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Source: *The Economic Journal*, Vol. 106, No. 434 (Jan., 1996), pp. 39-59

Published by: [Blackwell Publishing](#) for the [Royal Economic Society](#)

Stable URL: <http://www.jstor.org/stable/2234930>

Accessed: 14/10/2010 15:29

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THE ROLE OF INFORMAL FINANCE IN HOUSEHOLD CAPITAL ACCUMULATION: EVIDENCE FROM TAIWAN*

Timothy Besley and Alec R. Levenson

Economies that experience rapid growth also experience major changes in their consumption patterns, particularly for consumer durables. This paper studies the diffusion of durables in Taiwan between 1977 and 1991. We focus on the link between household accumulation of durables and participation in informal financial institutions. While growth in *per capita* income in Taiwan has been great, many households still rely on traditional forms of finance. We test the idea that rotating savings and credit associations, which are found worldwide, exist to lower the cost of saving for durables. Our analysis finds evidence of that link.

The rapid emergence of Taiwan as an industrialised economy has created a population whose consumption patterns, particularly for durable goods, are converging to those seen in industrialised countries. Since durable goods tend to be lumpy, access to a ready source of finance should reduce the cost of acquiring them; yet in Taiwan a pronounced reliance upon traditional financial institutions remains. In this paper, we study the pattern of durable goods diffusion in Taiwan and relate it to participation in rotating savings and credit associations (*roscas*). Broadly, our analysis focuses on the importance of informal financial intermediation for aiding capital accumulation in a developing economy. Our data provide a unique opportunity to measure the importance of small-scale intermediaries on the real side of the household economy. The evidence suggests that *roscas* are an important way for households to reduce the cost of durables acquisition.

Roscas are informal financial institutions that are found worldwide. In a *rosca* a group of individuals, typically who work in the same place or live in the same community, gather for a sequence of meetings. At each meeting, all *rosca* members put a contribution into a 'pot'. The pot is then allocated to one member by drawing lots or bidding. At future meetings members are required to contribute, with past winners excluded from receiving the pot. The meeting process repeats itself until each member has received the pot once. The winners' obligation to continue their contributions to the end of the *rosca* is enforced by the network of social ties that bind the community together. A typical

* We thank two anonymous referees, Dale Adams, David Card, Karen Needels, Christina Paxson, James Trussell, Kristen Willard, and participants at the 1994 NBER/ITAM Inter-American Seminar on Economics for their helpful comments; and the Directorate General of Budget Accounting and Statistics for providing the data. Levenson thanks the Center for International Studies at Princeton University and the Bradley Foundation for financial support. Gina Franco, Reiko Ishii and Cindy Zoghi provided excellent research assistance. This publication was made possible in part through support provided by the U.S. Agency for International Development under Cooperative Agreement No. DHR-0015-A-0031-00 to the Center on Institutional Reform and the Informal Sector (IRIS) and administered by the Office of Economic and Institutional Reform, Center for Economic Growth, Bureau for Global Programs, Field Support and Research. Any errors are our own.

Taiwanese *rosca* meets once a month, lasting for two to four years (Mao, 1985).¹ Roscas are a widespread form of financial intermediation in Taiwan (see our discussion of the data below). Studies of roscas to date have not provided evidence on their importance in durable goods acquisition. Taiwan provides an interesting context in which to study this.

There is a widespread view that Taiwan has achieved remarkable economic growth *despite* an underdeveloped formal financial sector. For example, '[i]n spite of all these shortcomings... [t]he financial system as a whole must have contained enough resilience and elasticity to meet the most urgent needs of a rapidly growing economy in a great transformation process' (Lundberg, 1979, p. 280). This 'resilience' is attributed to the large curb market, which bridges the needs of small businesses and consumers excluded from bank credit. For example, postdated cheques (by businesses purchasing from suppliers) and other informal credit arrangements have enabled small businesses to thrive (Cheng, 1986, p. 149; Wade, 1990, pp. 162–3). Our analysis suggests that, even if roscas draw savings away from the formal banking sector, they may stimulate demand for durables by households. Models of growth and development based on domestic demand, such as those of Rosenstein-Rodan (1943), Scitovsky (1954) and, more recently, Murphy *et al.* (1989), suggest that this could constitute an important feature of the development process.

Our analysis must be seen in the context of an economy that has achieved a remarkable savings rate (around 20%) for a prolonged period. This does not, however, imply that individuals would not benefit from intermediation, even of the kind provided by roscas. The latter can best be thought of as allowing their participants to reap gains from intertemporal trade.² One function of roscas is to allow a given stock of savings to be used more efficiently, although roscas may also affect the magnitude of savings. Even individuals with high savings propensities can be better off accumulating to buy durables in a *rosca*. Indeed the continued importance of such institutions in Taiwan is itself suggestive evidence of this.

The remainder of the paper is organised as follows. In the next Section we describe the data and explore the basic patterns of durable ownership and *rosca* participation. Section II begins with a discussion of the conceptual link between *rosca* participation and durable goods acquisition. We then construct an empirical specification that is motivated by this discussion. The empirical results are presented in Section III. Concluding remarks are offered in Section IV.

¹ There is a large anthropological literature on roscas beginning with Geertz (1962) and Ardener (1964). There are also a number of case studies. Roscas exist under many different names, such as *Chit Funds* in India and *Tontines* in parts of West Africa. In Taiwan, they are called *Hui*. An economic analysis of roscas and comparison between different organisational forms is available in Besley *et al.* (1993, 1994).

² See Besley (1995) and Besley *et al.* (1993) for further development of this idea.

I. PRELIMINARY ANALYSIS

I.1. *Background*

Our data are from the 1977–91 Personal Income Distribution Surveys, a series of cross-section data sets. The sample sizes range from about 9,700 households in the first year to 16,000 in the later years. After dropping those households with improper values, the base data set we use for the graphical analysis consists of 229,821 households. All the regressions limit the sample to those households with heads aged 25–65, further reducing the sample to 212,046 households.

The information on durables is drawn from the survey's enumeration of household stocks of various items. We study nineteen goods which satisfy three criteria: they (i) are included in (almost) all the years, (ii) can reasonably be thought of as durable, and (iii) show at least some diffusion.³ These are colour televisions, refrigerators, telephones, air conditioner/heaters, electric rice cookers, electric fans, video cassette recorders (VCRs), stereo equipment,⁴ clothes washing machines, food mixers, electric/regular pianos, cameras, kitchen (exhaust) fans, gas stoves, microwave ovens, gas hot water heaters, automobiles, motorcycles, and computers. The questions enumerate the total number of each of these items the household owns. Here we study the initial acquisition of durables and classify a household as owning the durable if its stock is one or more.⁵ Table 2 (which we discuss further below), columns 4–6, reports the level of ownership in the first and last years, and the change between the two (i.e. diffusion), for those households with heads aged 25–65. Rice cookers and electric fans exhibit the lowest rates of diffusion in the fifteen years at under 5%; colour televisions, telephones, VCRs and kitchen fans are among the highest with greater than 60%.

Rosca information in our data is fairly limited. Though a household may participate in multiple roscas during the survey year, we only have aggregate information on (i) the total amount of money paid into a rosca since its inception if the household has not won the pot yet ('net saving'), and (ii) the total amount of money to be paid through the end of the rosca if the household has already won the pot ('net borrowing'). These two measures are reported on a recall basis for both the beginning and end of the survey year. There is very little information on the interest payments/bids. Since we are interested in rosca participation only, we count the household as participating during the survey year if any of the four rosca variables are nonzero.

³ Black and white televisions are an example of a durable which we do not analyse because during this time there is net decumulation by households.

⁴ We classify a household as owning stereo equipment if it owns any component, such as a record player or a compact disk player, in that year.

⁵ While there might be a link between acquisition of any durable and rosca participation it is in some ways cleaner to use the initial decision to acquire. If anything this will lead us to understate the importance of roscas.

1.2. *Rosca Participation in Taiwan: An Overview*

This section reviews some basic findings on participation in roscas, which are amplified in Levenson and Besley (1995). Roscas are a prevalent form of informal financial intermediation in Taiwan. Mao (1985, p. 141), for example, cites a 'conservative' estimate by Wen Li Chung that 'total Hui membership approximates 85% of the island's population'. A more accurate estimate is probably the one provided by a 1985 Ministry of Justice study that found that '68% of adults in Taiwan had participated in [hui]' (quoted in Winn, 1994, p. 214). Both of these estimates, particularly the latter, apparently indicate membership over an extended period; whereas our data measure active participation at a point in time (one year), naturally showing lower rates of participation.⁶ Our data show average yearly participation rates of 15–25% of all households (Table 1⁷).

Table 1
Household Rosca Participation by Year

| Year | Mean |
|------|-------|
| 1977 | 0.240 |
| 1978 | 0.265 |
| 1979 | 0.308 |
| 1980 | 0.290 |
| 1981 | 0.260 |
| 1982 | 0.267 |
| 1983 | 0.219 |
| 1984 | 0.120 |
| 1985 | 0.053 |
| 1986 | 0.179 |
| 1987 | 0.162 |
| 1988 | 0.163 |
| 1989 | 0.180 |
| 1990 | 0.199 |
| 1991 | 0.225 |

The sample size is 212,046.

Rosca participation is not stable through time. Table 1 shows a dramatic collapse in rosca participation between 1983 and 1985. Mao (1985, p. 141)

⁶ Liu (1987) used a sample frame similar to that used to collect our data to conduct his own survey. He reported 'total' household saving (borrowing) in roscas of NT 82.7 (82.0) billion for 1982. A direct comparison with the estimates from our data is not possible because Liu collected and reported information that differs from that available in the national sample we used. Liu apparently used an urban sample that consisted of only 1,030 households out of the more than 15,000 in our data. Differences in the time of year during which the data were collected or in the sampling weights used to construct national estimates may impede our ability to compare his estimates with ours. We were not able to verify whether such differences actually posed such a problem for comparison. We did, however, calculate that there was a total NT 48.1 (34.7) billion saved in (borrowed from) roscas at the end of 1982, according to our data. This does not include interest earned, and does not include funds from roscas that disbanded during the year. It is still possible that our data understate the extent of participation. We were not able to verify this, however, given the lack of comparable data.

⁷ Table 1 uses the subsample consisting of those households with heads aged 25–65. This is the sample used in all following tables. The estimates in Table 1 do not change if the entire base sample is used instead (differing at most by 1% in any year).

documents part of this episode: 'In November 1983, the financial sector of Taiwan was startled by the largest-ever-scale Hui default in her history ... [t]his incidence has led several legislators to urge for governmental regulation on Hui operation.' Though the initial default was apparently limited to one town, the size of the default was so large (approximately one hundred million in U.S. dollars) as to cause the politicians to take notice. The subsequent calls for regulation, as well as reevaluation by participants of the risk of roscas, most likely caused at least part of the fall in rosca participation starting in 1983 and continuing into 1984. There appear to have been a number of other large defaults as well. A writer for the *Financial Times* (1984) reported that '[m]any Hwei leaders have over the past few years simply run off with the cash. One recent case left investors short of an estimated \$9.75 m[illion].'

This period of financial turmoil continued into 1985. The Tenth Credit Cooperative, Taiwan's biggest credit union and one part of the Cathay banking and industrial group, collapsed in February 1985.⁸ This led to pressure for a government clampdown on the informal financial markets, in which the Cathay companies had had extensive dealings. Further, there was a significant shift of funds into the formal banking system, much of which reputedly came from the informal sector. After 1985, the recovery in rosca participation probably reflects revived confidence in the informal financial markets; and the fact that the proposed reforms which would have restricted access to those markets did not materialise. It should also be noted that 1985 was a year of 'recession' in Taiwan. GNP growth fell sharply to 5.6% from 11.6% in 1984, although it was back to 12.6% the following year (Republic of China, 1991). Such a negative shock may have engendered rosca failures if individuals had taken on significant commitments in anticipation of continued growth.

Roscas can serve a number of different functions.⁹ We focus on their role in allowing individuals to acquire durables earlier than through saving by themselves. In Taiwan, though, roscas also yield a higher return to saving than many other available sources;¹⁰ so this provides a potentially powerful inducement for participation.

⁸ According to newspaper accounts (*Economist*, 1985; *Financial Times*, 1985*a-d*; *Wall Street Journal*, 1985*a-d*) the Taipei authorities discovered that Tenth Credit had zero cash reserves and more than one hundred million (U.S.) dollars of virtually worthless loans as assets for an equally large amount of deposits. The scandal precipitated street demonstrations and government resignations.

⁹ Bouman (1977) and Geertz (1962) suggest purchasing a bicycle or a tin roof as typical purposes of a rosca. For Taiwan, Mao (1985, p. 153) cites the purchase of housing and renovation, and durable goods, as well as education expenses, wedding expenses and foreign travel. Wu (1980, pp. 28-9) also lists saving for education, weddings and travel in addition to saving for durables. Lumpy goods acquisition is not the unique function of roscas. Wu adds guarding against illness or calamity and emergency expenses among the additional motives for rosca participation, thus stressing that some insurance role may also be important (where a large lump sum payment may be involved). Wu and Hsueh (1991) and Mao (1985, p. 152) describe arbitraging roscas - whereby an individual participates in multiple roscas at the same time, using the early winnings from low interest rate roscas to finance the payments for high interest rate roscas. Thus roscas may be used simply for the high return to saving that they may yield.

¹⁰ Wu's (1980) survey found that (i) 75% of rosca participants in Taiwan believe that roscas 'are a very good way to save' (pp. 21-2) and (ii) typical interest rates range between 17 and 28% (pp. 109-11). Liu's (1987) survey yielded an average annual interest rate of 20.27% (p. 86). There is also the question of whether individuals pay tax on the interest earned in roscas.

Rosca participation in Taiwan increases with income (Levenson and Besley, 1995). This could reflect the more expensive durables purchased by the rich. It may also indicate that they derive larger gains from intertemporal trade. Further, low income individuals may have more erratic incomes than salaried workers, making them more susceptible to defaulting on their rosca contributions. Since the ability to make an uninterrupted stream of payments is a desirable characteristic for rosca participants, we should expect to see larger numbers of participants in the more stable, lower-turnover jobs. Levenson and Besley (1995) report evidence to support this. Below, we exploit this by using occupational variables as instruments.

I.3. *Durables Diffusion*

The standard model of the diffusion of technical innovations posits an S-shaped, or logistic, curve for the time path of adoption (see, for example, Griliches, 1957, on hybrid corn). The durables that we study are not innovations, in most cases having been available in other countries for some time. However, many of the issues raised there are pertinent for Taiwan.¹¹ For example, diffusion could represent a gradual learning process in which adopters acquire information about household durables as they observe others purchasing them.

However, the growth of income throughout the period is most likely the primary determinant of observed diffusion as the costs of durables relative to lifetime incomes fall throughout the period. Initially we expect only the richest households to purchase a particular durable. Then, as incomes rise, households in the densely populated middle of the income distribution would be able to afford the good; until, finally, only the poorest households would not have acquired the good.

Financing constraints may also be important for lumpy investments, as individuals desire to borrow to finance purchases. As Besley *et al.* (1993) show, this could lead to gradual diffusion of durables among a group of identical individuals. Capital market institutions then ration access to the good through time.

Durables diffusion in Taiwan conforms broadly to the logistic pattern. Fig. 1 shows the proportion of Taiwanese households that own a given durable for a number of different items over the years of our data.¹² Note that there have been dramatic changes in the composition of household durables ownership despite the short fifteen-year time span. The largest increases are for vcrs, kitchen fans, gas hot water heaters, colour televisions, telephones, air conditioner/heaters, washing machines, and cameras (see also Table 2). The

¹¹ See Deaton and Muellbauer (1980, pp. 366–72) for a review of the relevant literature and models.

¹² Though the logistic diffusion path is not traced out exactly by any individual commodity, each part of the S-curve is represented roughly by three different sets of the durables in Fig. 1. Those in Fig. 1(a) are at the initial stage of accumulation in the early years. Those in Figs 1(b) and (c) are in the middle stage of accumulation and those in Fig. 1(d) have reached almost complete saturation by the last year.

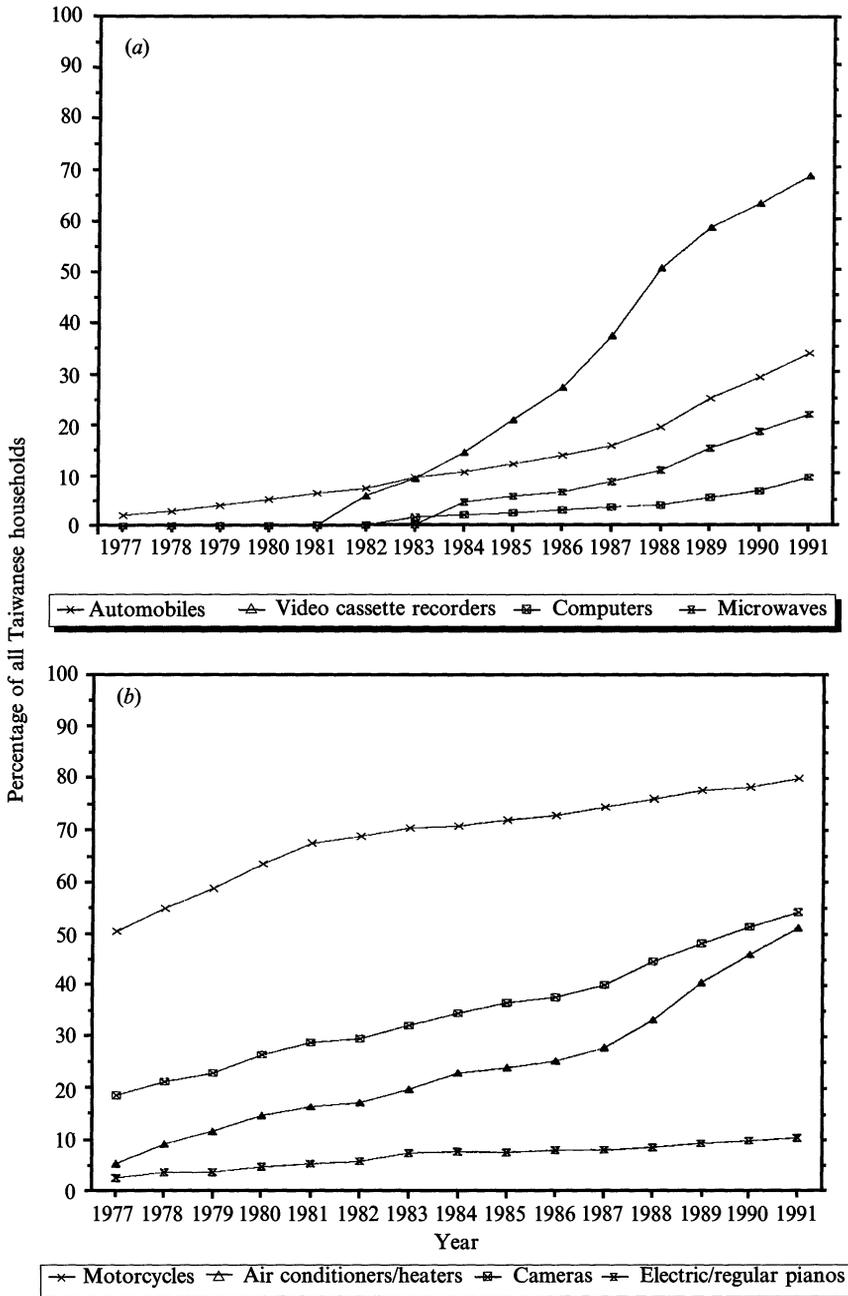


Fig. 1 (a, b). For legend see page 46.

increases in the fraction of households owning motorcycles and automobiles are slightly lower, but perhaps more impressive given the relatively high cost of these items.

Fig. 2 graphs the diffusion of four durables (clothes washers, telephones,

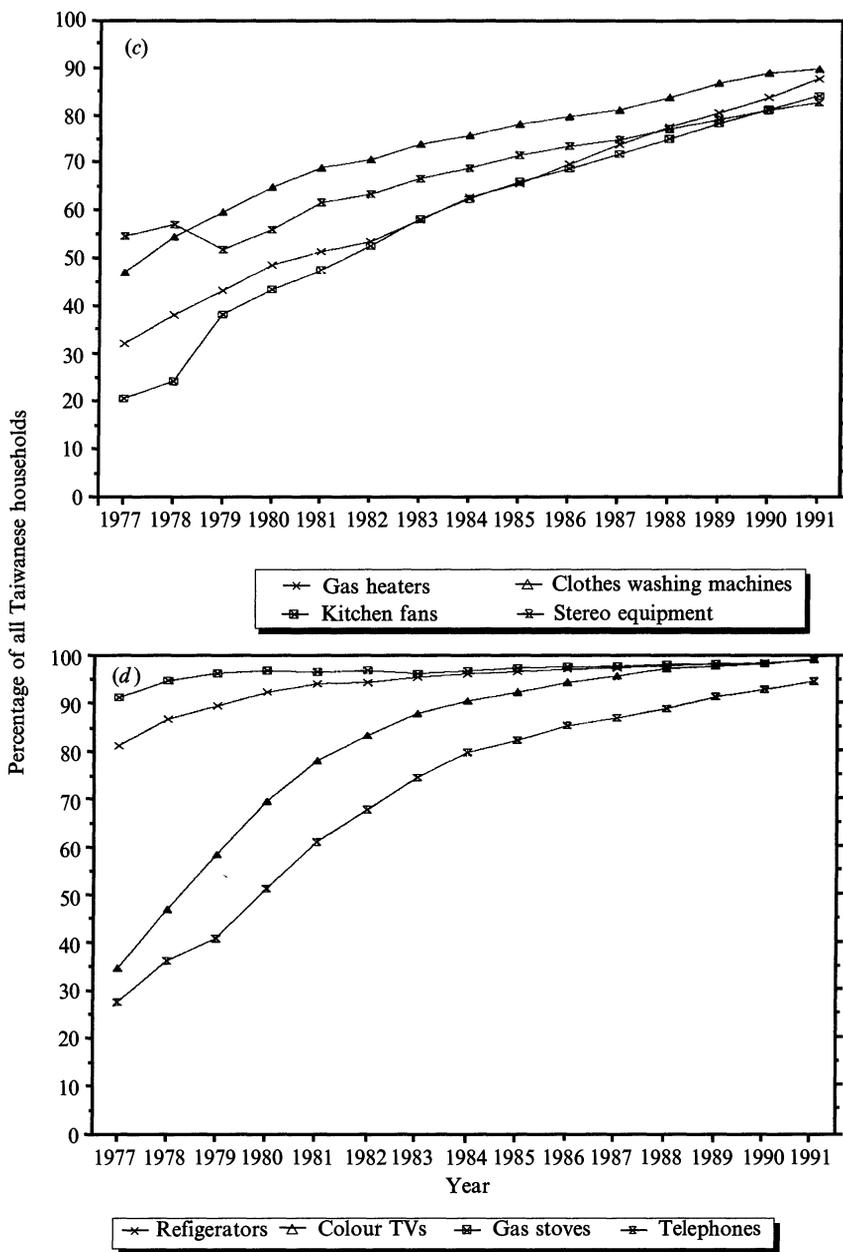


Fig. 1. Diffusion of various durables.

colour televisions and refrigerators) by income decile and rosca participation. In each case the two lines for the first decile correspond to the proportion of households within that decile who own the durable conditional on rosca participation, i.e. one line is for those in the decile who participate in a rosca

Table 2
Summary Statistics

| Durable | (1) Years | (2) Number of non-owners ($\sum_{c,t} not_{c,t-1}$) | (3) Number of cohort obs | (4) Aggregate ownership first year (%) | (5) Aggregate ownership last year (%) | (6) Change in- aggregate ownership (%) | (7) Mean (s.d.) frac. coh. acquiring |
|------------------|--------------|--|--------------------------------|--|---|--|---|
| Electric fans | 1977-90 | 8,958 | 520 | 92.2 | 96.3 | 4.1 | 0.049 (0.354) |
| Rice cookers | 1977-90 | 8,040 | 520 | 92.7 | 97.2 | 4.5 | 0.064 (0.351) |
| Gas stoves | 1977-90 | 5,504 | 518 | 91.6 | 98.4 | 6.8 | 0.132 (0.463) |
| Pianos | 1977-91 | 181,889 | 560 | 2.5 | 11.0 | 8.5 | 0.008 (0.022) |
| Computers | 1982-91 | 129,825 | 360 | 0.0 1982 1.5 1983 | 9.7 | 9.7 1982 8.2 1983 | 0.012 (0.018) 1982-91 |
| Food mixers | 1977-91 | 123,238 | 560 | 30.8 | 41.0 | 10.2 | 0.011 (0.065) |
| Refrigerators | 1977-91 | 9,477 | 558 | 82.0 | 99.3 | 17.3 | 0.213 (0.327) |
| Microwaves | 1983-91 | 108,961 | 320 | 0.0 1983 4.6 1984 | 22.5 | 22.5 1983 17.9 1984 | 0.032 (0.027) 1983-91 |
| Stereo equipment | 1977-91 | 61,423 | 560 | 54.8 | 83.7 | 28.9 | 0.061 (0.130) |
| Motorcycles | 1977-91 | 56,350 | 560 | 51.4 | 82.7 | 31.3 | 0.052 (0.116) |
| Automobiles | 1977-91 | 170,418 | 560 | 2.1 | 36.1 | 34.0 | 0.028 (0.038) |
| Cameras | 1977-91 | 125,417 | 560 | 19.1 | 56.6 | 37.5 | 0.042 (0.060) |
| Clothes washers | 1977-91 | 48,598 | 560 | 47.8 | 90.8 | 43.0 | 0.107 (0.135) |
| Air con/heaters | 1977-91 | 148,553 | 560 | 5.2 | 52.0 | 46.8 | 0.046 (0.054) |
| Gas heaters | 1977-91 | 73,630 | 560 | 32.7 | 88.3 | 55.6 | 0.099 (0.100) |
| Kitchen fans | 1977-91 | 79,466 | 560 | 21.0 | 85.3 | 64.3 | 0.109 (0.093) |
| Colour TVs | 1977-91 | 32,540 | 559 | 35.0 | 99.5 | 64.5 | 0.242 (0.149) |
| Telephones | 1977-91 | 53,876 | 560 | 28.0 | 95.7 | 67.7 | 0.165 (0.124) |
| VCRs | 1981-91 | 104,070 | 400 | 0.0 1981 6.1 1982 | 70.7 | 70.7 1981 64.6 1982 | 0.099 (0.072) 1981-91 |

Each durable was enumerated in 1977 with the exception of vcrs, microwaves and computers, which were first enumerated in 1982, 1984 and 1983, respectively. We implicitly assume that no one owned those three durables in the years prior to their enumeration.

The number of non-owners is the total number of households that did not own the durable (i.e. those in the 'at risk' population) for all the years except the last year, since only those households that did not own as of year $t-1$ were used in calculating the conditional expectations.

The means in column seven are weighted by the number of non-owners (column two).

during the year, the other for those who do not. Fig. 2 is a nonparametric way of examining the relationship between rosca use and durable ownership, controlling for income.¹³

The relationships depicted in Fig. 2 are between durables ownership and rosca participation, but inferences can also be made about durables purchases. Although the data do not distinguish ownership of durables from those purchased during the survey year, the difference in the fraction of households

¹³ Graphs of durable ownership by rosca participation alone (not reported) show that, in the case of almost every single durable, ownership is significantly higher among rosca participants in every year. However, there is a spurious correlation caused by income. The graphs by income decile and rosca participation show virtually no difference between rosca participants for a number of durables (computers, microwaves, and pianos); and for the rest, which show patterns similar to, though not as stark as, those in Fig. 2, the effect either is present, only in or is strongest for the lower deciles of the income distribution.

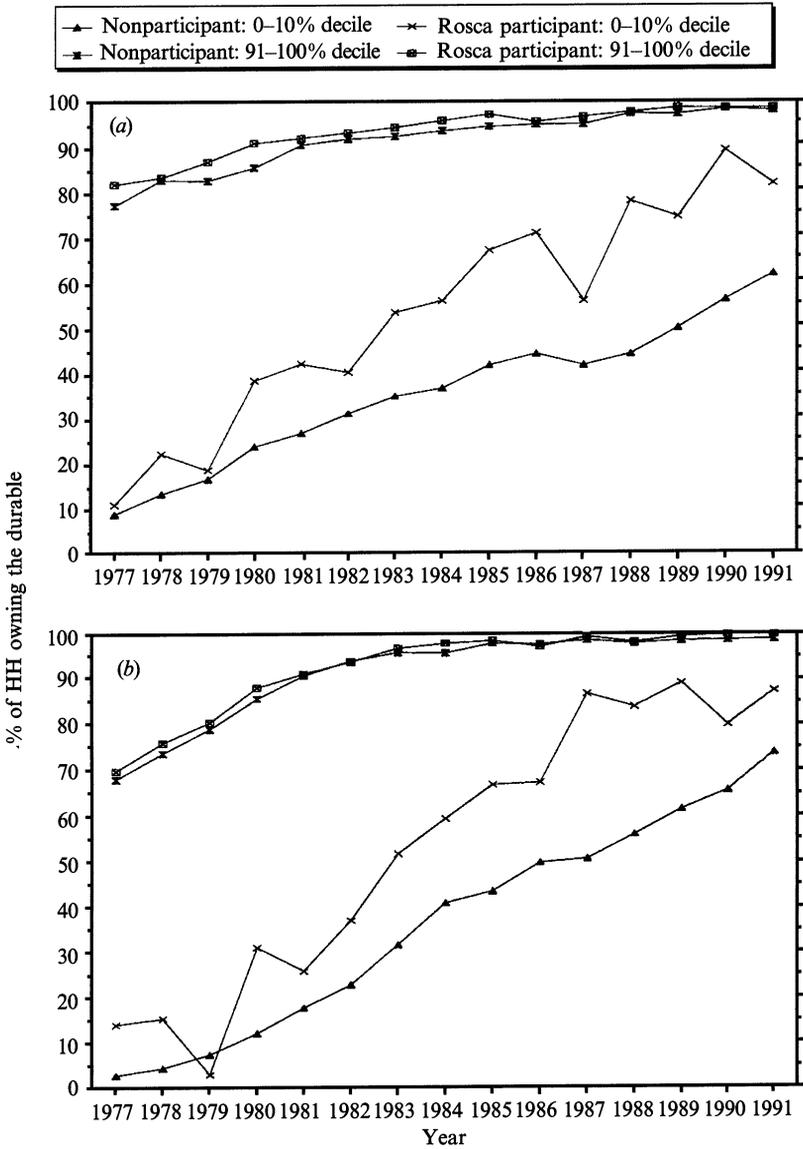


Fig. 2 (a, b). For legend see facing page.

owning a good from one year to the next gives a reasonable indicator of acquisition rates.¹⁴ Fig. 2 reveals that the level of ownership of each of the durables among households in the first income decile is higher for rosca participants in (almost) every year; while there is virtually no greater level of

¹⁴ We are implicitly assuming that there is little movement of individual households from one income decile to another between years. Undoubtedly there are some households whose income grows or falls more rapidly than average for their decile, thereby causing them to rise into/fall down to the adjoining income decile. However, for the society as a whole it is highly unlikely that these households make up more than a small fraction of the population.

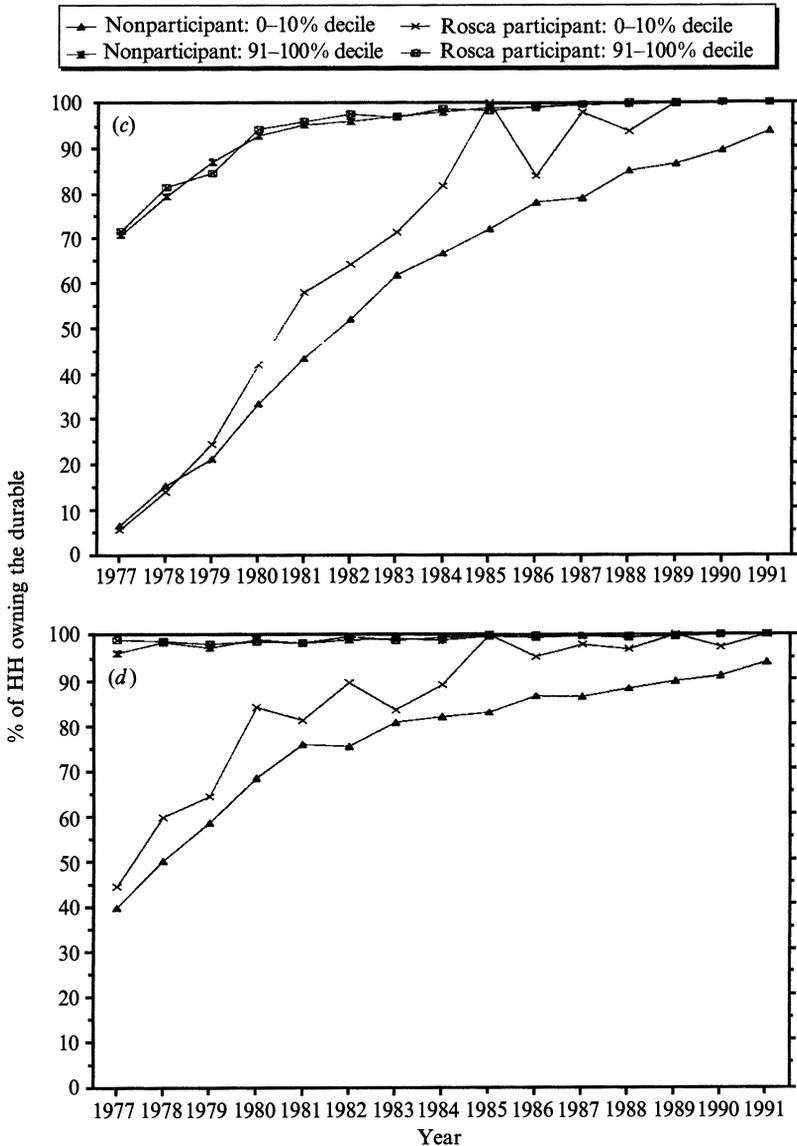


Fig. 2. Ownership of selected durables by income decile and Rosca participation. (a) Clothes washers; (b) telephones; (c) colour TVs; (d) refrigerators.

ownership for Rosca participants in the tenth decile (with the possible exception of clothes washing machines). The first and last income deciles show the greatest contrast, although the pattern exists for other deciles as well. It is least perceptible for the middle and upper income deciles. The graph shows only a positive association between Rosca use and durables purchase. Nonetheless, the pattern is consistent with the motivations for Rosca use described above: a vehicle for saving (purchasing durables) for high (low) income households. Our analysis below explores this link further.

II. FRAMEWORK

II.1. *Conceptual Background*

A theoretical perspective on the link between rosca participation and durable goods acquisition is developed in Besley *et al.* (1993, 1994). They show that in a world where a group of individuals wishes to gain access to an indivisible durable consumption good, and has no access to external finance, a rosca provides a means of realising gains from intertemporal trade.

The idea is easily illustrated by means of an example. Consider ten individuals each of whom wishes to own a durable that costs \$100. Left to their own efforts, they might save \$10 per week over ten weeks. After that each individual would be able to enjoy the services of the durable. This is inefficient. After only one week, it would be possible to pool the joint savings of the ten individuals to buy one durable. Thus one (lucky) individual could enjoy its services after only a week of saving rather than having to wait for the full ten weeks. The same would be true in the second week. In fact, by the tenth week everyone would own a durable except the last individual who receives it then, precisely when he would have received it had he saved on his own. The result is a Pareto improvement – every rosca member gains over the no-trade outcome, or at least is no worse off (the case for the last person).

The group must, however, find a means of rationing access to the durable since everyone would want to receive the \$100 pot in the first week. The two principal methods of rationing access to the pot are drawing lots (what Besley *et al.* call a *random rosca*) and bidding (a *bidding rosca*). The latter creates something akin to an interest rate profile as those who receive the pot early pledge to compensate those who wait by offering larger future contributions. In the *hui* that are studied here, bidding is normally used. In Taiwan it is not

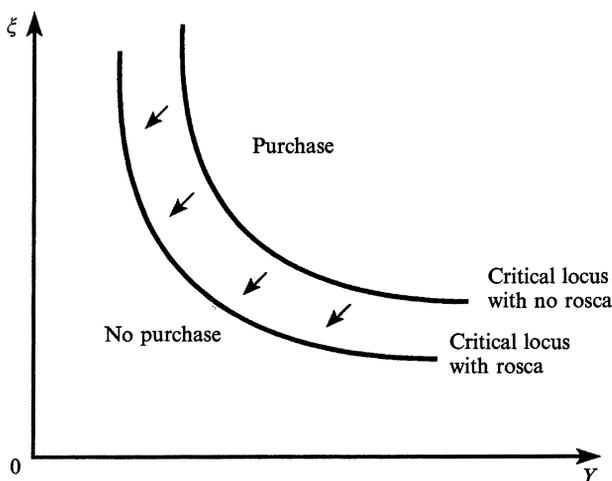


Fig. 3. The effect of joining a rosca on durables purchase.

uncommon to hear that some individuals (the relatively wealthy) join rosca with no immediate desire to purchase durables. They aim to earn interest from the premiums paid by the rosca members who win the pot early on.

Suppose now that we parameterise individuals by two characteristics: Y is a measure of their income and ξ is a measure of how much they value a particular durable good. The locus in Fig. 3 illustrates the critical values of these characteristics which make individuals indifferent between acquiring and not acquiring a durable. Joining a rosca shifts this locus downwards and to the left. This implies that individuals who would not previously have found it worthwhile to buy the durable now wish to. This yields two empirical hypotheses:

Speed: Joining a rosca allows a group of individuals to speed up their acquisition of a given durable good.

Depth: The existence of rosca expands the set of individuals who choose to buy a given durable so that overall diffusion extends more deeply into the population.

The above discussion assumed no access to external sources of finance. This reflects the reality in Taiwan for many individuals who seek consumer credit.¹⁵ We also ignored default problems in the rosca. By being formed from among members of the same community (i.e. friends and relatives) or the same work place, rosca can circumvent many of the information and enforcement problems which pervade capital markets in the early stages of economic development. Rosca may also avoid government regulation.

However, not all individuals choose to save by participating in rosca. Some have good sources of capital elsewhere, for example a bank loan or an inheritance. Others do not have access to a social network in which rosca flourish. Since individuals tend to contribute fixed amounts of their incomes to the rosca pot, we would also expect to see rosca more prevalent among occupations with relatively stable income streams. Long job tenure should also be complementary with ability to enforce repayment. Both of these points underscore the finding in Levenson and Besley (1995) of higher rosca participation in the more-secure government jobs.

II.2. *Empirical Specification*

Our empirical specification has two main features: (i) a functional form that permits consistency with the micro data, even though the estimation is conducted on grouped data; and (ii) a fairly flexible relationship between age and the characteristics of durables' purchasers.

Consider the decision of household i to buy a durable good for the first time, assuming a unit demand. We represent this by the household's *hazard* function, denoted by $\lambda_i(t)$, which gives the probability that it decides to purchase the

¹⁵ In some countries such as Taiwan, the government has biased financial sector development towards the industrial and away from the consumption sector in the belief that this better promotes long run economic development.

durable t periods after the durable first became available (conditional on not already having purchased).¹⁶ We suppose that this takes the following form:

$$\lambda_i(t) = \lambda_0(t) + \beta' \mathbf{X}_{it} + \epsilon_{it}, \quad (1)$$

where $\lambda_0(t)$ is the common *baseline hazard* which depends only on time, \mathbf{X}_{it} is a vector of demographic characteristics of the household, and ϵ_{it} is an idiosyncratic error term. Since (1) is linear in \mathbf{X}_{it} , we can aggregate across individuals to get the cohort hazard.

We do not measure a household member's access to roscas, only whether anyone in the household actually participates. Ignoring concerns about endogeneity, we include a dummy variable r_{it} in (1), which equals one if any household member participates in a rosca, zero otherwise. Thus we have:

$$\lambda_i(t) = \lambda_0(t) + \beta' \mathbf{X}_{it} + \alpha r_{it} + \epsilon_{it}. \quad (2)$$

The hypotheses that we claimed above are captured by $\alpha > 0$.¹⁷

We do not have panel data. Hence, we estimate the model on birth cohorts, constructed from the time-series of cross-sections; where the 'age' of the household is assumed to be the age of the household head. In doing so we replace the individual household level variables \mathbf{X}_{it} and r_{it} in (2) by cohort means, \mathbf{X}_{ct} and r_{ct} , conditional on not owning the durable at the beginning of period t . Similarly, we replace $\lambda_i(t)$ by $\lambda_c(t)$, which is the fraction of the cohort that own the durable during period t (a year in our data) conditional on not owning it at the end of period $t-1$. Since the number of people sampled from each birth cohort varies from year to year, our estimate of $\lambda_c(t)$ is calculated as:

$$\lambda_c(t) = \frac{own_{ct}/tot_{ct} - own_{ct-1}/tot_{ct-1}}{not_{ct-1}/tot_{ct-1}}, \quad (3)$$

where own_{ct} is the number of sample households in the birth cohort that own the durable at time t , tot_{ct} is the total number of households sampled from the cohort at time t , and not_{ct-1} is the number of sample households that do not own the durable at time $t-1$. We will use lower case notation (own , tot and not) to indicate sample values and upper case notation (OWN , TOT and NOT) for population values. Averaging (2) across the birth cohorts and conditioning on not owning at $t-1$, we thus obtain

$$\lambda_c(t) = \lambda_0(t) + \beta' \mathbf{X}_{ct} + \alpha r_{ct} + \epsilon_{ct}. \quad (4)$$

Note that the way we have defined λ means that α can be interpreted as the contribution of rosca participation to the net difference in the rate at which the durable is accumulated. An estimate of, say, 0.05 for α would indicate 5% faster diffusion of the durable for those cohorts that fully participated in roscas relative to those that did not participate at all. A difference in participation

¹⁶ For those households formed after the durable was introduced in Taiwan, the time frame is the number of periods since household formation.

¹⁷ It is not possible to specify separate tests of the two hypotheses about speed and depth of durables accumulation.

rates of 50% would translate into 2.5% faster diffusion for the same estimated α .

Our data do not permit direct estimation of (4). In theory, the variables in \mathbf{X}_{ct} should be the mean characteristics of the subset of households that had not purchased the durable prior to time t . We only actually observe whether a household owns the durable at the year's end. Hence, we use \mathbf{X}_{ct-1} , the average characteristics of the cohort members who did not own the durable at the end of period $t-1$. The main drawback with this is the fact that contemporaneous shocks to household characteristics will not be properly represented.

We also do not measure r_{ct} directly either. We know who participates in a rosca in period t , but not who among this group did not own the durable when the year began. However, in this case, even if we were able to observe this variable, there would be a question about including it uninstrumented in the regression due to the potential endogeneity of the decision to join a rosca; i.e. individuals may choose to join a rosca because they desire to purchase certain durable goods. Consequently we used r_{ct-1} , mean rosca participation among those who do not own the durable in the previous period, as the regressor. Since even this measure of participation may still be endogenous to the decision to purchase a durable – the household might have to join the rosca at time $t-1$ to ensure it has a good chance of winning the pot by time t – we also tried an instrumental variables specification detailed below.

To estimate $\lambda_0(t)$, first note that if a typical household in each cohort were formed at the same age, then we could estimate $\lambda_0(t)$ non-parametrically by including a set of age dummies in (4). However this may be too restrictive because there are systematic differences in age at first marriage between cohorts of different generations. To capture this we also include a set of cohort dummy variables. Finally, we allow the baseline hazard to depend upon macroeconomic variables, specifically, GDP growth, the interest rate on time deposits and the inflation rate. With the possible exception of the interest rate, we cannot offer a good structural interpretation of why these should be important. However, our aim is to capture the effect of macroeconomic shocks that might influence the durables purchase decision that are not captured in the period $t-1$ cohort characteristics that we include.

Substituting the age and cohort variables into (4), the basic equation to be estimated is thus

$$\lambda_c(t) = \gamma' \mathbf{\Gamma} + \delta' \mathbf{\Phi} + \theta' \mathbf{Z}_t + \beta' \mathbf{X}_{ct-1} + \alpha r_{ct-1} + \epsilon_{ct}, \quad (5)$$

where $\mathbf{\Gamma}$ is a vector of age dummies, $\mathbf{\Phi}$ is a vector of cohort dummies and \mathbf{Z}_t are the macroeconomic variables. It is worth noting that sampling error can result in negative values for $\lambda_c(t)$ even if the underlying population has a non-decreasing level of ownership, i.e. $(OWN_{ct}/TOT_{ct} \geqslant OWN_{ct-1}/TOT_{ct-1})$. The fraction of cohort/year observations with negative values will typically be larger (i) the slower is the underlying rate of diffusion in the cohort population (i.e. the smaller is $OWN_{ct}/TOT_{ct} - OWN_{ct-1}/TOT_{ct-1}$), and (ii) the smaller is the number of observations sampled for the cohort in either of the adjacent years (i.e. the smaller either tot_{ct} or tot_{ct-1} is). This is indeed the case in our data.

Note also that (i) tends to be true if either the durable has diffused throughout the whole population (as in the case of gas stoves in our data), or if the diffusion path is relatively flat (as with pianos).

Equation (5) does not deal with our concern about the endogeneity of rosca participation. If individuals chose to join a rosca when they anticipate buying a durable, then we would find a positive association between rosca participation and durables accumulation in an equation such as (5). However, the causation would run in reverse, from durables acquisition to rosca participation. This is quite consistent with the theory. However, we could not rule out force of habit, custom or tradition driving rosca participation rather than desire to speed up capital accumulation. To provide convincing evidence that roscas produce faster and deeper diffusion we need to demonstrate a link between access to roscas and durables accumulation, thus measuring how making roscas available to otherwise excluded individuals would increase capital accumulation. Ideally, therefore, we need some variable that predicts rosca participation but can be excluded from the accumulation equation. Here, we experiment with using occupation in this way. This is valid if tastes for durables' acquisition are distributed independently of occupational choice. We also used twice-lagged cohort rosca participation (among the households that did not own the durable) as an instrument.

II.3. Cohort Formation

To estimate (5) using our data we restricted the analysis to those households with heads aged 25–65. Younger household heads are excluded because they are under counted in the data, due to military service and college attendance. Older household heads are excluded because they are potentially subject to sample selection bias. The household head in our data is defined as the person who makes the most money; thus when older parents retire their households might 'disappear' from the cohort as their incomes drop or they move in with their working children. For further discussion see Levenson (1993).

Summary statistics from the cohort data are contained in Table 2. The durables are arranged in increasing order of aggregate diffusion, from top to bottom. As indicated in column 1 not all the durables are enumerated in each year of the survey. In 1991, rice cookers, electric fans and gas stoves were dropped from the survey. Similarly, vcrcs, microwaves and computers were added to the survey in 1982, 1984 and 1983, respectively. The number of cohort/year observations is in column 3, and the number of households used to calculate the cohort means ($\sum_{c,t} not_{ct-1}$) is in column 2. The last column contains the mean and standard deviation of $\lambda_c(t)$, the fraction of the cohort ('at risk') that acquires the durable.

III. RESULTS

The results from running (5) for each of the nineteen durable goods are reported in Table 3. In the first column we report α , the effect of rosca participation on the rate of accumulation. The durables are arranged, as in Table 3, with the slowest diffusers listed first.

Table 3
Basic Durables Accumulation Regression

| Durable | Mean cohort rosca participation | t-statistic | Root MSE | Number of observations |
|------------------|---------------------------------|-------------|----------|------------------------|
| Electric fans | 0.448 | 2.17* | 0.365 | 520 |
| Rice cookers | -0.128 | 0.77 | 0.369 | 520 |
| Gas stoves | 0.182 | 0.90 | 0.463 | 518 |
| Pianos | 0.033 | 1.48 | 0.022 | 560 |
| Computers | 0.108 | 3.19** | 0.016 | 360 |
| Food mixers | 0.175 | 2.99** | 0.064 | 560 |
| Refrigerators | 0.054 | 0.30 | 0.342 | 558 |
| Microwaves | 0.142 | 2.31* | 0.025 | 320 |
| Stereo equipment | 0.190 | 1.70 | 0.124 | 560 |
| Motorcycles | 0.216 | 1.82 | 0.117 | 560 |
| Automobiles | 0.063 | 2.19* | 0.031 | 560 |
| Cameras | 0.159 | 2.89** | 0.058 | 560 |
| Clothes washers | 0.181 | 1.48 | 0.133 | 560 |
| Air con/heaters | 0.221 | 5.50** | 0.046 | 560 |
| Gas heaters | 0.323 | 3.66** | 0.097 | 560 |
| Kitchen fans | 0.272 | 3.29** | 0.094 | 560 |
| Colour TVs | 0.271 | 1.88 | 0.149 | 559 |
| Telephones | 0.142 | 1.24 | 0.117 | 560 |
| VCRs | 0.078 | 1.72 | 0.049 | 400 |

* Significant at 5 %; ** significant at 1 %.

The dependent variable is the within-cohort increase in the rate of ownership of the durable good. The standard errors have been corrected for arbitrary forms of heteroskedasticity. Each regression contains a constant; GDP growth; time deposits interest rate; consumer price inflation; and controls for whether the household head is a mainlander, the number of other income earners in the household who are mainlanders, total household income, the number of children, the number of adults, and the occupation of both the household head and other household members.

The results give reasonable support to the view that there is a positive association between rosca participation and durable goods acquisition for these data. The results reveal that almost every coefficient is positive. Moreover, the coefficients are significant at better than 5 % for around half the durables and about one-third are significant at 1 %. Among those that are significant, rosca participation is associated with faster durables accumulation on the order of 6–45 %. Taken together, the table provides some encouragement to the view that there is a positive relationship between rosca participation in a cohort and the decision to acquire durables. Of particular note is the positive coefficient for the acquisition of automobiles which, at the very least, is consonant with anecdotal accounts.

The evidence is not an artifact of the specification adopted here. This kind of guardedly positive evidence, i.e. mostly positive coefficients, many of which are significant at better than a 5 % level of confidence, is characteristic of almost every specification that we have tried. More encouraging still, we have not been able to find sensible specifications in which we observe negative and significant coefficients on the rosca participation variable.

We also pursued a slightly different approach which uses the dramatic fall in rosca participation in the years 1983–5 (Table 1) as a natural experiment.

Table 4
Dummy for 1983–5 in Place of Mean Cohort Rosca Participation

| Durable | 1983–5 dummy | t-statistic | Root MSE | Number of observations |
|------------------|--------------|-------------|----------|------------------------|
| Electric fans | –0.110 | 2.59** | 0.364 | 520 |
| Rice cookers | –0.092 | 2.07* | 0.368 | 520 |
| Gas stoves | 0.082 | 1.42 | 0.462 | 518 |
| Pianos | –0.008 | 2.61** | 0.022 | 560 |
| Computers | –0.003 | 0.66 | 0.017 | 360 |
| Food mixers | –0.009 | 1.03 | 0.064 | 560 |
| Refrigerators | –0.095 | 2.15* | 0.341 | 558 |
| Microwaves | –0.022 | 0.43 | 0.026 | 320 |
| Stereo equipment | 0.004 | 0.26 | 0.124 | 560 |
| Motorcycles | –0.007 | 0.44 | 0.118 | 560 |
| Automobiles | –0.012 | 2.85** | 0.031 | 560 |
| Cameras | –0.024 | 2.97** | 0.058 | 560 |
| Clothes washers | –0.034 | 1.92 | 0.132 | 560 |
| Air con/heaters | –0.023 | 3.80** | 0.046 | 560 |
| Gas heaters | –0.028 | 2.41* | 0.098 | 560 |
| Kitchen fans | –0.042 | 3.64** | 0.094 | 560 |
| Colour TVs | –0.057 | 2.34* | 0.148 | 559 |
| Telephones | 0.015 | 0.86 | 0.117 | 560 |
| VCRs | –0.013 | 2.02* | 0.049 | 400 |

* Significant at 5%; ** significant at 1%.

The dependent variable is the within-cohort increase in the rate of ownership of the durable good. The standard errors have been corrected for arbitrary forms of heteroskedasticity. Each regression contains a constant; GDP growth; time deposits interest rate; consumer price inflation; and controls for whether the household head is a mainlander, the number of other income earners in the household who are mainlanders, total household income, the number of children, the number of adults, and the occupation of both the household head and other household members.

Our theory predicts that this should lead to a fall in durables acquisition *ceteris paribus*. To test this, we replaced the cohort level rosca participation variable with a dummy variable for the years 1983–5. The results are reported in Table 4. The predicted negative effect shows up in all the cases in which the rosca variable showed up as significant in Table 3, and is significant for most. It is, of course, crucial that there is no omitted macroeconomic variable which drives both the fall in rosca participation and durables accumulation during these critical three years. In pursuit of this, we augmented the set of macroeconomic variables with a number of leading indicators of Taiwan's macroeconomic performance without affecting the reported results. Thus, the idea that the period 1983–5 is special principally because of the decline in rosca participation during these years seems reasonable.

Our final specification attempts to deal with the issue of endogeneity. The results that instrument rosca participation with a set of occupational dummies and twice-lagged rosca participation are presented in Table 5. While there is no question that this weakens our results somewhat, there is still a good deal of consistency between these and the uninstrumented results. There are positive

Table 5
Rosca Participation Instrumented with Lagged Participation and All the Household Occupation Variables

| Durable | Instrumented mean cohort rosca participation | | F-test: exclude the instruments from second stage regression? | | F-test: the instruments are insignificant in the first stage regression? | |
|------------------|--|--------|---|---------|--|---------|
| | Coefficient | t-stat | Statistic | p-value | Statistic | p-value |
| Electric fans | -1.071 | 1.22 | 0.76 | 0.803 | 1.19 | 0.239 |
| Rice cookers | 0.268 | 0.42 | 0.72 | 0.845 | 1.38 | 0.102 |
| Gas stoves | -0.832 | 1.13 | 0.77 | 0.789 | 1.36 | 0.115 |
| Pianos | 0.109 | 2.23* | 0.53 | 0.973 | 3.91 | 0.000** |
| Computers | 0.041 | 0.58 | 1.21 | 0.225 | 4.77 | 0.000** |
| Food mixers | 0.383 | 2.14* | 0.76 | 0.800 | 2.49 | 0.000** |
| Refrigerators | -1.253 | 1.17 | 0.53 | 0.973 | 0.98 | 0.488 |
| Microwaves | 0.295 | 2.76** | 0.87 | 0.646 | 4.58 | 0.000** |
| Stereo equipment | -0.388 | 0.95 | 1.09 | 0.349 | 1.60 | 0.033* |
| Motorcycles | 1.263 | 2.79** | 0.40 | 0.997 | 1.62 | 0.029* |
| Automobiles | 0.084 | 1.20 | 0.50 | 0.983 | 4.13 | 0.000** |
| Cameras | 0.283 | 1.81 | 0.87 | 0.660 | 2.61 | 0.000** |
| Clothes washers | 0.112 | 0.26 | 0.89 | 0.621 | 1.56 | 0.41* |
| Air con/heaters | 0.345 | 3.54** | 0.67 | 0.895 | 3.85 | 0.000** |
| Gas heaters | -0.314 | 1.30 | 0.36 | 0.999 | 3.10 | 0.000** |
| Kitchen fans | -0.447 | 1.61 | 0.38 | 0.998 | 2.15 | 0.001** |
| Colour TVs | 0.368 | 0.63 | 1.17 | 0.258 | 1.40 | 0.094 |
| Telephones | 0.209 | 0.51 | 0.59 | 0.948 | 1.89 | 0.006** |
| VCRs | 0.200 | 2.07* | 0.78 | 0.777 | 3.80 | 0.000** |

* Significant at 5%, ** significant at 1%.

Additional regressors: constant, GDP growth, time deposits interest rate, consumer price inflation, proportion of the (cohort's) household heads that are mainlanders, the average number of other income earners in the household who are mainlanders, the number of children, and the number of adults.

and significant coefficients in a number of cases and no negative and significant coefficients. The results passed a standard test of overidentification.¹⁸

IV. CONCLUDING REMARKS

This paper has investigated the role of a common informal financial institution in durable goods accumulation in Taiwan. Our results are broadly suggestive of an economically significant link between participation in rotating savings and credit associations and durables accumulation by households. This confirms the potential importance of the link between capital accumulation and the availability of financial institutions. In traditional development economics, the informal sector was very often written off as backward, irrelevant and antithetical to the goal of economic development. More recently, the contribution of the informal sector to economic development has

¹⁸ The reader might also note that the results are stronger if we include a set of year dummy variables as instruments for rosca participation. This, we conjecture, reflects the fact that the time pattern of rosca participation around 1984-5 is captured in the predicted rosca participation from the first stage regression.

been better appreciated. Our study presents preliminary evidence on the importance of informal finance, even in an economy that has undergone significant modernisation. Taiwan is now a middle income country which has many modern institutions and a relatively wealthy population. Even so, the use of informal finance remains quite strong. This is a reminder that some institutions may take more time to build than others, and that a banking system which serves the needs of the whole population cannot be created instantly. Roscas are observed frequently even in developed countries where access to capital markets may be limited for some groups.

Overall, our analysis underlines the notion that the informal sector can be productive. In this case it permits individuals to reap gains from intertemporal trade, which leads to increased capital accumulation. This may have some important implications for a number of discussions concerning the design of development policy.

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Date of receipt of final typescript: July 1995

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