ADBI Working Paper Series

INCOME AND CONSUMPTION INEQUALITY IN THE PHILIPPINES: A STOCHASTIC DOMINANCE ANALYSIS OF HOUSEHOLD UNIT RECORDS

Maria Rebecca Valenzuela,
Wing-Keung Wong, and
Zhu Zhen Zhen

No. 662
February 2017

Asian Development Bank Institute

Maria Rebecca Valenzuela is senior lecturer, Department of Economics, Monash University. Wing-Keung Wong is professor, Department of Finance, Asia University. Zhu Zhen Zhen is research fellow, Department of Economics, Lingnan University.

Suggested citation:

Valenzuela, M., W. Wong, and Z. Zhen. 2017. Income and Consumption Inequality in the Philippines: A Stochastic Dominance Analysis of Household Unit Records. ADBI Working Paper 662. Tokyo: Asian Development Bank Institute. Available: https://www.adb.org/publications/income-consumption-inequality-philippines

Please contact the authors for information about this paper.

Email: rebecca.valenzuela@monash.edu

Asian Development Bank Institute
Kasumigaseki Building, 8th Floor
3-2-5 Kasumigaseki, Chiyoda-ku
Tokyo 100-6008, Japan

Tel: +81-3-3593-5500
Fax: +81-3-3593-5571
URL: www.adbi.org
E-mail: info@adbi.org

Abstract

In this paper, we employ stochastic dominance (SD) analysis on household unit records to measure relative welfare levels and investigate sources of inequality in the Philippines from 2000 to 2012. Using SD techniques developed in Chow, Valenzuela, and Wong (2016), we test for richness and poorness in the population across various social, economic, and demographic dimensions. Our SD composition approach and application of tests showed higher and improved relative welfare levels exist for urban, non-agricultural households, and that compared with wages and business income, other sources of income have grown in importance in narrowing welfare gaps over time. We also found that gender of household head and education attainments matter for welfare outcomes. In terms of age, we found high concentrations of poor income units among the youngest cohort (aged 30 and under), and high concentrations of richer income units in the older, over-60 cohort. These results help explain persistently high levels of income inequality observed in the Philippine economy.

JEL Classification: I32, J11, J14

Contents

1. INTRODUCTION

Economic inequality in the Philippines has been the subject of numerous previous studies. Income inequality is generally high in the country, with Gini coefficient estimates averaging 0.45 in the last 15 years alone. The literature indicates fluctuations in the country's overall rates over the long term. While estimates were all found to be consistently high, income inequality rates appear to have declined during the slow-growth period between 1975 and 1986, increased between 1988 and 1995, decreased again between 1996 and 2000, and finally increasing again during the high-growth period between 2000 and 2009 (Dacuycuy 2006; Akita and Pagulayan 2014). A significant number of studies attribute this to substantial disparity of incomes among the country's various provinces and regions. (See, for example, Tay 2014; Mehta et al. 2013; Kurita and Kurosaki 2011; Mapa et al. 2009). A recent study by Martinez et al. (2014) examined the role of income mobility in explaining the country's high inequality rates and finds that income mobility is a factor that contributes significantly to slow income growth but not to income inequality. To date, a full understanding of why high inequality has persisted in the Philippines remains to be seen.

Much has been learned from these and earlier attempts to analyze inequality in the Philippines. That said, the existing literature can provide only limited insights into a long-run trend for at least three reasons: (i) all studies use province-level data to measure and assess inequality; (ii) all studies use income data to analyze inequality—none have used expenditure; and (iii) all of these studies use singular inequality indexes. On (i) above, it is clear that these studies focused on identifying determinants of inequality from a macroeconomic perspective. Given the wide interest in the issue, it is curious that none, to date, have used widely available household level data to provide a complementary, microeconomic perspective to the issue. On the second point (ii), there is consensus in the literature that consumption behavior, captured in expenditure data, more accurately reflects the welfare levels of individuals or households than does income. Income, however, is more commonly used in inequality studies, simply because income data continues to be more accessible than expenditure data. In the Philippines, though, expenditure data has recently become more available and repeated waves of expenditure survey data can now be accessed from as early as the mid-1970s. On the third point (iii), suffice it to say that singular or scalar measures of inequality, such as the Gini or Atkinson indexes, are known to suffer from a lack of universal acceptance of the value judgments of the underlying welfare functions, and from which contradicting conclusions can arise. Further, the singular index analysis that dominates the inequality literature for the Philippines emphasizes welfare inequality differences between provinces or regions, and as such fails to consider the whole distributions of outcomes.

In this paper, we revisit the issue of economic inequality in the Philippines and examine long-term trends in the distribution of both income and expenditure in the recent past. The aim is to provide the literature with a unified and consistent view of long-term welfare in the country through a systematic analysis of Philippine cross-sectional inequality using both unit-record income and expenditure data from five rounds of the Philippines' Family Income and Expenditure Survey (FIES) covering the period 2000 to 2012. Further, we use stochastic dominance (SD) analysis techniques to provide a more accurate measure of levels of inequality at each time point in the last 12 years. Our full distribution approach will have greater capacity, compared with singular indexes, for analyzing potentially important distinctions between different parts of the

distribution. The decomposition method within the stochastic dominance approach will provide a novel way to identify sources of change in inequality levels over time.

One major contribution of this paper pertains to the use of tests for richness and poorness developed in Chow, Valenzuela, and Wong (2016) to measure changes in relative inequality for the entire population over the 12 years that we cover. We also divide population units along several dimensions and use SD tests to analyze significant changes in relative welfare within and between the subgroups. We investigate the long-term trends in income and consumption inequality in the Philippines in light of the fact that the country has strengthened economically from 2000 onward on the back of strong economic fundamentals and a globally competitive workforce. Within this 12-year growth period, we test the distributional impacts of changing family structures, changing preferences for children and such other social preferences, and changing government tax and transfer policies. We believe this is the only study to use household unit records to analyze inequality in the Philippines; it is the only one that provides a consistent framework for inequality analysis for this economy over a long period of time. As such, it brings Philippine inequality estimates and analysis up to date.

2. CONCEPTUAL FRAMEWORK: THE STOCHASTIC DOMINANCE APPROACH

An important contribution of this paper is the use of stochastic dominance analysis. The term stochastic dominance (SD for short) is generally used in decision theory to refer to situations where one outcome (or a probability distribution over outcomes) can be ranked as superior to another. In the area of distributional analysis, the SD approach is useful when alternative inequality indexes fail to provide unambiguous rankings of the same distributions, a situation which is not so uncommon given the varying weights that different indexes attach to different parts of a distribution. SD analysis is often preferred over the scalar index approach for at least two reasons. First, SD tests can rank welfare situations over very wide classes of welfare functions and so are "ethically robust," much unlike scalar measures, which are known to suffer from a lack of universal acceptance of the value judgments of the underlying welfare functions and from which contradicting conclusions can arise. Second, SD analysis considers the whole distributions of outcomes and is therefore better able to reveal crucial details and potentially important distinctions between different parts of the distribution. As such, SD results have proved themselves to be more useful in the wider policy sense.

We begin with a definition of the implicit welfare function that underpins all foregoing analysis. Let F be a distribution function and u represent the corresponding utility or social welfare of individuals (or households); u is increasing in its argument x. We then define a social welfare function (SWF) of the form

$$W(F) = \int u(x)dF(x) \quad (1)$$

where $u: \mathbb{R}_+ \to \mathbb{R}$ is a continuous function. W(F) represents the collective welfare of all members of society, or the overall social state. We assume W(F) in (1) to be symmetric and increasing in all its arguments so that various ethical criteria of desirable, well-behaved SWFs can be used. Different SWFs of the form in (1) give the same order of ranking as that of stochastic dominance analysis if one distribution is found to stochastically dominate the other in the first-order. If we impose an additional restriction that the second derivative of $u''(x)$ is negative, then all SWFs in this restricted class

likewise give a unanimous ranking of two distributions if one dominates the other at the second order.[1]

2.1 Definitions of ASD and Its Interpretation

To implement the stochastic dominance approach, we consider welfare outcomes X and Y defined over the real number space $\Omega = [a, b]$; that is, $X, Y \in \Omega = [a, b]$ with probability distribution functions F and G, respectively, where a is strictly non-negative.[2] To facilitate exposition, we let X and Y be income series.[3] For any x, we define the k-order cumulative distribution functions F_k^A and G_k^A of X and Y to be:

$$F_j^A(x) = \int_a^x F_{j-1}^A(t)\, dt \text{ and } G_j^A(x) = \int_a^x G_{j-1}^A(t)\, dt, \text{ for } j = 2, 3\,; \tag{2}$$

Also, we define $F_1^A(x) = \int_a^x f\,(t)dt$ and $G_1^A(x) = \int_a^x g\,(t)dt$ where f and g denote the probability density functions of X and Y. We now define ascending stochastic dominance (ASD).

Definition 1: *X* is said to first (second)-order dominate *Y* by ASD, denoted by $X \succ_1^A Y$ or $\mathrm{F} \succ_1^{\mathrm{A}} \mathrm{G}$ ($X \succ_2^A Y$ or $F \succ_2^A G$) if and only if $F_1^A(x) \leq G_1^A(x)$ $\left(F_2^A(x) \leq G_2^A(x)\right)$ for all x with strict inequality for at least one interval of x. Also, *X* is said to third-order dominate *Y* by ASD, denoted by $X \succ_3^A Y$ or $\mathrm{F} \succ_3^{\mathrm{A}} \mathrm{G}$, if and only if $F_3^A(x) \leq G_3^A(x)$ for all x, with a strong inequality for at least one x_0 and for at least one interval of x and $\mu_X \geq \mu_Y$, where μ_X and μ_Y denote the means of *X* and *Y*, respectively.

We denote findings of first-, second-, and third-order ascending stochastic dominance by FASD, SASD, and TASD, respectively. The j-order ASD can be defined similarly for any $j > 3$. In empirical studies comparing income distributions, if all individuals with incomes equal to or below a specified value of *x* are considered poor, then findings of FASD of *X* over *Y* ($X \succ_1^A Y$) means that distribution *F* will always have a lesser or equal proportion of poor income units compared with distribution *G* for any value of *x*. More simply, we say that FASD of X over Y implies that the proportion of poor units in X is less than the proportion of poor units in Y. On the other hand, SASD of *X* over *Y* ($X \succ_2^A Y$) means that the integral of the cumulative probability of *X* is less than that of *Y*. But unlike a FASD finding, a SASD finding does not necessarily imply that the income distribution of the units in X has a lesser proportion of poor units compared with that in Y for any income level *x*. Rather, it implies that income distribution *X* has a lesser proportion of poor units compared with that in Y *for some relatively low income levels.* For this reason, we will refer to the test that can detect ASD relations as the "test for poorness."

ASD findings are highly relevant to social welfare analysis. Foster and Shorrocks (1988) show that for the class of all monotonic, symmetric, additively separable social welfare functions of the form in (1), the following statement holds:

$$F \succ_j^A G \text{ if and only if } W(F) \geq W(G) \text{ for all } u \in \mathcal{U}_j^A \text{ for } j = 1, 2, \text{ and } 3. \tag{3}$$

---

[1] See Foster and Shorrocks (1988) for detail.

[2] We note that this is a strict condition that can be relaxed empirically to accommodate the kinds of welfare outcomes under study. For instance, "a" is strictly positive for income but could be negative for wealth.

[3] In general, X and Y may refer to any chosen welfare outcome or indicator such as expenditures, wealth, well-being, etc. in continuously measurable units.

Here, $\mathcal{U}_1^A \subset \mathcal{U}$ is defined for all $u'(x) > 0$, $\mathcal{U}_2^A \subset \mathcal{U}_1^A$ is defined by for all $u''(x) < 0$, and $\mathcal{U}_3^A \subset \mathcal{U}_2^A$ is defined for all $u'''(x) > 0$. These effectively imply that condition (3) holds only for concave social welfare functions. The use of this result to inequality analysis was pioneered by Atkinson (1970) who showed, among other things, that second-order stochastic dominance is equivalent to Lorenz dominance if the means of the compared income series are the same.

2.2 Definitions of DSD and Its Interpretations

We now set the notation for introducing the concept of descending stochastic dominance (DSD) for income distributions. Let F_j^D and G_j^D be the j^{th}-order reverse cumulative distribution functions for observed outcomes *X* and Y. For any argument *x*, they are defined as follows:

$$F_j^D(x) = \int_x^b F_{j-1}^D(t)dt \text{ and } G_j^D(x) = \int_x^b G_{j-1}^D(t)dt \text{ for } j = 2, 3 \text{ ;} \quad (4)$$

$F_1^D(x) = \int_x^b f(t)dt$ and $G_1^D(x) = \int_x^b g(t)dt$ where f and g denote the probability density functions of *X* and Y, respectively.

Definition 2: *X* is said to first (second)-order dominate *Y* by DSD, denoted by $X \succ_1^D Y$ or $F \succ_1^D G$ ($X \succ_2^D Y$ or $\succ_2^D G$), if and only if $F_1^D(x) \geq G_1^D(x)$ ($F_2^D(x) \geq G_2^D(x)$), for all x with strict inequality for at least one interval of x. Also, *X* is said to third-order dominate *Y* by DSD, denoted by $X \succ_3^D Y$ or $F \succ_3^D G$, if and only if $F_3^D(x) \geq G_3^D(x)$ for all x with a strict inequality for at least one interval of x, and $\mu_X \geq \mu_Y$ where μ_X and μ_Y denote the mean of *X* and *Y*, respectively.

We denote findings of first-, second-, and third-order descending stochastic dominance by FDSD, SDSD, and TDSD, respectively. The j-order ASD can be defined similarly for any $j > 3$. If we consider all individuals with incomes equal to or above a specified value of *x* to be rich, then, findings of FDSD of *X* over *Y* ($X \succ_1^D Y$) imply that the reverse cumulative distribution of *X*, F_j^D, will always have a higher proportion of rich individuals than that of the reverse cumulative distribution of *Y*, G_j^D, for any income level *x*. On the other hand, findings of SDSD of *X* over *Y* ($X \succ_2^D Y$) means that the integral of the reverse cumulative probability of *X* always lies above that of *Y*. However, the income distribution of the units in X does not necessarily have a higher proportion of rich units compared with that in Y for any income level. Instead SDSD means that the former has a higher proportion of rich units than that in Y *for some relatively higher income levels*. To be more specific, for income levels x_A and x_B where $x_A < x_B$, $X \succ_2^D Y$ means that distribution *F* will always have a higher proportion of rich income units than distribution *G* for any *x* that is ≥ x_B, at the same time that *F* could also have a smaller proportion of rich income units compared with *G* for values of *x* in the range [x_A, x_B]. Because of these, we will refer to the test that can detect DSD relations as the "test for richness."

In similar fashion to ASD results, DSD-based findings carry important implications for social welfare analysis. Let W denote the class of all monotonic, symmetric, additively separable social welfare functions of the form first specified in equation (1), that is, $W(F) = \int u(x)dF(x)$, where $u: \mathbb{R}_+ \to \mathbb{R}$ is a continuous function. Further, for DSD analysis, we let $\mathcal{U}_1^D \subset \mathcal{U}$ be defined for all $u'(x) > 0$; we let $\mathcal{U}_2^D \subset \mathcal{U}_1^D$ be defined for all $u''(x) > 0$, and we let $\mathcal{U}_3^D \subset \mathcal{U}_2^D$ be defined by $u'''(x) > 0$. Under these settings, we can obtain the following result for income distribution analysis:

$$F \succ_j^D G \text{ if and only if } W(F) \geq W(G), \text{ or all } W \in \mathcal{U}_j^D \text{ for all } j = 1, 2, \text{ and } 3. \quad (5)$$

Equation (5) shows that DSD implies welfare dominance, and to show this in greater detail we follow the approach of Wong and Li (1999) and Levy (2015) for convex stochastic dominance theory. These studies show that the FDSD under a convex social welfare function is equivalent to FASD under a concave social welfare function; we show that $\int_x^b [G(t) - F(t)]\, dt \geq 0 \Longrightarrow W(F) \geq W(G)$ for second- and third-order cases only.

To this end, we use the definition of the social welfare function in (1) as follows:

$$\begin{aligned} W(F) - W(G) &= \int_a^b u(x) dF(x) - \int_a^b u(x) dG(x) \\ &= \int_a^b u(x)\,[f(x) - g(x)] dx \end{aligned} \tag{6}$$

Integrating (6) by parts, we get:

$$W(F) - W(G) = u'^{(b)} \textstyle\int_a^b [G(t) - F(t)] dt - \displaystyle\int_a^b u''(x) \left(\int_a^x [G(t) - F(t)] dt \right) dx. \tag{7}$$

The second term in (7) can be rewritten as:

$$\begin{aligned} &- \int_a^b u'(x) \quad \left(\int_a^x [G(t) - F(t)] dt \right) dx = - \int_a^b u''(x) \left(\int_a^b [G(t) - F(t)] dt \right) dx \\ &+ \int_a^b u''(x) \left(\int_x^b [G(t) - F(t)] dt \right) dx. \end{aligned} \tag{8}$$

Then, we have:

$$W(F) - W(G) = u'(a) \int_a^b [G(t) - F(t)]\, dt + \int_a^b u''(x) \left(\int_x^b [G(t) - F(t)] dt \right) dx. \tag{9}$$

Given that $W \in \mathcal{U}_2^D$, it follows that F dominates G by SDSD. Equivalently, we say that $\int_x^b [G(t) - F(t)] dt \geq 0$ implies that the social welfare level in distribution F is preferred to the social welfare level in distribution G, that is, $W(F) \geq W(G)$.

For the third-order case, we have:

$$W(F) - W(G) = u'(a) \textstyle\int_a^b [G(t) - F(t)]\, dt + \displaystyle\int_a^b u''(x) \left(\int_x^b [G(t) - F(t) dt] \right) dx. \tag{10}$$

Integrating the second right-hand side term in (10) by parts yields:

$$\int_a^b u''(x)\left(\int_x^b [G(t)-F(t)dt]\right)dx = u''(x)\left(\int_a^x \int_t^b [G(z)-F(z)]\,dzdt\right)\Bigg|_a^b - \int_a^b u'''(x)\left(\int_a^x \int_t^b [G(z)-F(z)]\,dzdt\right)dx. \tag{11}$$

and rewriting, we have:

$$u''(x)\left\{\left(\int_a^b \int_t^b [G(z)-F(z)]\,dzdt\right)-\left(\int_x^b \int_t^b [G(z)-F(z)]\,dzdt\right)\right\}\Bigg|_a^b - \int_a^b u'''(x)\left\{\left(\int_a^b \int_t^b [G(z)-F(z)]\,dzdt\right)-\left(\int_x^b \int_t^b [G(z)-F(z)]\,dzdt\right)\right\}dx. \tag{12}$$

Using (12) to rewrite (10), we get the following result:

$$W(F)-W(G) = u'^{(a)}\int_a^b [G(t)-F(t)]dt + u''(a)\left(\int_a^b \int_t^b [G(z)-F(z)]\,dzdt\right) + \int_a^b u'''(x)\left(\int_x^b \int_t^b [G(z)-F(z)]\,dzdt\right)dx. \tag{13}$$

From (13), we can see that for F to dominate G by TDSD, we require both $\mu_x - \mu_Y \geq 0$ and $\int_x^b \int_t^b [G(z)-F(z)]\,dzdt \geq 0$ for all $x \in [a,b]$, which implies $W(F)-W(G) \geq 0$ for any $W \in \mathcal{U}_3^D$.

The preceding section implies that conclusions of DSD, e.g., *F* over *G,* could be applied to social welfare functions that are increasing and convex. Furthermore, if the social welfare function is convex, it implies that the DSD approach is the more appropriate approach to use. In practice, the true form of the social welfare function is unknown, which leaves the choice between ASD and DSD approaches indeterminate. We recommend using the ASD and DSD approaches simultaneously, and advise caution in the interpretation of results.

3. TESTS FOR RICHNESS AND POORNESS

To make meaningful comparisons of the rankings implied by stochastic dominance, it is necessary to perform significance tests on the results. In the economic literature, tests of stochastic dominance are of two types—those that make inferences based on the comparison of the object *x* (e.g., income or wealth) at all points in the support (e.g., Barrett and Donald 2003; Linton, Maasoumi, and Whang 2005), and those that make inferences based on the comparison of objects at arbitrarily chosen fixed values along the ordered distribution (e.g., Anderson 2004; Davidson and Duclos 2000; Bai et al. 2015). The former are variants of the Kolmogorov-Smirnov tests and are highly desirable because of their consistency property (Barrett and Donald 2003), but they are

also noted for difficulty in constructing appropriate rejection regions (McFadden 1989). The latter type, on the other hand, are strongly preferred in practice because of their flexibility in the number of comparison points required, although they also have a greater tendency to introduce test inconsistency (Davidson and Duclos 2000). In light of this, studies such as Wei and Zhang (2003), Tse and Zhang (2004), and more recently, Bai et al. (2015) have focused on introducing methodology that can help select critical points and provide consistency for these types of SD tests. Lean, Wong, and Zhang (2008) also show that these types of SD tests are robust to non-*i.i.d*. data, including heteroscedastic data, and are convenient for comparing any parts of distributions under study.

The ASD and DSD tests we used here are based on a generalized Kolmogorov-Smirnov test which are derived and illustrated in Chow et al. (2016).[4] We follow their lead and also use bootstrap resampling techniques to operationalize our SD tests.

We set the notation as follows: Assume $\{f_i\}(i = 1,2,\cdots N_f)$ and $\{g_i\}\big(i = 1,2,\cdots N_g\big)$ are observations drawn from the income distributions X and Y, with distribution functions *F* and *G*, respectively. Their associated integrals, $F_j^A(x)$ and $G_j^A(x)$, and reverse integrals, $F_j^D(x)$ and $G_j^D(x)$, are defined in (2) and (4), respectively, for $j = 1, 2, 3$. We set a grid of preselected points on our distribution $x_1, x_2, \ldots, x_k$ for the test.

3.1 Test for Poorness

To test for poorness, we apply ASD principle to test the following set of null hypotheses[5] for a pre-designed set of finite values of *x*:

$$H_0: F_j^A(x_i) = G_j^A(x_i) \text{ for all } x_i;$$
$$H_A: F_j^A(x_i) \neq G_j^A(x_i) \text{ for some } x_i;$$
$$H_{A1}: F_j^A(x_i) \leq G_j^A(x_i) \text{ for all } x_i, F_j^A(x_i) < G_j^A(x_i) \text{for some } x_i;$$
$$H_{A2}: F_j^A(x_i) \geq G_j^A(x_i) \text{ for all } x_i, F_j^A(x_i) > G_j^A(x_i) \text{for some } x_i;$$

for all $i = 1, 2, \ldots, k$ and *j* = 1, 2, and 3. We note that in the above hypotheses, H_A is set to be exclusive of both H_{A1} and H_{A2}. This means that if the test does not reject H_{A1} or H_{A2}, it will not be classified as H_A. The *j*th-order ASD test statistic is:

$$T_j^A(x) = \frac{\hat{F}_j^A(x) - \hat{G}_j^A(x)}{\sqrt{\hat{V}_j^A(x)}} \tag{14}$$

where $\hat{V}_j^A(x) = \hat{V}_{F_j}^A(x) + \hat{V}_{G_j}^A(x) - 2\hat{V}_{FG_j}^A(x)$;

$$\hat{V}_{H_j}^A(x) = \frac{1}{N_h}\left[\frac{1}{N_h((j-1)!)^2}\sum_{i=1}^{N_h}(x - h_i)_+^{2(j-1)} - \hat{H}_j^A(x)^2\right], H = F, G;\ h = f, g;$$

$$\hat{V}_{FG_j}^A(x) = \frac{1}{N_h}\left[\frac{1}{N_h((j-1)!)^2}\sum_{i=1}^{N_h}(x - f_i)_+^{j-1}(x - g_i)_+^{j-1} - \hat{F}_j^A(x)\hat{G}_j^A(x)\right]$$

[4] Chow, Valenzuela, and Wong (2016) use tests that build on the tests used in Linton, Maasoumi, and Whang (2005), Barrett and Donald (2003), and Maasoumi and Heshmati (2000).

[5] Following Bishop, Formby, and Thistle (1992).

and $\widehat{H}_j^A(x) = \frac{1}{N_h(j-1)!}\sum_{i=1}^{N_h}(x-h_i)_+^{j-1}$.

Following Bai et al. (2015), we apply the following decision rules:

$$\max_{1\le k\le K}\left|T_j^A(x_k)\right| < M_\alpha^j, \text{accept } H_0: X =_j Y$$
$$\max_{1\le k\le K}T_j^A(x_k) > M_\alpha^j \text{and} \min_{1\le k\le K}T_j^A(x_k) < -M_\alpha^j, \text{accept } H_A: X \neq_j Y$$
$$\max_{1\le k\le K}T_j^A(x_k) < M_\alpha^j \text{and} \min_{1\le k\le K}T_j^A(x_k) < -M_\alpha^j, \text{accept } H_{A1}: X \succeq_j Y$$
$$\max_{1\le k\le K}T_j^A(x_k) > M_\alpha^j \text{and} \min_{1\le k\le K}T_j^A(x_k) > -M_\alpha^j, \text{accept } H_{A2}: Y \succeq_j X$$

where M_α^j is the bootstrapped critical value of the *j*th-order ASD statistic.

The test statistic is compared with M_α^j at each point of the combined sample. However, it is empirically difficult to do so when the sample size is very large. To make the computation easy, we specify *K* equal-distance grid points $\{x_k, k = 1,2,\dots,K\}$ to cover the common support of random samples $\{X_i\}$ and $\{Y_i\}$. Simulations show that the performance of the modified ASD statistic is not sensitive to the number of grid points for some reasonably large number. In practice, we follow Fong, Wong, and Lean (2005) and Gasbarro, Wong, and Zumwalt (2007) and choose *K* = 100. We note that Bai et al. (2015) improved the ASD test by deriving the limiting process of the ASD statistic $T_j^A(x)$ so that the ASD test can be performed by using $\max_{\mathrm{x}}\left|T_j^A(x)\right|$ to take care of the dependency of the partitions. In this paper, we suggest applying this ASD test by using both a limited number of grids and a $\max_{\mathrm{x}}\left|T_j^A(x)\right|$ comparison. Fong, Wong, and Lean (2005), Valenzuela, Lean, and Athanasopoulous (2014) and others used the former, while Bai et al. (2015) adopted the latter. No previous study has used both, and this is what we do in this paper. Further, we follow Bai et al. (2015) and use simulation to obtain the critical value M_α^j in our analysis.

3.2 Test for Richness

To test for richness, we apply the DSD principles on the following null hypotheses:

$$H_0: F_j^D(x_i) = G_j^D(x_i) \text{ for all } x_i;$$
$$H_D: F_j^D(x_i) \neq G_j^D(x_i) \text{ for some } x_i;$$
$$H_{D1}: F_j^D(x_i) \geq G_j^D(x_i) \text{ for all } x_i, F_j^D(x_i) > G_j^D(x_i) \text{ for some } x_i;$$
$$H_{D2}: F_j^D(x_i) \leq G_j^D(x_i) \text{ for all } x_i, F_j^D(x_i) < G_j^D(x_i) \text{ for some } x_i;$$

$i = 1,2,\dots,k$ and j = 1, 2, and 3. Not rejecting either H_0, H_A or H_D implies the nonexistence of any SD relationship between X and Y, and that neither of these distributions is preferred to the other. If $H_{A1}(H_{A2})$ of order one is accepted, $X(Y)$ stochastically dominates $Y(X)$ at first order, while if $H_{D1}(H_{D2})$ of order one is accepted, distribution $X(Y)$ stochastically dominates $Y(X)$ at first order. If H_{A1} (H_{A2}) $[H_{D1}$ $(H_{D2})]$ is accepted at order two (three), a particular distribution stochastically dominates the other at second- (third-) order.

For our test of richness, the *j*-order DSD test statistic, T_j^D is:

$$T_j^D(x) = \frac{\hat{F}_j^D(x) - \hat{G}_j^D(x)}{\sqrt{\hat{V}_j^D(x)}} \quad (15)$$

where $\hat{V}_j^D(x) = \hat{V}_{F_j}^D(x) + \hat{V}_{G_j}^D(x) - 2\hat{V}_{FG_j}^D(x)$;

$$\hat{H}_j^D(x) = \frac{1}{N_h(j-1)!}\sum_{i=1}^{N_h}(h_i - x)_+^{j-1};$$

$$\hat{V}_{H_j}^D(x) = \frac{1}{N_h}\left[\frac{1}{N_h((j-1)!)^2}\sum_{i=1}^{N_h}(h_i - x)_+^{2(j-1)} - \hat{H}_j^D(x)^2\right], H = F, G;\ h = f, g;$$

$$\hat{V}_{FG_j}^D(x) = \frac{1}{N_h}\left[\frac{1}{N_h((j-1)!)^2}\sum_{i=1}^{N_h}(f_i - x)_+^{j-1}(\mathrm{g}_i - x)_+^{j-1} - \hat{F}_j^D(x)\hat{G}_j^D(x)\right].$$

To determine DSD, we follow Bai et al. (2015) and apply the following decision rules:

$$\max_{1\le k\le K}\left|T_j^D(x_k)\right| < M_\alpha^j, \text{accept } H_0: X =_j Y$$
$$\max_{1\le k\le K}T_j^D(x_k) > M_\alpha^j \text{and} \min_{1\le k\le K}T_j^D(x_k) < -M_\alpha^j, \text{accept } H_D: X \ne_j Y$$
$$\max_{1\le k\le K}T_j^D(x_k) > M_\alpha^j \text{and} \min_{1\le k\le K}T_j^D(x_k) > -M_\alpha^j, \text{accept } H_{D1}: X \underline{\succeq}_j Y$$
$$\max_{1\le k\le K}T_j^D(x_k) < M_\alpha^j \text{and} \min_{1\le k\le K}T_j^D(x_k) < -M_\alpha^j, \text{accept } H_{D2}: Y \underline{\succeq}_j X$$

where M_α^j is the bootstrapped critical value of the *j*-order DSD statistic. The test statistic is compared with M_α^j at each point of the combined sample.[6] As in the ASD tests, we follow Fong, Lean, and Wong (2005, 2008) and Valenzuela, Lean, and Athanasopoulous (2014) and make 100 partitions in the common support for the distributions *X* and *Y*, use simulation to obtain the critical value M_α^j, and use $\max_x\left|T_j^D(x)\right|$ to test for the convex preference assumption of income units in the upper end of the income distributions.

4. COUNTRY CONTEXT AND DATA

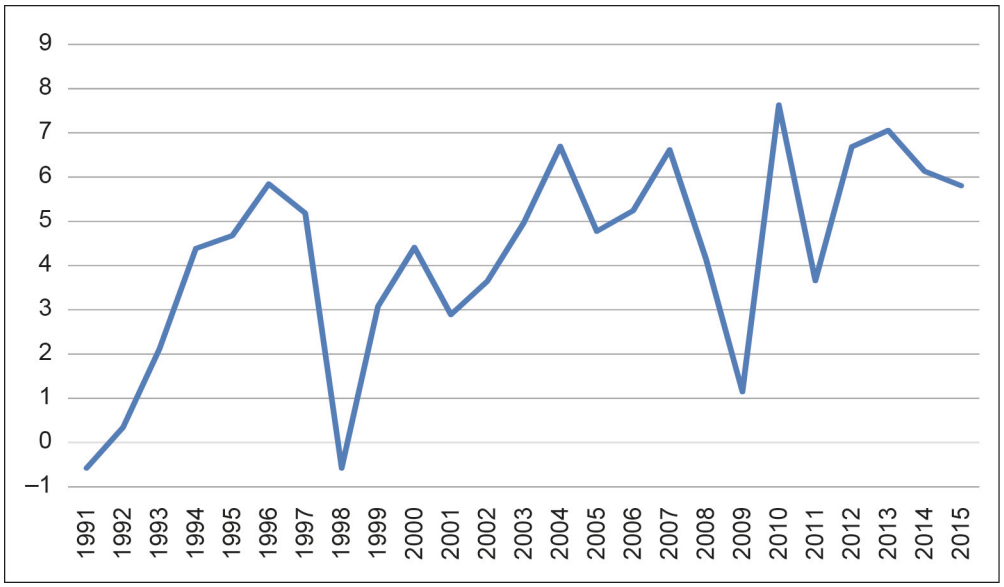
The World Bank describes the Philippines as one of the most dynamic economies in East Asia. From a slow-moving economy in the 1980s and 1990s, the Philippines strengthened its economic performance from 2001 onward on the back of sound economic fundamentals and a globally recognized competitive workforce. The Philippines is the world's largest center for business process outsourcing, it also has a strong industrial sector based on the manufacturing of electronics and other high-tech components for overseas corporations. During the 2000s, the economic growth was boosted from several channels – increased government spending, a strong inflow of foreign direct investment, and increased migrant remittances all provided strong

[6] Refer to Bai et al. (2015) for the construction of the bootstrapped critical value M_α^j.

boost to demand. At the same time, the services sector emerged as a main engine of growth on the supply side. Currently, the economy grows at around 6% and is the third-fastest-growing economy in the region, trailing only behind the People's Republic of China and Viet Nam.

Figure 1 shows Philippine GDP growth rates from 1991 until 2015. The country is shown to have a slow and quite volatile path to increasing growth over the last 25 years, with sharp declines marking domestic effects of international economic downturns—the Asian financial crisis of 1997 and the global economic crisis of 2007/2008.

Figure 1: Philippines Gross Domestic Product growth
(annual %)



Source: World Development Indicators, World Bank.

The World Bank has much more limited long-term data on poverty levels for the Philippines, but estimates suggest that extreme poverty in the Philippines has been declining in more recent times. Other independent assessments show that extreme poverty in particular has been drastically reduced, but that high rates of structural poverty remain, especially among households depending on agriculture. On inequality, previous studies are consistent in showing persistently high levels of inequality in the country. Regional inequality was found to be a significant driver, but the role of income mobility is not apparent.[7] As far as we are aware, there is still no study that has fully explored using the Family Income and Expenditure Survey (FIES) collected by the Philippines National Statistics Office for a thorough and rigorous analysis of inequality in the Philippines.

In this study, we use household unit records from five rounds of the FIES to study inequality and changes in living standards in the Philippines in recent times. Here, we use 2000, 2003, 2006, 2009, and 2012 waves of cross-sectional FIES data covering an average of 39,000 households each year. The FIES are a series of surveys designed to obtain details of expenditure, income, and a wide range of demographic characteristics of private households in the Philippines on a nationwide basis. The

[7] See, for example, Mapa et al. (2009), Kurita and Kurosaki (2011), Akita and Pagulayan (2014), World Bank (2015); Martinez et al. (2014), and Shorrocks and Wan (2005).

information on demographic characteristics, income, and infrequent expenditure items (e.g., vehicle and property purchases, household bills) were recorded by personal interview, and details of all other expenditures made by each household member, 15 years old or older, during a 2-week period, were recorded in personal diaries.[8] The public-use files were representative of the Philippine population and the sample of households enumerated evenly over the respective 12-month period.

The household is the basic unit of our analysis and is defined as a person or a group of people living together having common provision for food and other essentials of living. A household includes both adults and children, where children are typically those aged under 15 but can also include those up to age 24 years who are fully financially dependent on the parent(s) as defined in the survey. Each FIES sample is chosen using a stratified procedure, and so it was necessary to use the sampling weights provided to ensure that conclusions drawn from the sample analysis apply to the general population as well. Households classified as multiple family types were excluded in the analysis. Such households consist mainly of unrelated young adults (as in students sharing a house), and so the income and expenditure information obtained from interviewing one member cannot be simply taken as true for all the others in the house. We also follow the standard practice of excluding households with negative incomes and negative expenditures as these are known to cause large distortions in the results (see, for example, Valenzuela, Lean, and Athanasopoulous 2014). Altogether, we use around 90% of the full FIES sample (depending on the year)[9], and the subsamples for each year are still large and sufficiently rich in information to allow some hypotheses testing for smaller population groups.

We analyze expenditure data to make inferences about the welfare of households in the population. In the FIES, expenditure information is available for 11 broad categories including such items as food, fuel and power, clothing, health, transport, recreation, current housing, etc. We use total nondurable expenditure of the households to minimize imputation problems associated with the consumption of durables.[10] Nondurable consumption is here defined as total expenditure minus indirect savings and all expenditures on durables. To obtain this, we deduct all household expenditures on furniture and equipment (including cars), all investment expenditures such as mortgage repayments and other capital housing costs, as well as all items reflecting deferred consumption (e.g., expenditures on life insurance and superannuation payments). Note that we use nondurable consumption, which includes current housing expenditures. Items under current housing include rent payments and the insurance components of mortgage repayments, and all housing maintenance costs (interest rates, insurance, repairs, etc.). For homeowners, we used imputed rents to more accurately reflect their welfare levels in the analysis.[11]

[8] Regular but infrequent bills are pro-rated and the expenditure items correspond to average weekly amounts.

[9] The total household exclusions from the FIES data we used each year ranged from 8.6% (1983/1984) to 11.7% (2003/2004) of the total FIES sample.

[10] For use of nondurable expenditures rather than all expenditures (see Valenzuela et al. 2014 for a more extended discussion; other works that can be cited are those of Barrett and Pendakur).

[11] Hedonic regressions methods were used to estimate the flow of housing services/rents for those identified as homeowners.

To ensure meaningful analysis over time and space, the income and expenditure series obtained from each survey year were adjusted using adult equivalence scales. Equivalence scales are indexes that show the relative income (or expenditure) levels required by people in different circumstances to attain the same level of economic well-being. Use of an appropriate adult equivalent scale ensures that incomes and expenditures are comparable across various types and sizes of households. The adult equivalence scale used here was the square root of family size due to Buhmann et al. (1987). The second adjustment needed for the data was the conversion of all nominal values in the raw data sets to 2006 dollars using the national consumer price index.

5. EMPIRICAL RESULTS AND DISCUSSION

Table 1 presents some descriptive statistics from our sample population. Here we can see that household coverage was large, ranging from 38,400 households in 2009 to as many as 42,094 households in 2003. The share of urban households was steady at 45% in the period up to 2009, but data shows this proportion reduced to 38% in 2012, in favor of an increase in the share of rural households. Wages and salaries was the main source of income for a majority of the households (46%–48%) during the study period, while the balance is shared between those that draw mainly from entrepreneurial activities and from other sources (26%–27% share each). As can be seen, this latter divide has not always been equal; rather, we see a sustained decrease in the share of households relying on entrepreneurial activities for income over time. This decrease coincides with a sustained increase in households' reliance on other sources, increasing from 20% in 2003 to 26% in 2012. There is good reason to believe that an increase in the number of households receiving remittances has much to do with this trend. As we can see, there is a steady increase across the years of the proportion of households receiving remittances, from just 18% in 2000 to 26% in 2012. The data further show that a typical head of household is male, is between 31 and 60 years old, and has completed some high school education at most. There is a clear trend toward the aging of the population, with households increasingly being headed by members over age 60.

Tables 2 presents singular measures of poverty and inequality for selected population groups in each survey year. We can see from the upper panel that across the whole population, the proportion of poor in the total population stood at 25.86% in 2000, declined marginally to 25.14% in 2003, and then increased again to 26.07% in 2012. Estimates of poverty incidence from total incomes tend to be higher than those computed from total expenditures; similar trends can be observed, though. Poverty rates by age group show that households with older heads (aged 60+) have the highest poverty rates; this group also has the highest poverty growth rate compared with the other age groups. We also find that there is highest poverty in the households that draw their main income from entrepreneurial activities, compared with those who earn income mainly from wages and salaries or from other sources. Poverty rates are highest among households whose heads had some years in college, but did not complete the degree; this was followed closely by those who just finished high school and/or had fewer years of education than that. In the lower panel of Table 2, the estimated Gini indexes show that, in general, inequality has been high since 2000 and levels have steadily risen from 2000 to 2012 for the total population. The indexes have tended to rise with age for both total income and total expenditure. We find that inequality is positively related to age.

Table 1: Summary Statistics, Philippines' Family Income and Expenditure Survey, 2000–2012

	2000			2003		
	%	Income	Expenditure	%	Income	Expenditure
All Households	39,615	142,531	115,237	42,094	137,758	114,960
		(197,581)	(128,630)		(250,922)	(120,646)
Urban households	–	n.a.	n.a.	–	n.a.	n.a.
	–	–	–	–	–	–
Rural households	–	n.a.	n.a.	–	n.a.	n.a.
	–	–	–	–	–	–
Agricultural households	–	n.a.	n.a.	0.30	62,444	58,271
	–	–	–		(70,318)	(40,197)
Nonagricultural households	–	n.a.	n.a.	0.70	169,537	138,879
	–	–	–		(289,896)	(134,489)
Main source of income: wages/salaries	–	n.a.	n.a.	0.46	150,727	127,228
	–	–	–		(158,562)	(119,785)
Main source of income: entrepreneurial act	–	n.a.	n.a.	0.34	104,921	86,447
	–	–	–		(317,488)	(90,672)
Main source of income: other	–	n.a.	n.a.	0.20	164,271	135,674
	–	–	–		(286,035)	(153,957)
Household remittance receiving	0.18	212,827	168,775	0.21	217,583	179,143
		(206,142)	(140,584)		(243,572)	(158,877)
Household NOT remittance receiving	0.82	127,036	103,436	0.79	116,875	98,168
		(192,219)	(122,743)		(248,618)	(101,983)
Own home	–	n.a.	n.a.	0.87	137,099	113,584
	–	–	–		(263,011)	(122,497)
Rent	–	n.a.	n.a.	0.09	158,151	138,153
	–	–	–		(154,479)	(115,429)
Squat	–	n.a.	n.a.	0.03	99,368	87,233
	–	–	–		(88,261)	(64,429)
All Households	39,615	142,531	115,237	42,094	137,758	114,960
		(197,581)	(128,630)		(250,922)	(120,646)
Heads age 30 and under	0.07	105,073	89,428	0.13	97,933	86,298
		(105,996)	(80,858)		(102,250)	(77,266)
Heads age 31–60	0.71	148,121	120,459	0.69	144,446	121,362
		(197,848)	(125,342)		(257,753)	(120,885)
Heads age 61 and above	0.21	136,487	106,489	0.17	141,245	111,160
		(217,890)	(149,448)		(295,619)	(141,445)
Heads completed elementary or less	0.45	84,787	73,123	0.47	82,591	73,025
		(77,535)	(58,609)		(75,600)	(56,725)
Heads completed high school or less	0.32	130,558	108,463	0.32	127,825	110,381
		(133,919)	(80,001)		(120,213)	(84,720)
Heads college undergrad	0.12	203,920	160,498	0.11	209,093	167,258
		(222,148)	(127,698)		(557,610)	(127,721)
Heads college graduate	0.11	349,769	260,155	0.10	360,368	276,294
		(405,555)	(264,098)		(391,357)	(235,366)
Heads male	0.82	139,511	113,614	0.84	134,145	112,414
		(196,954)	(127,772)		(262,264)	(117,071)
Heads female	0.18	156,750	122,880	0.16	156,768	128,349
		(199,906)	(132,342)		(178,657)	(137,168)

continued on next page

Table 1 *continued*

	2006			2009		
	%	Income	Expenditure	%	Income	Expenditure
All Households	38,483	163,528	138,892	38,400	195,812	165,985
		(201,747)	(143,125)		(290,247)	(164,982)
Urban households	0.45	231,061	193,488	0.45	268,844	226,022
		(253,045)	(179,498)		(369,146)	(205,639)
Rural households	0.55	108,564	94,458	0.55	135,711	116,578
		(122,405)	(80,837)		(182,845)	(97,018)
Agricultural households	0.27	76,480	70,942	0.26	99,430	90,586
		(77,756)	(53,453)		(121,814)	(83,510)
Nonagricultural households	0.73	196,512	164,640	0.74	229,492	192,333
		(223,327)	(157,327)		(322,672)	(177,801)
Main source of income: wages/salaries	0.45	180,536	153,608	0.45	209,831	180,684
		(193,306)	(144,217)		(207,488)	(162,556)
Main source of income: entrepreneurial act	0.32	122,078	103,649	0.30	155,286	128,138
		(180618)	(114,640)		(248,941)	(131,684)
Main source of income: other	0.23	188,968	160,015	0.24	219,991	185,559
		(235,095)	(166,522)		(431,436)	(196,053)
Household remittance receiving	0.23	242,312	202,167	0.26	281,285	236,518
		(237,776)	(173,096)		(278,628)	(195,630)
Household NOT remittance receiving	0.77	139,579	119,658	0.77	165,764	141,190
		(182,837)	(126,561)		(288,267)	(144,814)
Own home	0.88	161,249	136,293	0.85	196,122	165,133
		(205,783)	(143,952)		(299,390)	(167,984)
Rent	0.08	200,200	174,481	0.08	227,349	196,672
		(182,963)	(146,101)		(291,679)	(173,364)
Squat	0.04	134,769	120,584	0.03	150,938	137,659
		(112,807)	(95,853)		(114,991)	(95,050)
All Households	38,483	163,528	138,892	38,400	195,812	165,985
		(201,747)	(143,125)		(290,247)	(164,982)
Heads age 30 and under	0.09	123,347	109,525	0.07	149,320	133,921
		(142,951)	(98,744)		(142,951)	(119,128)
Heads age 31–60	0.71	169,059	144,083	0.71	198,459	169,960
		(203,414)	(142,800)		(243,683)	(160,950)
Heads age 61 and above	0.20	161,565	133,372	0.23	201,036	162,816
		(219,773)	(158,276)		(424,872)	(186,560)
Heads completed elementary or less	0.42	100,746	89,619	0.44	117,318	105,138
		(106,850)	(73,800)		(105,912)	(80,337)
Heads completed high school or less	0.33	152,766	133,432	0.34	179,151	157,133
		(141,697)	(104,083)		(154,676)	(113,961)
Heads college undergrad	0.11	231,833	195,525	0.11	264,883	226,409
		(197,487)	(146,286)		(214,784)	(164,736)
Heads college graduate	0.10	414,742	323,428	0.11	494,685	377,939
		(394,413)	(263,825)		(698,204)	(302,903)
Heads male	0.82	158,470	135,331	0.80	190,000	161,369
		(197,142)	(138,560)		(300,678)	(157,436)
Heads female	0.18	186,518	155,082	0.20	218,460	183,974
		(220,031)	(161,288)		(244,096)	(190,521)

continued on next page

Table 1 *continued*

	2012		
	%	**Income**	**Expenditure**
All Households	40,171	217,619	177,172
		(256,168)	(172,554)
Urban households	0.38	296,253	242,991
		(321,154)	(218,102)
Rural households	0.62	168,871	136,369
		(184,701)	(119,979)
Agricultural households	0.25	107,210	92,933
		(99,092)	(58,763)
Nonagricultural households	0.75	253,529	204,571
		(277,213)	(187,823)
Main source of income: wages/salaries	0.48	234,006	192,886
		(237,944)	(180,538)
Main source of income: entrepreneurial act	0.27	179,111	140,478
		(266,284)	(136,111)
Main source of income: other	0.26	227,013	185,940
		(264,411)	(185,109)
Household remittance receiving	0.26	309,460	246,518
		(274,171)	(195,827)
Household NOT remittance receiving	0.74	186,008	153,304
		(238,203)	(156,845)
Own home	0.90	215,199	173,960
		(257,558)	(172,770)
Rent	0.07	259,432	224,831
		(229,293)	(179,766)
Squat	0.03	190,263	159,663
		(167,727)	(124,201)
All Households	40171	217,619	177,172
		(256,168)	(172,554)
Heads age 30 and under	0.06	162,263	140,334
		(163,603)	(121,446)
Heads age 31–60	0.69	221,302	181,797
		(253,056)	(172,364)
Heads age 61 and above	0.25	221,918	173,920
		(272,704)	(183,064)
Heads completed elementary or less	0.43	132,279	112,262
		(115,941)	(83,464)
Heads completed high school or less	0.35	204,742	170,475
		(189,623)	(122,975)
Heads college undergrad	0.02	303,895	249,208
		(237,870)	(162,128)
Heads college graduate	0.19	426,725	329,764
		(415,558)	(275,402)
Heads male	0.79	211,647	173,208
		(249,197)	(170,231)
Heads female	0.21	239,554	191,732
		(268,452)	(180,095)

Table 2: Welfare Measures, Philippines, Selected Groups

		Total Income				
		2000	**2003**	**2006**	**2009**	**2012**
Head Count Ratio						
All Households		**0.2586**	**0.2514**	**0.2585**	**0.2425**	**0.2607**
Age of household head	30 & under	0.2454	0.2682	0.1877	0.2484	0.2716
	31–60	0.2492	0.2586	0.1581	0.2643	0.2686
	60+	0.3364	0.3419	0.3396	0.3825	0.3616
Educational attainment of household head	< = primary	0.2254	0.2382	0.2277	0.2384	0.2616
	< = high school	0.3264	0.3319	0.3196	0.3325	0.3516
	College undergrad	0.3364	0.3419	0.3396	0.3825	0.3616
	College graduate	0.2492	0.2586	0.3581	0.2643	0.2686
Main source of income	Wages & salaries	0.2592	0.2686	0.2581	0.2674	0.2736
	Entr activities	0.3164	0.3319	0.3296	0.3625	0.3416
	Others	0.2522	0.2556	0.2581	0.2643	0.2686
Home tenure type	Own home	0.2354	0.2682	0.1877	0.2484	0.2716
	Rent	0.3364	0.3419	0.3396	0.3825	0.3616
	Others	0.3492	0.3586	0.3581	0.3643	0.3686
Gini Index						
All Households		**0.4351**	**0.4493**	**0.4559**	**0.4602**	**0.4682**
Age of household head	30 & under	0.3935	0.4029	0.4262	0.3904	0.3935
	31–60	0.4305	0.4459	0.4657	0.4665	0.4768
	60+	0.4736	0.4852	0.4956	0.4913	0.5193
Educational attainment of household head	< = primary	0.3835	0.4029	0.4162	0.3904	0.3945
	< = high school	0.4405	0.4559	0.4657	0.4605	0.4668
	College undergrad	0.4537	0.4658	0.4669	0.4703	0.4793
	College graduate	0.4827	0.4848	0.4975	0.4933	0.4983
Main source of income	Wages & salaries	0.3935	0.4029	0.4262	0.3904	0.3935
	Entr activities	0.4605	0.4659	0.4757	0.4865	0.4868
	Others	0.4817	0.4831	0.4855	0.4943	0.5083
Home tenure type	Own home	0.3935	0.4029	0.4262	0.3904	0.3935
	Rent	0.4505	0.4559	0.4657	0.4665	0.4768
	Others	0.4807	0.4844	0.4723	0.4934	0.5123

continued on next page

Table 2 *continued*

		Total Expenditure				
		2000	**2003**	**2006**	**2009**	**2012**
Head Count Ratio						
All Households		**0.2568**	**0.2499**	**0.2502**	**0.2545**	**0.2592**
Age of household head	30 & under	0.2454	0.2479	0.2503	0.2528	0.2554
	31–60	0.2492	0.2517	0.2542	0.2568	0.2593
	60+	0.3364	0.3398	0.3432	0.3466	0.3501
Educational attainment of household head	< = primary	0.2254	0.2277	0.2299	0.2322	0.2346
	< = high school	0.3164	0.3196	0.3228	0.3260	0.3292
	College undergrad	0.3216	0.3248	0.3281	0.3313	0.3347
	College graduate	0.2392	0.2416	0.2440	0.2464	0.2489
Main source of income	Wages & salaries	0.2444	0.2469	0.2493	0.2518	0.2543
	Entr activities	0.3216	0.3248	0.3281	0.3313	0.3347
	Others	0.2492	0.2517	0.2542	0.2568	0.2593
Home tenure type	Own home	0.2354	0.2378	0.2401	0.2425	0.2450
	Rent	0.3216	0.3248	0.3281	0.3313	0.3347
	Others	0.3392	0.3426	0.3460	0.3495	0.3530
Gini Index						
All Households		**0.4642**	**0.4542**	**0.4602**	**0.4782**	**0.4742**
Age of household head	30 & under	0.3835	0.3873	0.3912	0.3951	0.3991
	31–60	0.4211	0.4334	0.4552	0.4561	0.4668
	60+	0.4554	0.4752	0.4851	0.4814	0.5091
Educational attainment of household head	< = primary	0.3865	0.3904	0.3943	0.3982	0.4022
	< = high school	0.4305	0.4453	0.4502	0.4651	0.4900
	College undergrad	0.4437	0.4593	0.4550	0.4608	0.4666
	College graduate	0.4737	0.4793	0.4850	0.4808	0.4966
Main source of income	Wages & salaries	0.3815	0.3853	0.3892	0.3931	0.3970
	Entr activities	0.4575	0.4614	0.4653	0.4692	0.4732
	Others	0.4724	0.4778	0.4733	0.4888	0.4844
Home tenure type	Own home	0.3715	0.3752	0.3790	0.3828	0.3866
	Rent	0.4475	0.4413	0.4551	0.4689	0.4628
	Others	0.4714	0.4768	0.4723	0.4878	0.4934

Stochastic dominance test results for comparing distributions over time are summarized in Tables 3–8. For *Total Income* ***INC***, we find that the distribution in 2000 ($\boldsymbol{INC^{00}}$) dominated that of all the other years in the study, by both SASD and SDSD, suggesting that $\boldsymbol{INC^{00}}$ has a lower proportion of poor units in relatively low income levels compared with the distribution in every other year. The pairwise comparison of distribution between the later years shows that $\boldsymbol{INC^{00}}$ was SASD dominated by $\boldsymbol{INC^{06}}$, which was in turn SASD dominated by $\boldsymbol{INC^{09}}$, suggesting that there are diminishing proportions of relatively poor units in the distribution as time progressed. In the SDSD sense, however, no distribution between 2003, 2006, and 2009 appeared to dominate the other.

Table 3: ASD and DSD Test Results, Total Incomes, Total Expenditure, Households by Urbanity, Agricultural Household Status

Income or Expenditure Distributions*	Income Distributions				Expenditure Distributions			
	INC^{03}	INC^{06}	INC^{09}	INC^{12}	EXP^{03}	EXP^{06}	EXP^{09}	EXP^{12}
INC^{00}	$\succ^{A}_{2,3} \equiv$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$\succ^{A}_{2,3} =$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$= \succ^{D}_{3}$	$= \prec^{D}_{2,3}$
INC^{03}		$\prec^{A}_{2,3} =$	$\prec^{A}_{2,3} =$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$		$\prec^{A}_{2,3} =$	$\prec^{A}_{2,3} =$	$\prec^{A}_{2,3} \succ^{D}_{2,3}$
INC^{06}			$\prec^{A}_{2,3} =$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$			$\prec^{A}_{2,3} =$	$= =$
INC^{12}				$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$				$= =$
	URB^{03}	URB^{06}	URB^{09}	URB^{12}	URB^{03}	URB^{06}	URB^{09}	URB^{12}
URB^{06}			$\prec^{A}_{2,3} =$	$= =$			$= =$	$= =$
URB^{09}				$= =$				$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$
	RUR^{03}	RUR^{06}	RUR^{09}	RUR^{12}	RUR^{03}	RUR^{06}	RUR^{09}	RUR^{12}
RUR^{06}			$\prec^{A}_{2,3} =$	$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$			$\prec^{A}_{2,3} =$	$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$
RUR^{09}				$\prec^{A}_{2,3} =$				$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$
	RUR^{03}	RUR^{06}	RUR^{09}	RUR^{12}	RUR^{03}	RUR^{06}	RUR^{09}	RUR^{12}
URB^{09}			$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$				$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	
URB^{12}				$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$				$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$
	AGR^{03}	AGR^{06}	AGR^{09}	AGR^{12}	AGR^{03}	AGR^{06}	AGR^{09}	AGR^{12}
AGR^{03}		$\prec^{A}_{2,3} \prec^{D}_{2,3}$	$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$	$\prec^{A}_{2,3} =$		$\prec^{A}_{2,3} =$	$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$	$\prec^{A}_{2,3} =$
AGR^{06}			$\prec^{A}_{2,3} \prec^{D}_{2,3}$	$\prec^{A}_{2,3} =$			$\prec^{A}_{2,3} \prec^{D}_{2,3}$	$\prec^{A}_{2,3} =$
AGR^{09}				$= =$				$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$
	N_AGR^{03}	N_AGR^{06}	N_AGR^{09}	N_AGR^{12}	N_AGR^{03}	N_AGR^{06}	N_AGR^{09}	N_AGR^{12}
N_AGR^{03}		$= =$	$= =$	$= =$		$= =$	$\prec^{A}_{2,3} =$	$= =$
N_AGR^{06}			$\prec^{A}_{2,3} =$	$= =$			$= =$	$= \succ^{D}_{2,3}$
N_AGR^{09}				$= =$				$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$
	N_AGR^{03}	N_AGR^{06}	N_AGR^{09}	N_AGR^{12}	N_AGR^{03}	N_AGR^{06}	N_AGR^{09}	N_AGR^{12}
AGR^{09}			$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$				$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$	
AGR^{12}				$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$				$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$

*Income distributions are compared with income distributions; expenditure distributions are compared with expenditure distributions.

Table 4: ASD and DSD Test Results, Households by Source of Income

Income or Expenditure Distributions*	Income Distributions				Expenditure Distributions			
	$Wages^{03}$	$Wages^{06}$	$Wages^{09}$	$Wages^{12}$	$Wages^{03}$	$Wages^{06}$	$Wages^{09}$	$Wages^{12}$
$Wages^{03}$		$= =$	$\prec^{A}_{2,3} =$	$\prec^{A}_{2,3} =$		$\prec^{A}_{2,3} =$	$\prec^{A}_{2,3} =$	$= =$
$Wages^{06}$			$\prec^{A}_{2,3} =$	$= =$			$= =$	$= =$
$Wage^{09}$				$= =$				$\succ^{A}_{2,3} =$
	EA^{03}	EA^{06}	EA^{09}	EA^{12}	EA^{03}	EA^{06}	EA^{09}	EA^{12}
EA^{03}		$= =$	$\prec^{A}_{2,3} =$	$\prec^{A}_{2,3} =$		$= =$	$\prec^{A}_{2,3} =$	$\prec^{A}_{2,3} =$
EA^{06}			$\prec^{A}_{2,3} =$	$\prec^{A}_{2,3} =$			$\prec^{A}_{2,3} \prec^{D}_{2,3}$	$\prec^{A}_{2,3} =$
EA^{09}				$\prec^{A}_{2,3} =$				$= =$
	OTH^{03}	OTH^{06}	OTH^{09}	OTH^{12}	OTH^{03}	OTH^{06}	OTH^{09}	OTH^{12}
OTH^{03}		$= =$	$= =$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$		$\prec^{A}_{2,3} =$	$\prec^{A}_{2,3} =$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$
OTH^{06}			$\prec^{A}_{2,3} =$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$			$= =$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$
OTH^{09}				$\prec^{A}_{2,3} =$				$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$
	EA^{03}	EA^{06}	EA^{09}	EA^{12}	EA^{03}	EA^{06}	EA^{09}	EA^{12}
$Wages^{03}$	$\succ^{A}_{2,3} =$				$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$			
$Wages^{06}$		$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$				$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$		
$Wages^{09}$			$\succ^{A}_{2,3} \prec^{D}_{3}$				$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	
$Wages^{12}$				$\succ^{A}_{2,3} \prec^{D}_{3}$				$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$
	OTH^{03}	OTH^{06}	OTH^{09}	OTH^{12}	OTH^{03}	OTH^{06}	OTH^{09}	OTH^{12}
$Wages^{03}$	$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$				$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$			
$Wages^{06}$		$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$				$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$		
$Wages^{09}$			$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$				$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$	
$Wages^{12}$				$= \prec^{D}_{2,3}$				$= \prec^{D}_{2,3}$
	OTH^{03}	OTH^{06}	OTH^{09}	OTH^{12}	OTH^{03}	OTH^{06}	OTH^{09}	OTH^{12}
EA^{03}	$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$				$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$			
EA^{06}		$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$				$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$		
EA^{09}			$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$				$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$	
EA^{12}				$= \prec^{D}_{2,3}$				$= \prec^{D}_{2,3}$

*Income distributions are compared with income distributions; expenditure distributions are compared with expenditure distributions.

Table 5: ASD and DSD Test Results, Households by Remittance Receipt Status

Income or Expenditure Distributions*	Income Distributions				
	RRH^{00}	***RH^{03}***	***RRH^{06}***	***RRH^{09}***	***RRH^{12}***
RRH^{00}		$\succ^{A}_{2,3} =$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$\succ^{A}_{2,3} =$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$
RRH^{03}			$\prec^{A}_{2,3} =$	$\prec^{A}_{2,3} =$	$\prec^{A}_{2,3} =$
RHH^{06}				$\prec^{A}_{2,3} =$	$\prec^{A}_{2,3} =$
RHH^{09}					$= =$
	N_RRH^{00}	***N_RRH^{03}***	***N_RRH^{06}***	***N_RRH^{09}***	***N_RRH^{12}***
N_RRH^{00}		$\succ^{A}_{2,3} =$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$\succ^{A}_{2,3} =$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$
N_RRH^{03}			$\succ^{A}_{2,3} =$	$\succ^{A}_{2,3} =$	$\succ^{A}_{2,3} =$
N_RHH^{06}				$\prec^{A}_{2,3} =$	$\prec^{A}_{2,3} =$
N_RHH^{09}					$= \succ^{D}_{2,3}$
	N_RRH^{00}	***N_RRH^{03}***	***N_RRH^{06}***	***N_RRH^{09}***	***N_RRH^{12}***
RRH^{00}	$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$				
RRH^{03}		$\prec^{A}_{2,3} =$			
RHH^{06}			$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$		
RHH^{09}				$\prec^{A}_{2,3} =$	
RHH^{12}					$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$
Income or Expenditure Distributions*	**Expenditure Distributions**				
	RRH^{00}	***RRH^{03}***	***RRH^{06}***	***RRH^{09}***	***RRH^{12}***
RRH^{00}		$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$
RRH^{03}			$\prec^{A}_{2,3} =$	$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$	$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$
RHH^{06}				$\prec^{A}_{2,3} =$	$= =$
RHH^{09}					$\prec^{A}_{2,3} =$
	N_RRH^{00}	***N_RRH^{03}***	***N_RRH^{06}***	***N_RRH^{09}***	***N_RRH^{12}***
N_RRH^{00}		$\succ^{A}_{2,3} =$	$\succ^{A}_{2,3} =$	$\succ^{A}_{2,3} =$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$
N_RRH^{03}			$\succ^{A}_{2,3} =$	$= =$	$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$
N_RHH^{06}				$\prec^{A}_{2,3} =$	$= =$
N_RHH^{09}					$\succ^{A}_{2,3} =$
	N_RRH^{00}	***N_RRH^{03}***	***N_RRH^{06}***	***N_RRH^{09}***	***N_RRH^{12}***
RRH^{00}	$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$				
RRH^{03}		$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$			
RHH^{06}			$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$		
RHH^{09}				$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$	
RHH^{12}					$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$

*Income distributions are compared with income distributions; expenditure distributions are compared with expenditure distributions.

Table 6: ASD and DSD Test Results Households by Age of Household Head

Income or Expenditure Distributions*	Income Distributions				
	$U30^{00}$	$U30^{03}$	$U30^{06}$	$U30^{09}$	$U30^{12}$
$U30^{00}$		$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$\succ^{A}_{2,3} =$	$= =$	$= =$
$U30^{03}$			$\prec^{A}_{2,3} =$	$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$	$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$
$U30^{06}$				$\prec^{A}_{2,3} =$	$\prec^{A}_{2,3} =$
$U30^{09}$					$= =$
	3160^{00}	3160^{03}	3160^{06}	3160^{09}	3160^{12}
3160^{00}		$\succ^{A}_{2,3} =$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$
3160^{03}			$= =$	$\prec^{A}_{2,3} =$	$\prec^{A}_{2,3} =$
3160^{06}				$\prec^{A}_{2,3} =$	$\prec^{A}_{2,3} =$
3160^{09}					$= =$
	$OV60^{00}$	$OV60^{03}$	$OV60^{06}$	$OV60^{09}$	$OV60^{12}$
$OV60^{00}$		$\succ^{A}_{2,3} =$	$\succ^{A}_{2,3} =$	$= =$	$= =$
$OV60^{03}$			$= =$	$\prec^{A}_{2,3} =$	$\prec^{A}_{2,3} =$
$OV60^{06}$				$\prec^{A}_{2,3} =$	$\prec^{A}_{2,3} =$
$OV60^{09}$					$= =$
	3160^{00}	3160^{03}	3160^{06}	3160^{09}	3160^{12}
$U30^{00}$	$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$				
$U30^{03}$		$\prec^{A}_{2,3} =$			
$U30^{06}$			$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$		
$U30^{09}$				$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$	
$U30^{12}$					$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$
	$OV60^{00}$	$OV60^{03}$	$OV60^{06}$	$OV60^{09}$	$OV60^{12}$
$U30^{00}$	$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$				
$U30^{03}$		$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$			
$U30^{06}$			$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$		
$U30^{09}$				$\prec^{A}_{2,3} =$	
$U30^{12}$					$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$
	$OV60^{00}$	$OV60^{03}$	$OV60^{06}$	$OV60^{09}$	$OV60^{12}$
3160^{00}	$= =$				
3160^{03}		$\prec^{A}_{2,3} =$			
3160^{06}			$= =$		
3160^{09}				$\prec^{A}_{2,3} =$	
3160^{12}					$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$

continued on next page

Table 6 *continued*

Income or Expenditure Distributions*	Expenditure Distributions				
	U30^{00}	***U30^{03}***	***U30^{06}***	***U30^{09}***	***U30^{12}***
U30^{00}		$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$=\,=$	$\prec^{A}_{2,3} =$	$=\,=$
U30^{03}			$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$	$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$	$\prec^{A}_{2,3} =$
U30^{06}				$\prec^{A}_{2,3} =$	$=\,=$
U30^{09}					$=\,=$
	3160^{00}	***3160^{03}***	***3160^{06}***	***3160^{09}***	***3160^{12}***
3160^{00}		$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$\succ^{A}_{2,3} =$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$
3160^{03}			$\prec^{A}_{2,3} =$	$\prec^{A}_{2,3} =$	$\prec^{A}_{2,3} =$
3160^{06}				$\prec^{A}_{2,3} =$	$=\,=$
3160^{09}					$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$
	OV60^{00}	***OV60^{03}***	***OV60^{06}***	***OV60^{09}***	***OV60^{12}***
OV60^{00}		$\succ^{A}_{2,3} =$	$=\,=$	$\prec^{A}_{2,3} =$	$=\,=$
OV60^{03}			$=\,=$	$\prec^{A}_{2,3} =$	$\prec^{A}_{2,3} =$
OV60^{06}				$\prec^{A}_{2,3} =$	$\prec^{A}_{2,3} =$
OV60^{09}					$\succ^{A}_{2,3} \succ^{D}_{2,3}$
	3160^{00}	***3160^{03}***	***3160^{06}***	***3160^{09}***	***3160^{12}***
U30^{00}	$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$				
U30^{03}		$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$			
U30^{06}			$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$		
U30^{09}				$\prec^{A}_{2,3} =$	
U30^{12}					$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$
	OV60^{00}	***OV60^{03}***	***OV60^{06}***	***OV60^{09}***	***OV60^{12}***
U30^{00}	$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$				
U30^{03}		$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$			
U30^{06}			$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$		
U30^{09}				$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$	
U30^{12}					$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$
	OV60^{00}	***OV60^{03}***	***OV60^{06}***	***OV60^{09}***	***OV60^{12}***
3160^{00}	$\succ^{A}_{2,3} =$				
3160^{03}		$\succ^{A}_{2,3} =$			
3160^{06}			$\succ^{A}_{2,3} =$		
3160^{09}				$= \prec^{D}_{2,3}$	
3160^{12}					$= \prec^{D}_{2,3}$

*Income distributions are compared with income distributions; expenditure distributions are compared with expenditure distributions.

Table 7: ASD and DSD Test Results Households by Gender of Household Head

Income or Expenditure Distributions*	Income Distributions				
	MALE^{00}	***MALE^{03}***	***MALE^{06}***	***MALE^{09}***	***MALE^{12}***
MALE^{00}		$\succ^{A}_{2,3} =$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$\succ^{A}_{2,3} =$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$
MALE03			$\prec^{A}_{2,3} =$	$\prec^{A}_{2,3} =$	$\prec^{A}_{2,3} =$
MALE06				$\prec^{A}_{2,3} =$	$\prec^{A}_{2,3} =$
MALE^{09}					$= =$
	FEMALE^{00}	***FEMALE^{03}***	***FEMALE^{06}***	***FEMALE^{09}***	***FEMALE^{12}***
FEMALE^{00}		$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$\succ^{A}_{2,3} =$	$= =$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$
FEMALE^{03}			$= =$	$\prec^{A}_{2,3} =$	$= =$
FEMALE^{06}				$\prec^{A}_{2,3} =$	$= =$
FEMALE^{09}					$= =$
	FEMALE^{00}	***FEMALE^{03}***	***FEMALE^{06}***	***FEMALE^{09}***	***FEMALE^{12}***
MALE^{00}	$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$				
MALE^{03}		$\prec^{A}_{2,3} =$			
MALE^{06}			$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$		
MALE^{09}				$\prec^{A}_{2,3} =$	
MALE^{12}					$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$
Income or Expenditure Distributions*	**Expenditure Distributions**				
	MALE^{00}	***MALE^{03}***	***MALE^{06}***	***MALE^{09}***	***MALE^{12}***
MALE^{00}		$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$\succ^{A}_{2,3} \succ^{D}_{2,3}$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$
MALE03			$\prec^{A}_{2,3} =$	$\prec^{A}_{2,3} =$	$\prec^{A}_{2,3} =$
MALE06				$\prec^{A}_{2,3} =$	$= =$
MALE^{09}					$\succ^{A}_{2,3} =$
	FEMALE^{00}	***FEMALE^{03}***	***FEMALE^{06}***	***FEMALE^{09}***	***FEMALE^{12}***
FEMALE^{00}		$= =$	$= =$	$\prec^{A}_{2,3} =$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$
FEMALE^{03}			$= =$	$\prec^{A}_{2,3} =$	$\prec^{\mathrm{A}}_{2,3} \succ^{\mathrm{D}}_{2,3}$
FEMALE^{06}				$= =$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$
FEMALE^{09}					$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$
	FEMALE^{00}	***FEMALE^{03}***	***FEMALE^{06}***	***FEMALE^{09}***	***FEMALE^{12}***
MALE^{00}	$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$				
MALE^{03}		$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$			
MALE^{06}			$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$		
MALE^{09}				$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$	
MALE^{12}					$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$

*Income distributions are compared with income distributions; expenditure distributions are compared with expenditure distributions.

Table 8: ASD and DSD Test Results, Households by Educational Attainment of Household Head

Income or Expenditure Distributions*	Income Distributions				
	PRIM^{00}	***PRIM^{03}***	***PRIM^{06}***	***PRIM^{90}***	***PRIM^{12}***
PRIM^{00}		$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$\succ^{A}_{2,3} =$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$= =$
PRIM^{03}			$\prec^{A}_{2,3} =$	$= =$	$\prec^{A}_{2,3} =$
PRIM^{06}				$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$\prec^{A}_{2,3} =$
PRIM^{09}					$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$
	SEC^{00}	***SEC^{03}***	***SEC^{06}***	***SEC^{09}***	***SEC^{12}***
SEC^{00}		$\succ^{A}_{2,3} =$	$\succ^{A}_{2,3} =$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$= =$
SEC^{03}			$= =$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$\prec^{A}_{2,3} =$
SEC^{06}				$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$\prec^{A}_{2,3} =$
SEC^{09}					$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$
	COLL2^{00}	***COLL2^{03}***	***COLL2^{06}***	***COLL2^{09}***	***COLL2^{12}***
COLL2^{00}		$\succ^{A}_{2,3} =$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$= =$
COLL2^{03}			$= =$	$\succ^{A}_{2,3} =$	$= =$
COLL2^{06}				$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$\prec^{A}_{2,3} =$
COLL2^{09}					$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$
	COLL4^{00}	***COLL4^{03}***	***COLL2^{06}***	***COL4^{09}***	***COLL4^{12}***
COLL4^{00}		$\succ^{A}_{2,3} =$	$\succ^{A}_{2,3} =$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	
COLL4^{03}			$= =$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$
COLL4^{06}				$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$
COLL4^{09}					$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$
	SEC^{00}	***SEC^{03}***	***SEC^{06}***	***SEC^{09}***	***SEC^{12}***
PRIM^{00}	$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$				
PRIM^{03}		$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$			
PRIM^{06}			$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$		
PRIM^{09}				$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$	
PRIM^{12}					$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$
	COLL2^{00}	***COLL2^{03}***	***COLL2^{06}***	***COLL2^{09}***	***COLL2^{12}***
PRIM^{00}	$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$				
PRIM^{03}		$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$			
PRIM^{06}			$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$		
PRIM^{09}				$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$	
PRIM^{12}					$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$

continued on next page

Table 8 *continued*

Income or Expenditure Distributions*	Expenditure Distributions				
	PRIM^{00}	***PRIM^{03}***	***PRIM^{06}***	***PRIM^{90}***	***PRIM^{12}***
PRIM^{00}		$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$
PRIM^{03}			$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$	$\prec^{A}_{2,3} \succ^{D}_{2,3}$	$\prec^{A}_{2,3} =$
PRIM^{06}				$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$\prec^{A}_{2,3} \succ^{D}_{2,3}$
PRIM^{09}					$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$
	SEC^{00}	***SEC^{03}***	***SEC^{06}***	***SEC^{09}***	***SEC^{12}***
SEC^{00}		$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$= =$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$= =$
SEC^{03}			$\prec^{A}_{2,3} =$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$\prec^{A}_{2,3} =$
SEC^{06}				$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$\prec^{A}_{2,3} \succ^{D}_{2,3}$
SEC^{09}					$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$
	COLL2^{00}	***COLL2^{03}***	***COLL2^{06}***	***COLL2^{09}***	***COLL2^{12}***
COLL2^{00}		$= =$	$= =$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$\prec^{A}_{2,3} \succ^{D}_{2,3}$
COLL2^{03}			$= =$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$\prec^{A}_{2,3} \succ^{D}_{2,3}$
COLL2^{06}				$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$\prec^{A}_{2,3} =$
COLL2^{09}					$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$
	COLL4^{00}	***COLL4^{03}***	***COLL4^{06}***	***COLL4^{09}***	***COLL4^{12}***
COLL4^{00}		$= =$	$= =$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$
COLL4^{03}			$= =$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$
COLL4^{06}				$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$
COLL4^{09}					$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$
	SEC^{00}	***SEC^{03}***	***SEC^{06}***	***SEC^{09}***	***SEC^{12}***
PRIM^{00}	$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$				
PRIM^{03}		$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$			
PRIM^{06}			$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$		
PRIM^{09}				$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$	
PRIM^{12}					$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$
	COLL2^{00}	***COLL2^{03}***	***COLL2^{06}***	***COLL2^{09}***	***COLL2^{12}***
PRIM^{00}	$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$				
PRIM^{03}		$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$			
PRIM^{06}			$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$		
PRIM^{09}				$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$	
PRIM^{12}					$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$

continued on next page

Table 8 *continued*

Income or Expenditure Distributions*	Income Distributions				
	COLL2^{00}	***COLL2^{03}***	***COLL2^{06}***	***COLL2^{09}***	***COLL2^{12}***
SEC^{00}	$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$				
SEC^{03}		$\prec^{A}_{2,3} =$			
SEC^{06}			$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$		
SEC^{09}				$\prec^{A}_{2,3} =$	
SEC^{12}					$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$
	COLL4^{00}	***COLL4^{03}***	***COLL2^{06}***	***COL4^{09}***	***COLL4^{12}***
SEC^{00}	$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$				
SEC^{03}		$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$			
SEC^{06}			$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$		
SEC^{09}				$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$	
SEC^{12}					$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$
	COLL4^{00}	***COLL4^{03}***	***COLL2^{06}***	***COL4^{09}***	***COLL4^{12}***
COLL2^{00}	$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$				
COLL2^{03}		$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$			
COLL2^{06}			$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$		
COLL2^{09}				$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$	
COLL2^{12}					$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$
Income or Expenditure Distributions*	**Expenditure Distributions**				
	COLL2^{00}	***COLL2^{03}***	***COLL2^{06}***	***COLL2^{09}***	***COLL2^{12}***
SEC^{00}	$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$				
SEC^{03}		$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$			
SEC^{06}			$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$		
SEC^{09}				$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$	
SEC^{12}					$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$
	COLL4^{00}	***COLL4^{03}***	***COLL4^{06}***	***COLL4^{09}***	***COLL4^{12}***
SEC^{00}	$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$				
SEC^{03}		$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$			
SEC^{06}			$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$		
SEC^{09}				$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$	
SEC^{12}					$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$
	COLL4^{00}	***COLL4^{03}***	***COLL4^{06}***	***COLL4^{09}***	***COLL4^{12}***
COLL2^{00}	$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$				
COLL2^{03}		$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$			
COLL2^{06}			$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$		
COLL2^{09}				$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$	
COLL2^{12}					$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$

*Income distributions are compared with income distributions; expenditure distributions are compared with expenditure distributions.

Table 9: ASD and DSD Test Results, Households by Home Ownership Status

Income or Expenditure Distributions*	Income Distributions				Expenditure Distributions			
	OWN^{03}	OWN^{06}	OWN^{09}	OWN^{12}	OWN^{03}	OWN^{06}	OWN^{09}	OWN^{12}
OWN^{03}		$\prec^{A}_{2,3} =$	$\prec^{A}_{2,3} =$	$\prec^{A}_{2,3} =$		$\prec^{A}_{2,3} =$	$\prec^{A}_{2,3} =$	$\prec^{A}_{2,3} \succ^{D}_{2,3}$
OWN^{06}			$\prec^{A}_{2,3} =$	$\prec^{A}_{2,3} =$			$\prec^{A}_{2,3} =$	$\prec^{A}_{2,3} =$
OWN^{09}				$= =$				$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$
	$RENT^{03}$	$RENT^{06}$	$RENT^{09}$	$RENT^{12}$	$RENT^{03}$	$RENT^{06}$	$RENT^{09}$	$RENT^{12}$
$RENT^{03}$		$\prec^{A}_{2,3} =$	$= =$	$\prec^{A}_{2,3} =$		$\prec^{A}_{2,3} =$	$\prec^{A}_{2,3} =$	$\prec^{A}_{2,3} =$
$RENT^{06}$			$= =$	$\prec^{A}_{2,3} =$			$= =$	$\prec^{A}_{2,3} =$
$RENT^{09}$				$\prec^{A}_{2,3} =$				$\prec^{A}_{2,3} =$
	$SQUAT^{03}$	$SQUAT^{06}$	$SQUAT^{09}$	$SQUAT^{12}$	$SQUAT^{03}$	$SQUAT^{06}$	$SQUAT^{09}$	$SQUAT^{12}$
$SQUAT^{03}$		$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$	$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$	$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$		$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$	$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$	$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$
$SQUAT^{06}$			$\prec^{A}_{2,3} =$	$\prec^{A}_{2,3} =$			$\prec^{A}_{2,3} =$	$= =$
$SQUAT^{09}$				$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$				$= =$
	$RENT^{03}$	$RENT^{06}$	$RENT^{09}$	$RENT^{12}$	$RENT^{03}$	$RENT^{06}$	$RENT^{09}$	$RENT^{12}$
OWN^{03}	$\prec^{A}_{2,3} =$				$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$			
OWN^{06}		$\prec^{A}_{2,3} =$				$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$		
OWN^{09}			$\prec^{A}_{2,3} =$				$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$	
OWN^{12}				$\prec^{A}_{2,3} =$				$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$
	$SQUAT^{03}$	$SQUAT^{06}$	$SQUAT^{09}$	$SQUAT^{12}$	$SQUAT^{03}$	$SQUAT^{06}$	$SQUAT^{09}$	$SQUAT^{12}$
OWN^{03}	$\succ^{A}_{2,3} =$				$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$			
OWN^{06}		$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$				$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$		
OWN^{09}			$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$				$\succ^{A}_{1,2,3} \succ^{D}_{1,2,3}$	
OWN^{12}				$\succ^{A}_{2,3} =$				$\succ^{A}_{2,3} =$
	$SQUAT^{03}$	$SQUAT^{06}$	$SQUAT^{09}$	$SQUAT^{12}$	$SQUAT^{03}$	$SQUAT^{06}$	$SQUAT^{09}$	$SQUAT^{12}$
$RENT^{03}$	$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$				$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$			
$RENT^{06}$		$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$				$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$		
$RENT^{09}$			$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$				$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$	
$RENT^{12}$				$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$				$\prec^{A}_{1,2,3} \prec^{D}_{1,2,3}$

*Income distributions are compared with income distributions; expenditure distributions are compared with expenditure distributions.

The test results for pairwise comparisons for INC^{12} indicate a different trend altogether. Each set of results shows that the distribution for 2012 was both SASD and SDSD dominated by each of the corresponding distributions of the earlier years. This strongly indicates poorer relative welfare levels for both the poor end and the rich end of the distribution—that is, compared with 2012, the distributions in every other year had a lower proportion of poor units in relatively low income levels, at the same time that each one also had a higher proportion of richer units in relatively high income levels. The combined results of the ASD and DSD tests indicate worse levels of social welfare for 2012 income distributions compared with those of earlier years. In terms of expenditures, the first-order dominance of EXP^{00} over EXP^{03} and EXP^{06} in the SASD and SDSD sense is apparent. This suggests that EXP^{00} had a lower proportion of poor units in relatively low income levels for all years, while at the same time EXP^{03} and EXP^{06} both had higher proportions of rich units in relatively high income levels compared with EXP^{00}.

To obtain a deeper insight into the results obtained above and achieve a better characterization of relative welfare in the Philippines across demographic groups over time, we partitioned the sample into various household groups: by location (urban or rural), by type (agricultural or non-agricultural), by main source of income, by whether the households receive remittances from abroad, and by age and gender of household head. We take each pair in turn and routinely apply ASD and DSD tests for pairs of income distributions, and pairs of expenditure distributions between and within the years.

In the second panel of Table 3, our SD test results show that for both urban and rural households, the income distributions of 2009 ($\boldsymbol{URB^{09}}$) dominated that of 2006 ($\boldsymbol{URB^{06}}$) in the SASD sense, but no reverse or descending dominance was found between them. For comparison with 2012, no dominance relationship was detected among the urban households between the years; instead, the distribution of rural household incomes in 2012 ($\boldsymbol{RUR^{12}}$) appeared to dominate those of 2006 ($\boldsymbol{RUR^{06}}$) and 2009 ($\boldsymbol{RUR^{09}}$). Lastly on incomes, our tests also show strong dominance of urban distributions over their rural counterparts. For expenditures, our pairwise tests showed that $\boldsymbol{URB^{12}}$ was dominated by $\boldsymbol{URB^{06}}$ in both the FASD and FDSD sense, while $\boldsymbol{RUR^{09}}$ and $\boldsymbol{RUR^{12}}$ strongly dominated their earlier counterparts, suggesting higher welfare levels are achieved with time. Consistent with income results, the expenditure distributions of urban households strongly dominate those of rural households in both 2009 and 2012, in both the ASD and DSD tests. This implies that urban households in both 2009 and 2012 had higher levels of welfare compared with their rural counterparts.

Between agricultural and non-agricultural households, our SD test results indicate that income distributions of later years show higher welfare compared with their earlier counterparts. Strong FASD and FDSD results are observed for $\boldsymbol{AGR^{09}}$ over $\boldsymbol{AGR^{03}}$, where the rest dominate the other in the second order. The only exception was found for the comparison between $\boldsymbol{AGR^{12}}$ and $\boldsymbol{AGR^{09}}$ distributions, which returned with an equal result—meaning neither one dominated the other in both the ascending and descending order of comparison. Test results using the expenditure distributions suggest stronger dominance results between the years. As with income, the later expenditure distributions strongly dominated the earlier distributions. $\boldsymbol{AGR^{09}}$ first-order dominated $\boldsymbol{AGR^{03}}$ in both ascending and descending sense, while the rest exhibited dominance in second-order terms. For 2012 comparisons, though, it appears that $\boldsymbol{AGR^{12}}$ was strongly dominated by $\boldsymbol{AGR^{09}}$, indicating lower welfare levels for the later year distributions. Among non-agricultural households, the tests reveal no dominance between the distributions across the years, except for the second-order ascending dominance of 2009 distributions over the 2006 distributions. Using expenditures, findings of no dominance were also widespread, except for one matter —we find that $\boldsymbol{N\_AGR^{12}}$ was strongly dominated by $\boldsymbol{N\_AGR^{09}}$, indicating lower welfare levels for the later year distributions.

Table 4 presents results for pairwise comparisons of distributions when households are grouped by main source of income. For households dependent on wages and salaries, we find stochastic dominance of later year income distributions over earlier year pairs, that is, $\boldsymbol{Wages^{12}}$ dominated $\boldsymbol{Wages^{09}}$, while $\boldsymbol{Wages^{09}}$ dominated both $\boldsymbol{Wages^{03}}$ and $\boldsymbol{Wage^{06}}$. This is all in the SASD sense, as no dominance relationship is detected between the years in the descending order sense. Very similarly, among entrepreneur households, we find dominance of later years over earlier years in the SASD, but not the SDSD, sense. In contrast, for households depending on other sources—that is, neither wages nor business—we find the income distributions $\boldsymbol{OTH^{03}}$ and $\boldsymbol{OTH^{06}}$

dominating OTH^{12} in both the FASD and FDSD sense, while at the same time the income distribution OTH^{12} dominated OTH^{09} in the SASD sense only.

Comparing now the distributions of incomes between the various sources, we find that the ***OTH*** distributions generally dominate the wages and entrepreneur income distributions in all the within-year comparisons. This means that the ***OTH*** distribution has better welfare compared with the ***Wages*** distribution and the ***EA*** distribution, in both the ASD and DSD sense for the years 2003, 2006, and 2009, and in the SDSD sense in 2012. Results are identical for expenditure distribution comparisons. Between ***Wages*** and ***EA,*** though, the direction of dominance appears to change midway through the study period. In other words, ***Wages*** dominated ***EA*** in 2003 and 2006 in both the ASD and DSD sense. But in 2009 and 2012, the ***EA*** distributions appeared to dominate the ***Wages*** distribution in the descending order while still retaining the ASD over ***Wages***. However, when comparison is made using expenditure, this reversal of descending dominance effect disappears. The foregoing implies that whichever is the main source of income of households, the distributions of both incomes and expenditures have been improving over the years, from 2003 until at least 2009. The results further imply that distributions of 2012 have had some relative welfare losses compared with previous years' distributions, on both the lower and upper tails of the distributions, symptomatic of the increase in inequality levels experienced in the economy in the post-crisis years. Overall, the results show that wage and salary earner households experience relatively higher levels of welfare compared with entrepreneur households, but households relying on other incomes, such as remittances, can be altogether better off.

Welfare differences between remittance and non-remittance-receiving households can be gleaned from Table 5. Among remittance receivers, the distribution in 2000 (RRH^{00}) is shown to either first-order or at least second-order dominate the corresponding distributions of later years. The results also show that the RRH^{03} income and expenditure distributions appear to have the lowest level of welfare in that it is shown to be dominated by every other distribution they are SD test paired with. RRH^{06} is dominated by RRH^{09} and RRH^{12} by and large in the ASD test mainly, but not under DSD conditions.

In contrast, among households who do not receive remittances, the distributions of the earlier years appear to have higher welfare levels, that is, N_RRH^{00} showed strong dominance over each distribution in the later years, while N_RRH^{03} second-order dominated the distributions of later years N_RRH^{06}, N_RRH^{09} and N_RRH^{12} in the SASD sense. Dominance orderings between these last distributions (2006, 2009, and 2012) appear to have reversed from previous years, though results are mixed. For incomes, N_RRH^{06} is shown to be dominated by N_RRH^{09} and N_RRH^{12} in the SASD sense, while on the other hand N_RRH^{09} appears to dominate N_RRH^{12} in the SDSD sense. For expenditures, the results are even more mixed—with N_RRH^{06} shown to be SASD dominated by N_RRH^{09} only, and no dominance relationship with N_RRH^{12}, while N_RRH^{09} appears to SASD dominate N_RRH^{12}, something that we did not find with income earlier.

Lastly, the pairwise SD analysis between remittance receiving households and non-remittance-receiving households consistently show FASD and FDSD in favor of non-remittance-receiving households for all years for which pairs of expenditure distributions were tested. From the lower third panel of Table 5, strong first-order dominance results for income distributions were observed in favor of households who did not receive remittances, although second-order and no dominance were also observed. These imply that the distributions among the remittance receivers have, over the years, had lower levels of welfare compared with those who do not receive

remittances, and this holds true for both income and expenditure distributions. Put differently, this suggests that across the years, the non-remittance-receiving households were generally better off than those receiving remittances, having both a smaller proportion of poor units and a higher proportion of rich units in its distribution.

In Table 6, we can see the SASD and SDSD results when the sample is partitioned into three groups, by age of household head: under 30, 31–60, and over 60. For the youngest cohorts, we find strong first-order dominance of the 2000 income distribution over that of the 2003 income distribution, in both the SASD and SDSD sense. This suggests that the distribution $\boldsymbol{U30^{00}}$ has a lower proportion of poor units in relatively low income levels for all years compared with $\boldsymbol{U30^{03}}$, while $\boldsymbol{U30^{03}}$ has a higher proportion of rich units in relatively high income levels compared with $\boldsymbol{U30^{00}}$. Second-order dominance is observed when $\boldsymbol{U30^{00}}$ is compared with $\boldsymbol{U30^{06}}$ while no dominance is observed when $\boldsymbol{U30^{00}}$ is compared with even later years.

In contrast, results for the 31–60 age group distributions show consistently strong first-order dominance of $\boldsymbol{3160^{00}}$ over all of the other years—for both SASD and SDSD tests, and for both income and expenditure distributions as well. This implies that in 2000, the distributions associated with this group of households with heads in this middle group had a lesser proportion of poor units in relatively low income levels than the corresponding later year distributions; at the same time, these distributions for 2000 also had a higher proportion of rich units in relatively high income levels compared with the corresponding later year distributions in the paired tests. These suggest that the 2000 distribution enjoyed higher social welfare compared with every other year forward, regardless of the utility function being concave or convex.

Outside of 2000, the pairwise SD comparison of the 31–60 age group reveal familiar results—that later year distributions tended to dominate earlier counterparts. More specifically, in terms of income distributions, we find that $\boldsymbol{3160^{09}}$ dominated $\boldsymbol{3160^{03}}$ and $\boldsymbol{3160^{06}}$ while $\boldsymbol{3160^{12}}$ also dominated $\boldsymbol{3160^{03}}$ and $\boldsymbol{3160^{06}}$, but not $\boldsymbol{3160^{09}}$. All these results are in the SASD sense only as we found no dominance relationship in any of the descending tests we applied. This later year dominance pattern is also observed for the pairwise expenditure distribution tests, with results differing significantly only in the $\boldsymbol{3160^{12}}$ v $\boldsymbol{3160^{09}}$ comparison. SD tests on this pair showed second-order dominance of the 2009 over the 2012 distributions. This suggests that the distribution $\boldsymbol{3160^{09}}$ has a lower proportion of poor units in relatively low income levels for all years compared with $\boldsymbol{3160^{12}}$ at the same time that $\boldsymbol{3160^{12}}$ has a higher proportion of rich units in relatively high income levels compared with $\boldsymbol{3160^{09}}$. All these demonstrate the advantage of using our tests for both poorness and richness, which, in this case, avoids making misleading conclusions based on SASD alone.

For the over-60 age group distributions, we find that the 2000 income distribution $\boldsymbol{OV60^{00}}$ second-order dominated the corresponding distributions for 2003 and 2006, but not the other years where no dominance was found either way. We further find that $\boldsymbol{OV60^{09}}$ dominates $\boldsymbol{OV60^{03}}$ and $\boldsymbol{OV60^{06}}$ while $\boldsymbol{OV60^{12}}$ dominates $\boldsymbol{OV60^{03}}$ and $\boldsymbol{OV60^{06}}$ also, but not $\boldsymbol{OV60^{09}}$. All these were in the SASD sense only, as we found no dominance relationship existed in any of the descending tests. These results are more or less replicated comparing the expenditure distribution groups. These results suggest that the welfare of the oldest age group was at least as good, if not higher, in 2012 compared with the previous years, except perhaps for 2009 given the expenditure results.

Test results comparing income distributions across age groups are also revealing. The results found in the bottom panel of Table 6 show that the 30 and under age group distributions are always dominated by the 31–60 age group distributions—in both ascending and descending SD contexts. Further, we also find that the distributions for the two younger cohorts are both dominated by those of the over-60 group, with strength of dominance much more pronounced for the youngest group of households. Generally, these age group dominance findings also hold for the age group expenditure distribution comparisons; the exception is the expenditure comparison results for the two older age cohorts, where reverse results were found. That is, that the expenditure distribution for the 31–60 age group was found to dominate the corresponding distribution for the over-60 group, particularly in the years before the global financial crisis (2000, 2003, and 2006) in the SASD sense, while for 2009 and 2012, the distribution for the oldest group dominated in the SDSD sense. The first part of these results suggests that between 2000 and 2006, households with heads age 31–60 had a lesser proportion of poor units in relatively low income levels compared with those whose head was over 60 years old. The second part of these results indicate that in more recent years (2009 and 2012), the over-60 group had a higher proportion of rich units in relatively high income levels compared with the 31–60 age group. In other words, the older set was getting richer faster than the 31–60 age group. All these results make good economic sense in that it is consistent with life-cycle theories of income and savings—predicting low average incomes for the young; the highest income levels in middle age; and for the oldest cohorts, low incomes but the highest levels of savings and accumulated wealth.

Does gender of the household head matter? Results at the bottom of Table 7 show that distributions for female-headed households consistently dominate those of male-headed households all the time, for both ascending and descending tests. Results are the same using both income distributions and expenditure distributions. These results suggest that relative welfare levels, when measured by equality in the distribution of incomes or expenditures, are better among female-headed households compared with those of male-headed households.

Finally, does education level of household head matter? Results of our analysis using this criterion are found in Table 8. Overwhelmingly, the SD test results show higher welfare levels for distributions with more highly educated heads, which holds for both ascending and descending SD tests. These same results are obtained and hold for analyzing both income and expenditure distributions.

6. CONCLUSION

In this paper, we used stochastic dominance tests to achieve a more robust analysis of relative welfare levels in the Philippines. We demonstrate that the new tests of richness and poorness provide greater capacity for sharper inference and improved interpretation for welfare analysis. Empirically, our results highlight a number of important trends. Relative social welfare levels improved over time and favored urban and nonagricultural households more than their rural, agricultural counterparts. Our SD results showed that, in the past, households who drew their main income from wages and salaries enjoyed the highest welfare levels compared with those who depended on entrepreneurial activities or other sources for income. This, however, has changed in more recent years—we found higher welfare levels among those drawing from other sources, which is mainly from remittances. SD analysis by age showed increasing concentrations of poor income units among the youngest cohort (aged 30 and under), while there are high concentrations of richer income units in the over-60 distributions.

We also found large gaps in relative social well-being across gender and education groups—that is, female-headed households were relatively better off compared with their male-headed counterparts, while higher welfare levels were associated with those who had more years of education. Overall, our SD analysis composition approach and application of tests suggests that while poverty increased over time and high inequality levels persisted between 2000 and 2012, welfare levels in 2009 and 2012 actually improved in the economy compared with the early part of this decade.

Our major methodological contribution pertains to the use of the combined ASD and DSD approach to income distribution analysis. We successfully demonstrate that using the ASD and DSD together offers a better characterization and understanding of current and changing levels of inequality in a population than what could be achieved using the standard ASD approach alone. Our empirical application analyzing income distributions in the Philippines provides results that are theoretically consistent with predictions of the life-cycle theory of income and savings. As well, they provide new and useful insights into the relative welfare status of population groups in the economy over the 2000–2012 period. One finding, among others, is a high and increasing concentration of poor individuals among the younger cohorts, while concentrations of rich individuals among the older, retired cohorts have increased over time. This may be a viable explanation for the high inequality level that has persisted in the economy since the rapid growth years from 2000 onward.

REFERENCES

Akita, T., and M. Pagulayan. 2014. Structural Changes and Interregional Income Inequality in the Philippines, 1975–2009. *Review of Urban and Regional Development Studies* 26(2): 135–154.

Anderson, G. 2004. Toward an Empirical Analysis of Polarization. *Journal of Econometrics* 122(1): 1–26.

Atkinson, A. 1970. On the Measurement of Inequality. *Journal of Economic Theory* 2(3): 244–263.

Bai, Z., H. Li, M. McAleer, and W. K. Wong. 2015. Stochastic Dominance Statistics for Risk Averters and Risk Seekers: An Analysis of Stock Preferences for USA and China. *Quantitative Finance* 15(5): 889–900.

Barrett, G., and S. Donald. 2013. Consistent Tests for Stochastic Dominance. *Econometrica* 71(1): 71–104.

Bishop, J., J. Formby, and P. Thistle. 1992. Convergence of the South and Non-South Income Distributions, 1969–1979. *American Economic Review* 82(1): 262–272.

Buhmann, B., L. Rainwater, G. Schmaus, and T. Smeeding. 1987. Equivalence Scales, Well-Being and Inequality and Poverty. *Review of Income and Wealth* 34(2): 115–142.

Chow, S-C., M. Valenzuela, and W. Wong. 2016. New Tests for Richness and Poorness: A Stochastic Dominance Analysis of Income Distributions in Hong Kong. Discussion paper. Department of Economics, Monash University, Melbourne, Australia.

Dacuycuy, L. 2006. Explaining Male Wage Inequality in the Philippines: Non-Parametric and Semiparametric Approaches. *Applied Economics* 38(21): 2497–2511.

Davidson, R., and J.-Y. Duclos. 2000. Statistical Inference for Stochastic Dominance and for the Measurement of Poverty and Inequality. *Econometrica* 68(6): 1435–1464.

Fong, W., H. Lean, and W. Wong. 2008. Stochastic Dominance and Behavior towards Risk: The Market for Internet Stocks. *Journal of Economic Behavior & Organization* 68(1): 194–208.

Fong, W., W. Wong, and H. Lean. 2005. Stochastic Dominance and the Rationality of the Momentum Effect across Markets. *Journal of Financial Markets* 8(1): 89–109.

Foster, J., and A. Shorrocks. 1988. Poverty Orderings. *Econometrica* 56: 173–177.

Friedman, M., and L. Savage. 1948. The Utility Analysis of Choices Involving Risk. *Journal of Political Economy* 56(4): 279–304.

Gasbarro, D., W. Wong, and J. Zumwalt. 2007. Stochastic Dominance Analysis of iShares. *European Journal of Finance* 13(1): 89–101.

Kahneman, D., and A. Tversky. 1979. Prospect Theory: An Analysis of Decision Making under Risk. *Econometrica* 47(2): 263–292.

Kurita, K., and T. Kurosaki. 2011. Dynamics of Growth, Poverty and Inequality: A Panel Analysis of Regional Data from Thailand and the Philippines. *Asian Economic Journal* 25(1): 3–33.

Lean, H., W. Wong, and X. Zhang. 2008. The Size and Power of Some Stochastic Dominance Tests: A Monte Carlo Study for Correlated Heteroskedastic Distributions. *Mathematics and Computer in Simulation* 79(1): 30–48.

Levy, H. 2015. *Stochastic Dominance: Investment Decision Making under Uncertainty.* New York: Springer.

Linton, O., E. Maasoumi, and Y. Whang. 2005. Consistent Testing for Stochastic Dominance under General Sampling Schemes. *Review of Economic Studies* 72(3): 735–765.

Mapa, D., A. Balisacan, K. Briones, and M. Albis. 2009. What Really Matters for Income Growth in the Philippines: Empirical Evidence from Provincial Data. UPSS Working Paper No 2009-01. Quezon City: University of the Philippines School of Statistics.

Martinez, A., Jr., M. Western, M. Haynes, and W. Tomaszewski. 2014. How Income Segmentation Affects Income Mobility: Evidence from Panel Data in the Philippines. *Asia-Pacific Economic Literature* 28(1): 96–115

McFadden, D. Testing for Stochastic Dominance. 1989. In T. Fomby and T. Seo, eds. *Studies in the Economics of Uncertainty*. New York: Springer. pp. 113–134.

Mehta, A., J. Felipe, P. Quising, and S, Camingue, 2013. Where Have All the Education Workers Gone? Services and Wage Inequality in Three Asian Economies. *Metroeconomica* 64(3).

Shorrocks, A., and G. Wan. 2005. *Journal of Economic Geography* 5(1): 59–81.

Tay, S. 2014. Going Beyond the Gini Ratio: Individual Normative Values about Income Inequality in the Philippines. *Journal of Southeast Asian Economics* 31(3): 453–470.

Tse, Y., and X. Zhang. 2004. A Monte Carlo Investigation of Some Tests for Stochastic Dominance. *Journal of Statistical Computation and Simulation* 74(5): 361–378.

Valenzuela, M., H. Lean, and G. Athanasopoulous. 2014. Economic Inequality in Australia between 1983 and 2010: A Stochastic Dominance Analysis. *Economic Record* 90(288): 49–62.

Wei, S., and C. Zhang. 2003. Statistical and Economic Significance of Stock Return Predictability: A Mean–Variance Analysis. *Journal of Multinational Financial Management* 13(4): 443–463.

Wong, W. 2007. Stochastic Dominance and Mean-Variance Measures of Profit and Loss for Business Planning and Investment. *European Journal of Operational Research* 182(2): 829–843.

Wong, W., and C. Li. 1999. A Note on Convex Stochastic Dominance. *Economic Letters* 62(3): 293–300.