduce constraints on diversification, such as risk-reduction strategies, microcredit provision, rural services, rural non-farm enterprise development and infrastructure and education improvements are in general desirable.

Using the interaction of health shock and crop failure as an instrumental variable, we confirm that income diversification is strongly and positively associated with per capita consumption but is unlikely to help smooth consumption during a crisis. This holds true if we use the poverty headcount ratio as the measure of household welfare. These findings have strengthened the need for the public provision of well-designed safety nets as a risk-reducing and coping strategy. Our result also encourages the promotion of non-farm activities given that income diversification has played a critical role in improving household per capita consumption and poverty headcount ratio. Hence, development of non-farm activities should complement the effort to develop agriculture.

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