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

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The Role of Informal Finance in Household Capital Accumulation: Evidence from Taiwan

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Abstract

Economies that experience rapid growth also experience major changes in their consumption patterns. This is especially noticeable in the context of 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, the emergence of a developed financial system appears to have been slower: 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.

JEL Classification: O16, O17, D91.

1 Introduction:

The emergence of Taiwan as an industrialized economy is one of the most striking phenomena of recent economic history. This has led to the creation of a population whose consumption patterns, particularly for durable goods, are converging to the patterns seen in industrialized countries. Accumulation of durable goods often entails lump-sum payments and, thus, requires a source of finance. Yet in Taiwan there still appears to be a pronounced reliance upon traditional financial institutions. 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). We argue that the latter are an important way for households to reduce the cost of durables acquisition.

This paper contributes to two areas of interest. The first is the study of durable goods diffusion. Our data from Taiwan reveal the kind of classical diffusion paths that have been shown for other economies. We develop an analysis of birth cohorts to investigate the determinants of early acquisition by economic and demographic characteristics. The second concerns the link between financial markets and capital accumulation in a developing economy, casting light on the role of informal financial intermediation in Taiwan during a period of rapid growth. Our data provide an opportunity to measure the importance of small scale intermediaries on the real side of the household economy. It is well known that many economies, especially those in the early stages of economic development, rely heavily on informal finance. However, data on participation in such financial arrangements is rare, especially when they are combined with other information about the household.

Roscas are a type of informal financial intermediation that is found world-wide. 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 of the meetings, 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 all 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. There is a risk that those who win in the early rounds might default on their payments. However, the obligation of the winners to continue their contributions through the end of the rosca is enforced by the network of social ties that bind the community together. In Taiwan a typical rosca might meet once a month, and last for two to four years (Mao (1985)).

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 organizational forms is available in Besley, Coate and Loury (1992, 1993). While roscas have been widely studied, there is almost no evidence on how important they are in durable goods acquisition. The rapidly growing economy of Taiwan provides an interesting and unique context in which to study this. There is little doubt that roscas are a widespread form of financial intermediation in Taiwan. Our data suggest that fifteen to twenty percent of households use roscas in a given year.

The view that Taiwan has achieved remarkable economic growth *despite* an underdeveloped formal financial sector is widespread: "[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 has been praised for its ability to bridge the needs of small businesses and consumers excluded from bank credit. For

example, postdated checks (by businesses purchasing from suppliers) and other informal credit arrangements have enabled small businesses to thrive (Cheng (1986), p. 149; Wade (1990), pp. 162-163). Roscas have sometimes been derided for drawing savings away from the formal banking sector. This criticism is consonant with the attitude that much early development economics took toward the role of the informal sector. Whatever the merits of this view, our evidence suggests that roscas do serve to facilitate capital accumulation at the household level and thereby stimulate demand for durables. According to models of growth and development based on domestic demand, suggested by Rosenstein-Rodan (1943), Scitovsky (1954) and, more recently, Murphy *et al* (1989), this could constitute an important feature of the development process.

Our analysis must be seen in the context of an economy which has achieved a remarkable savings rate (around twenty percent) 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 inter temporal trade.[1] 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 will be better off accumulating to buy durables in a rosca. Indeed the continued importance of such institutions in Taiwan is itself evidence of this.

The remainder of the paper is organized as follows. In the next section we describe the data and explore the basic patterns of durable ownership and rosca participation. We build a theoretical model to analyze individuals' decisions to acquire durable goods, with and without access to a rosca, in section three. That model forges a link between rosca participation and

[1]See Besley (1993) and Besley Coate and Loury (1993) for further development of this idea.

durable goods acquisition that we should expect to see in the data. There we also discuss the decision to participate in a rosca and on what this might depend. In section four we construct an empirical specification suggested by the theory. The empirical results are presented in section five. Concluding remarks are offered in section six.

2 The Data

2.1 Background

Our data are drawn from the 1977-91 Personal Income Distribution Surveys, a series of cross-section data sets. The sample sizes range from 9,717 households in the first year to 16,434 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.[2] These are color televisions, refrigerators, telephones, air conditioner/heaters, electric rice cookers, electric fans, video cassette recorders (vcr's), stereo equipment,[3] 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

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

[3]We classify a household as owning stereo equipment if it owns any component, such as a phonograph or a cd player, in that year.

questions enumerate the total number of each of these items the household owns. Here we will study the initial acquisition of durables and classify a household as owning the durable if its stock is one or more.[4] Table 3 (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 percent; color televisions, telephones, vcr's and kitchen fans are among the highest with greater than 60 percent.

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.[5] 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.[6]

[4] 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 might lead us to understate the importance of roscas.

[5] While rosca interest income and payments are recorded by the interviewer, they are only reported as one component of total interest paid and received from all sources, including banks. It is impossible, therefore, to obtain an accurate measure of the rosca interest amounts.

[6] One might argue that rosca "winnings" (whether the household won a rosca during the year) is the appropriate variable linking rosca use and durables purchase. However, in the estimation we use time $t-1$ rosca use in place of contemporaneous rosca use to address the issue of joint endogeneity of time t rosca use and durables purchase. Since some of those who did not win during time $t-1$ win during time t, time $t-1$ rosca participation for everyone in a cohort — both winners and otherwise — is the measure we decided to use.

2.2 Rosca Participation in Taiwan: An Overview

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," though this may indicate membership over an extended period as opposed to active participation at a given point in time. Our data suggest a more conservative estimate, with average yearly participation rates of 15-25 percent of all households (Table 1)[7]. This may understate the true participation rate. Liu (1987) surveyed a subset of the households who were in our data set in 1982; and reported total year-end household saving (borrowing) in roscas of NT 82.7 (82.0) billion, compared with NT 48.1 (34.7) billion in our data. Notwithstanding, we will put faith in the survey data that we have available to us here.

According to our data, rosca participation is far from stable through time. Table 1 (and Figures 2, 4 and 5) shows that there is a dramatic collapse in rosca participation between 1983 and 1985. Mao documents this episode noting that "[i]n 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." ((1985), p.141) Though the default was apparently limited to one small 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. Such 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.

[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 one percent in any year).

A writer for the Financial Times 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]." (1984)

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 clamp down 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 materialize.[9]

Although we focus here on acquisition of durable goods, roscas can serve a number of different functions.[10] In the absence of other sources for financing consumption, roscas allow individuals

[8]According to newspaper accounts (Economist (1985); Financial Times (1985a, 1985b, 1985c, 1985d); Wall Street Journal (1985a, 1985b, 1985c, 1985d)) 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 precipatated street demonstrations and government resignations.

[9]One should also note that 1985 was a year of "recession" in Taiwan. GNP growth fell sharply to 5.6 percent from 11.6 percent in 1984, although it was back to 12.6 percent 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.

[10]Bouman (1977) and Geertz (1962) suggest purchasing a bicycle or a tin roofs as a typical purpose 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. 28-29) 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

to acquire a durable earlier than if they had to save up the money themselves ahead of time. The relationship between rosca participation and income has a number of influences. For small durables at least, high income/wealth individuals would be able to purchase them without joining a rosca, suggesting a negative correlation between income and rosca participation. This argument is reinforced by the idea that individuals with high incomes also typically have better capital market opportunities.

There are, however, at least three reasons why the relationship between rosca participation and income could be positive. First, the demand for durables seems likely to be normal, so that richer individuals will save for larger purchases. Hence their demand for rosca participation could actually be higher than that of low income individuals. Second, the fact that rosca participants have to make regular contributions might also suggest a positive association between rosca participation and income. Low income individuals may tend to have more erratic incomes than salaried workers. Hence they may be more susceptible to defaulting on their rosca contributions. Third, roscas may yield a higher return to saving than other available sources. In Taiwanese bidding roscas, those who draw the pot first are net borrowers, and those who draw last are net savers, over the life of the rosca.[11] For those who draw the pot toward the end, there can be a return as high as twenty percent.[12] Despite the risk of default, interest rates this

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.

[11] Mao (1985) has a nice treatment of this.

[12] Wu's (1980) survey found that (i) seventy-five percent of rosca participants in Taiwan believe that roscas "are a very good way to save," (pp. 21-22) and (ii) typical interest rates range between seventeen and twenty-eight

high are undoubtedly a draw to some savers.

These three reasons imply that rosca participation may rise with income. Figure 2 graphs mean rosca participation by income decile, revealing that rosca participation is lowest in the poorest income deciles. It also reveals that rosca participation is greatest in the richest income deciles.[13] Hence rosca participation appears to be a normal good. This finding is supported in the series of linear probability regressions investigating rosca participation among households with heads aged twenty-five to sixty-five which we report in Table 2. Regressors include age of the head, log(income), the numbers of children and adults, and cohort (age of head in 1977).[14] The results also show that rosca participation declines with age and is greater among older generations.

The first column in Table 2 reveals a weak negative correlation between rosca participation and age of the head; and controlling for birth cohort of the head gives a much stronger negative relationship (column two). These life-cycle effects in rosca participation make sense, given the necessity of buying durables when first setting up home. We also find here that the older generations are more likely to participate. This may represent some kind of institutional inertia, where the younger individuals are more likely to embrace new formal sector intermediaries. The addition of log(income) in the third column makes the estimated effects even stronger: aging an

percent (pp. 109-111). Liu's (1987) survey yielded an average annual interest rate of 20.27 percent (p. 86). Note that since there are no fees deducted by the organizer in a Taiwanese rosca, the interest rate paid by borrowers is equal to that received by lenders.

[13]This is the general pattern for all years. In each year through 1986, though, the contrast is even stronger: each richer income decile has higher rosca participation than the preceeding one (i.e. rosca participation increases monotonically with income decile for 1976-86).

[14]The youngest cohort is aged twenty-five (eleven) in 1991 (1977).

additional year implies a two percent smaller probability of participating; whereas being born a year earlier implies an almost two percent greater likelihood of participating at any given age. This is not surprising given that income increases with age and declines with cohort (Deaton and Paxson (1992)). The income effect in column three is large and positive.[15]

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. To investigate this, Figures 4 and 5 graph participation by industry and occupation of the household head for all the survey years.[16] Ideally, we would like to have

[15] Excluding income in the first two columns forces the coefficient on age to pick up the positive correlation between income and rosca participation. This causes the coefficient on age to become less negative. Similarly, the exclusion of income in column two causes the coefficient on cohort to become less positive (because it picks up the negative correlation between income and rosca participation).

Adding controls for the numbers of children and adults in column four, and for a host of other variables in column six (detailed at the bottom of the table), does nothing to change the size or sign of the estimated relationships. Column five tries an alternate specification for the linear age and cohort terms, substituting a set of dummy variables for ranges of each variable: the base age (cohort) group is those twenty-five to twenty-nine (eleven to nineteen in 1977). Doing so confirms that the linear terms are sufficient to describe the relationship with rosca participation.

[16] There are thirteen industry (agriculture; forestry; fishing; mining; manufacturing; utilities; commerce; construction; transportation; finance, insurance, real estate; public administration, social service, personal service; unemployed; other) and fourteen occupation (agriculture; forestry; fishing; professional/technical; administrative/managerial; clerical; sales; service; manufacturing; transportation; laborer/apprentice; military on duty; unemployed; other) classifications used in our data. Note that those whose occupation are agriculture, forestry or fishing are a subset of all who report the same for their industry: a manager of a large farm with multiple workers under his/her supervision would report agriculture for industry and manager for occupation. Similarly, those on active military duty have public administration for their industry, and military for their occupation.

a simple measure of the industry and occupation makeup of the entire household. Since, on average, the head accounts for three quarters of household income, we believe that the industry and occupation of the head are reasonable approximations to the source of income for the household.

The industry participation rates in Figure 4 are broken up into three rough groups:

(i) High: transportation, finance/insurance/real estate, public administration, utilities;

(ii) Medium: commerce, construction, mining, manufacturing, fishing; and

(iii) Low: agriculture, forestry, unemployed.

A comparable classification for the participation rates by occupation in Figure 5 is less obvious:

(i) High: professional/technical, administrative/managerial, clerical;

(ii) Medium: sales, service, manufacturing, transportation, fishing, military; and

(iii) Low: agriculture, forestry, laborer, unemployed.

These classifications are roughly consistent with the story told above: those with seasonal, menial or no employment have the lowest rosca participation. Those industries with the highest rate of participation are four of the five industries with the largest fraction of workers employed either directly by government agencies or in government enterprises (the fifth is forestry).[17]

The link between government work and high rosca use holds within occupation as well. Table 1.2 provides a breakdown of mean rosca participation by occupation and government worker status of the household head. For most occupations, rosca participation is higher among those who work for the government (ignoring those occupation/status cells with only a handful of observations). The difference is about five to eight percent. There are a few exceptions, though.

[17]Looking at the urban/rural divide in rosca participation largely mimics this picture, since the proportion of workers in primary industries (agriculture, forestry, fishing, or mining) is the main basis of this classification.

There is no difference in rosca use between administrator/managers in the public and private sectors; transportation equipment operators who work for government agencies are *less* likely to participate (though those who work for government enterprises are more likely); and laborers who work for government agencies show a lower rate of participation, though the difference is not statistically significant.[18]

2.3 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 are studying are not actually innovations. In most cases, the goods have been available in other countries for some time prior to being acquired in Taiwan. However, many of the influences on the gradual diffusion of an innovation are still pertinent here.[19] For example, diffusion could represent a gradual learning process in which adopters acquire information about household durables as they observe others purchasing them. This kind of learning externality is commonly thought to be important in the diffusion of innovations and could certainly be part of the process in Taiwan.

However, the growth of income throughout the period is most likely the primary determinant of observed diffusion. The costs of durables relative to lifetime incomes fall throughout the period, so that for given tastes, we should observe durables acquisition. Initially only the richest households at the upper tail of the income distribution would desire to purchase certain items.

[18] Appendix A contains a more detailed investigation of the decision to participate in a rosca in our data.

[19] Deaton and Muellbauer (1980, pp. 366-372) provide a review of the literature and some different models that have been proposed for studying durable goods diffusion.

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 have not acquired the good.

Financing constraints may also be important in explaining observed patterns of durables acquisition, as we discuss in greater detail below. For lumpy investments, it may be desirable to borrow in order to finance purchases. Thus the decision to acquire durables might reflect capital market opportunities. As shown in Besley, Coate and Loury (1992), this could give rise to gradual diffusion of durables among a group of identical individuals. In this context the role of capital market institutions is to ration access to the good through time.

The pattern of durables diffusion in Taiwan conforms broadly to the logistic pattern. Figure 1 shows the proportion of Taiwanese households that own a given durable for a number of different items over the years of our data. Note that despite the short period, there have been dramatic changes in the composition of household durables ownership in a time span of just fifteen years. The largest increases are for vcr's, kitchen fans, gas hot water heaters, color televisions, telephones, air conditioner/heaters, washing machines, and cameras (see also Table 3). The 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.

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 Figure 1. Those in the upper left graph are at the initial stage of accumulation in the early years. Those in the upper right and lower left are in the middle stage of accumulation and those in the lower right have reached almost complete saturation by the last year.

Figure 3 graphs the diffusion of four durables (clothes washers, telephones, color 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 during the year, the other for those who do not. Figure 3 is a nonparametric way of examining the relationship between rosca use and durable ownership, controlling for income.[20]

The relationships depicted in Figure 3 are between durables *ownership* and rosca participation, but inferences can also be made about durables purchases. Although the data does not distinguish ownership of durables from those purchased during the survey year, the difference in the fraction of households owning a good from one year to the next gives a reasonable indicator of acquisition rates.[21] Figure 3 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 ownership for rosca participants in the tenth decile (with the possible exception of washing machines). The first and last deciles show the greatest contrast, although the pattern persists for other deciles as well. It is least perceptible for the middle

[20]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 Figure 3, the effect either is present only in or is strongest for the lower deciles of the income distribution.

[21]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.

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 empirical work will explore this link further.

3 Theoretical Considerations

This section develops a theoretical perspective on the link between rosca participation and durable goods acquisition. This draws heavily on earlier work by Besley, Coate and Loury (1992, 1993). The model developed here is not directly applicable since it offers a very stylized representation of roscas. It is intended to develop a precise way of thinking about the relationship between roscas and durable goods accumulation — the focus of this paper. The ideas behind the model are, however, quite general. We will discuss a number of extensions of the simple structure that we use prior to developing an empirical specification for the Taiwanese data.

Consider a group of individuals who live for T years and wish to acquire an indivisible durable consumption good which has utility value of ξ and does not depreciate. Their utility is assumed to be additive, and equals $v(c) + \xi$ if they own the durable and $v(c)$ otherwise, where c is nondurable consumption. We assume that $v(\cdot)$ is smooth, increasing and concave. We also ignore discounting. Without access to any kind of credit, they must save up to buy the good. For simplicity assume that accumulated funds earn a zero rate of interest. Then, if they reduce their consumption to c in order to save up for a durable which costs B, they must save until at least time t defined by $t(y - c) = B$. Their lifetime utility will then have two components: utility during the period when they are saving and utility afterwards when they own the durable.

Thus their lifetime utility is equal to $tv(c) + (T-t)[v(y)+\xi]$. Assuming they choose c and t to maximize lifetime utility their optimization problem is thus

$$\underset{c,t}{Max}\ tv(c) + (T-t)[v(y)+\xi] \quad \text{subject to} \quad (y-c) \geq B. \tag{1}$$

Substituting the constraint into the objective function, we can write the maximization problem as one of choosing c to maximize $T(v(y)+\xi) - B\{v(y) - v(c) + \xi)\}/(y-c)$. Finally, defining $\mu(y,\xi) \equiv \underset{c}{Min}\ \{v(y) - v(c) + \xi)\}/(y-c)$, the maximal value of lifetime utility can be written as:

$$T(v(y)+\xi) - \mu(y,\xi)B. \tag{2}$$

Besley, Coate and Loury (1992, 1993) give this the following interpretation. The first term is what lifetime utility would be if the durable were free so that no saving up were required; while the second term (deducted from this) constitutes the *cost of saving* for the durable. The key observation, developed below, is that joining a rosca lowers this cost.

To determine whether any individual will actually find purchasing the durable to be worthwhile under autarky, observe that individuals who did not save up would have lifetime utility of $Tv(y)$. Thus an individual with characteristics (y,ξ) will choose to acquire a durable good if and only if

$$T\xi - \mu(y,\xi)B > 0, \tag{3}$$

i.e. if the total consumption benefits of owning a durable exceed the cost of saving up. It

is straightforward to show that this defines a downward sloping locus in (y, ξ) space which is illustrated in Figure 6.[22]

To get a complete picture of the diffusion path without capital markets, note that the optimal acquisition date is $t(y, \xi) = B\mu_\xi(y, \xi)$. As shown by Besley, Coate and Loury (1992), this follows from (1) using the Envelope Theorem. It is straightforward to show that this date is increasing in B and decreasing in y and ξ. Hence a higher cost durable will require a longer saving up period. In addition, a higher income level or value of the durable will lead to an earlier date of acquisition. If both y and ξ are idiosyncratic, then we would observe a diffusion path in which those with higher incomes and valuations of the durable acquire it first. This is not unique to the case without capital markets, as we will soon see; however, it is reminiscent of some of the raw data presented in the previous section.

Taiwanese roscas seem mainly to use bidding to allocate the pot of funds accumulated at each meeting date. We again use the simple model developed in Besley Coate and Loury (1992) to illustrate how this might work. We are particularly interested to see how rosca membership affects the decision to acquire a durable. We suppose that n identical individuals get together to form a rosca. The bidding procedure is used to establish the order of receipt of the pot and we assume that this is determined at the initial meeting. A bid is a pledge to contribute a certain amount to the rosca at a constant rate over its life, in exchange for receiving the pot at a certain meeting date; a higher bid naturally entitling an individual to an earlier receipt date.

[22] To see this, we need to show that $T\xi - B\mu(y, \xi)$ is increasing in ξ and y. The first follows from observing (using the envelope theorem) that $B\partial\mu(\xi, y)/\partial\xi = t$. The second property holds if and only if: $v'(y) - \frac{v(y)-v(c)+\xi}{y-c} \leq 0$. Using the fact that the choice of c satisfies $v'(c)(y-c) - \{v(y) - v(c) + \xi\} = 0$, this reduces to $v'(y)/v'(c) - 1 \leq 0$, which holds since $v(\cdot)$ is concave and $c \leq y$.

If the bidding rosca lasts until time t, bids will determine who receives the durable at each of the meeting dates $\{t/n, 2t/n, 3t/n, \ldots, t\}$. With b_i denoting the bid of individual i, we suppose that individual i receives the pot at time it/n. A set of bids $\{b_i\}_{i=1}^n$ constitutes an equilibrium if (i) no individual could do better by out-bidding someone else for a place in the queue; and (ii) contributions are sufficient to allow each participant to acquire the durable upon receiving the pot. The first condition is an obvious requirement of any bidding equilibrium. The second precludes the desirability of saving outside the rosca.

Since in equilibrium, the utility of individual i is given by $tv(y - b_i n/t) + (T - t)(v(y) + \xi) + t(1 - i/n)\xi$, condition (i) then implies that

$$v(y - b_i n/t) + (1 - i/n)\xi = v(y - b_j n/t) + (1 - j/n)\xi, \tag{4}$$

for all i, j, while condition (ii) implies that

$$\sum_{i=1}^n b_i = B. \tag{5}$$

These two equations uniquely determine the bids $\{b_i\}_{i=1}^n$, given the rosca's length of t.

Assuming that the length of the bidding rosca is chosen to maximize the utility of its representative member, consider the consumption rate of individual i : $c_i \equiv y - b_i n/t$. Substituting this into (5) yields

$$t \cdot [y - \tfrac{1}{n} \textstyle\sum_{i=1}^n c_i] = B. \tag{6}$$

Take some individual j. Equation (6) implies that $c_i = v^{-1}(v(c_j) - (j-i)\xi/n)$, for all $i = 1, ..., n$. Hence all other individuals' consumption levels can be determined from the equal utilities condition once c_j is known. Moreover, defining

$$\lambda_j(c_j)\tfrac{1}{n} \equiv \textstyle\sum_{i=1}^{n}[v^{-1}(v(c_j) - (j-i)\xi/n)] \tag{7}$$

as the average consumption level for the group and using (6), we may write $t = B/(y - \lambda_j(c_j))$. Hence the utility level of individual j can be written as:

$$W(c_j) = T \cdot [v(y) + \xi] - B \cdot [v(y) - v(c_j) + j\xi/n]/[y - \lambda_j(c_j)]. \tag{8}$$

Since, all members have identical utility levels, by construction, maximizing the utility of a particular member is just the same as maximizing the common utility level. Thus we can view the problem solved by the bidding rosca as choosing c_j to maximize (8).

The soiution can be written as:

$$W_B = T \cdot [v(y) + \xi] - B \cdot \mu_B(y, \xi), \tag{9}$$

where

$$\mu_B(\xi) \equiv \underset{0 \le c \le y}{Min} \left(\tfrac{v(y) - v(c) + j\xi/n}{y - \lambda_j(c)} \right), \xi \ge 0. \tag{10}$$

The basic idea is the same as in the case of no credit institutions which we discussed above. In particular, the second term in (9) represents the cost of saving for a durable. Besley, Coate

and Loury (1992) demonstrate that for given (y, ξ) we must have $\mu_B(y, \xi) < \mu(y, \xi)$ so that the cost of saving is lower in a rosca. The reason for this result should be clear: individuals are allocated the durable good during the life of the rosca; whereas in the absence of credit they can purchase it only after they have saved an amount equal to B (which takes as long as the length of the rosca). The function of joining a rosca can thus be viewed as lowering the cost of saving. Again an individual who might join a rosca may choose not to acquire the durable at all. The condition for choosing to acquire the durable good is:

$$T\xi - \mu_B(y, \xi)B \geq 0. \tag{11}$$

Since individuals could do no worse than saving up by themselves, they will join a rosca only if $\mu_B(y, \xi) \leq \mu(y, \xi)$. Hence we have a key observation from an empirical point of view, which is illustrated in Figure 6. Having the option of joining a rosca shifts the locus of critical values of (y, ξ) at which an individual will desire to acquire a durable good down and to the left. This follows from the fact that the maximal value of lifetime utility is unaffected by joining a rosca and individuals who join a rosca do so only if it lowers the cost of saving. Thus, holding all other characteristics fixed, roscas lead to faster acquisition of a durable good because individuals acquire the good continuously during their rosca membership; whereas under autarky, they have to wait until the end of the accumulation phase to obtain the good. This is the central empirical implication of the model and motivates the test for a link between rosca participation and durables acquisition.

Before undertaking the test, however, it is important to acknowledge the limitations of the model and discuss some broader considerations not captured so far. First, the model says nothing

about what determines an individual's *ability* to participate in a rosca. To pursue this further, it is necessary to think about why roscas exist at all. In an economy with a fully developed system of credit markets, roscas are likely to be less valuable as a way of financing durable goods purchases: individuals may prefer to take out loans from banks in order to finance durables purchases. There are, however, good reasons why roscas are able to function even in situations where capital markets are less than fully developed. At the heart of this is the way in which roscas are able to circumvent the kinds of information and enforcement problems which pervade capital markets in the early stages of economic development.[23] Roscas are able to overcome many of these problems because they are formed on two main bases: among members of the same community (*i.e.* friends and relatives) or the same work place. The common denominator for most roscas in Taiwan is that, while each individual rosca member may not personally know everyone else, all members know the rosca organizer quite well.[24] This web of social connections enables roscas to bring social pressure and local knowledge to bear on individuals who might be delinquent if they borrowed from a formal credit market.

[23]See Besley (1993) for further discussion of this and more general financial development issues.

[24]Mao (1985); this phenomenon was also identified in conversations one of the authors had with rosca participants in Taiwan. Mao (1985, p. 144) claims that the organizer assumes the default risk posed by all members, in that any defaulting member's obligations are paid by the organizer. However our conversations revealed another risk-sharing scheme: in some cases an organizer responds to a default by immediately organizing another rosca with every member from the original one except for the defaulter. The pot from the first period, which is usually awarded to the organizer without a bid (*i.e.* interest free), is then divided equally among the participants (excluding the organizer); with the organizer forefeiting the right to collect the pot during the life of the rosca. Note that while the organizer pays a penalty either way, in the latter scenario those members who had already won at the time of default gain at the expense of those who had not yet won. This does not hold in the case described by Mao.

In conclusion, not all individuals may choose to save by participating in roscas. First, individuals may have good sources of capital elsewhere, such as a bank loan or an inheritance. Second, individuals may not have access to a social network through which they are able to join roscas. Roscas that are formed among groups with poor information and enforcement will often result in default.[25] The cost of saving in a rosca is clearly larger if there is a probability that some members will default, *i.e.* refuse to honor their membership after they have won the pot. Most roscas function by making individuals contribute a fixed amount of their incomes to the pot. Hence we should expect to see roscas more prevalent among occupations with relatively stable income streams. Since individuals need to know each other well to circumvent default problems, it would seem that roscas should be more likely to survive in occupations with relatively long tenure. Both of these points underscore our finding above that there is higher rosca participation in the more-secure government jobs and lower rosca participation in seasonal occupations such as agriculture.

4 Empirical Specification

Our empirical specification allows for a fairly flexible relationship between time and the characteristics of durables' purchasers. We choose a functional form that permits consistency with the micro data; even though the model is actually estimated on grouped data. Although this is

[25]This is clear from the nature of the types of relationships that characterize roscas that perform well. As described above, such roscas are formed among friends, family, and co-workers. The obvious corollary is that roscas formed among people with other types of relationships, where personal information is more limited and the ability to bring social pressure to bear is much lower, must have relatively high default rates. In equilibrium such roscas might even cease to exist.

somewhat restrictive, it makes the interpretation of the results much clearer.

We begin by considering the decision of household i to buy a durable good, assuming that it has a unit demand for the good and has not bought it previously. We represent this by the household's *hazard* function, denoted by $\lambda_i(t)$, which gives the probability that it decides to purchase the durable t periods after the durable first became available (conditional on not already having purchased).[26] We specify this as having the following functional form:

$$\lambda_i(t) = \lambda_0(t) + \beta' X_{it} + \epsilon_{it}, \tag{12}$$

where $\lambda_0(t)$ is the underlying probability of purchasing the good which depends only on time and is common across households (commonly called the *baseline hazard*), X_{it} is a vector of demographic characteristics of the household, and ϵ_{it} is an idiosyncratic error term. Since (12) is linear in X_{it}, we can easily aggregate across individuals to get the hazard function for the cohort.

Above, we suggested that belonging to a rosca should enable a household to acquire the durable earlier. We do not actually measure a household member's *access* to roscas, only whether anyone in the household actually participates. Ignoring for the moment possible concerns about endogeneity, we might consider including a dummy variable r_{it} in (12), which is equal to one if anyone in the household participates in a rosca. Thus we get:

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

$$\lambda_i(t) = \lambda_0(t) + \beta' X_{it} + \alpha r_{it} + \epsilon_{it}. \tag{13}$$

Our hypothesis is that $\alpha > 0$, *i.e. those households that participate in roscas have higher rates of accumulation,* all else equal.

We do not have panel data. We therefore estimate our 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 X_{it} and r_{it} in (13) by *cohort means*, 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:

$$\lambda_c(t) = \frac{\frac{own_{ct}}{tot_{ct}} - \frac{own_{ct-1}}{tot_{ct-1}}}{\frac{not_{ct-1}}{tot_{ct-1}}}, \tag{14}$$

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 (13) across birth cohorts and conditioning on not owning at $t-1$, we thus obtain

$$\lambda_c(t) = \lambda_0(t) + \beta' X_{ct} + \alpha r_{ct} + \epsilon_{ct}. \tag{15}$$

In fact our data do not permit us to estimate (15) directly either. In theory, the variables in 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 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 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. We tried two methods of estimation. One is to include average rosca participation for those who *own* the durable at time t as a regressor. Since this is not what theory tells us should appear on the right hand side, this introduces the possibility of measurement error as well as the aforementioned endogeneity problem. Hence we used r_{ct-1} (lagged rosca participation for the year $t-1$ population who *do not own* the relevant durable) as an instrument. The second, simpler, method is to estimate a reduced form where r_{ct-1} is used directly as a regressor. Fortunately our findings from pursuing both of these approaches were broadly similar and, in the interests of brevity, we chose to report the reduced form results using the second method.

To estimate $\lambda_0(t)$, first note that if a typical household in each cohort were formed at the

same age, then we could non-parametrically estimate $\lambda_0(t)$ by including a set of age dummies in (15). 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.

Substituting the age and cohort variables into (15), the basic equation to be estimated is thus

$$\lambda_c(t) = \gamma'\Gamma + \delta'\Phi + \beta' X_{ct-1} + \alpha r_{ct-1} + \epsilon_{ct}. \tag{16}$$

where Γ is a vector of age dummies and Φ is a vector of cohort dummies. 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., $(OWN_{ct}/TOT_{ct} \geq OWN_{ct-1}/TOT_{ct-1})$. 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).

4.1 Cohort Formation

To estimate (16) using our data we restricted the analysis to those households with heads aged 25-65, the same subset used in the rosca-age regressions in Table 2. 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 3. 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, vcr's, 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.

5 Results

5.1 Rosca Use and Durables Accumulation

The results from running (16) for a number of different specifications for each of the nineteen durable goods are reported in Table 4. In each column we report α, the effect of rosca participation on the rate of accumulation. The first column reports results from regressing $\lambda_c(t)$ on rosca participation and a constant. In each succeeding column, we include additional regressors (along with all regressors from the preceding one). The durables are arranged, as in Table 3,

with the slowest diffusers listed first.

The first column shows that the simple correlation between rosca participation and the rate of accumulation is positive and significantly different from zero (p-value $< .05$) for eight of the durables. It is negative and significant for automobiles and vcr's. The latter is not too worrisome given that we have not yet controlled for many other influences. In effect, the baseline hazard, $\lambda_0(t)$, is forced to be constant across age groups and cohorts.

After adding age and cohort dummies a clear pattern emerges. The coefficient on the rosca variable is positive and significant for a large number of the durables being studied. There is also no case in which the coefficient for rosca participation is negative and significant (p-value $< .10$). Moreover, as we might expect, rosca participation appears to have no statistically significant effect on the first three durables in the list, for which there is virtually no diffusion throughout the period. The addition of controls for total household income (column 3), demographic characteristics of the household (column 4),[27] and occupation (column 5)[28] does not change the basic pattern.

We take this as evidence in favor of our hypothesis: participating in a rosca in the previous year is associated with faster accumulation of durable goods in the current year. There are a

[27]The four demographic controls are (i) the proportion of the (cohort's) household heads that are mainlanders, (ii) the average number of income earners in the household who are mainlanders, (iii) the average number of children, and (iv) the average number of adults.

[28]The occupation controls consist of (i) a set of variables for the head indicating the proportion of the (cohort's) household heads employed in nine occupation classes (the base group is those who are unemloyed), and (ii) a set of variables for the other income earners in the household indicating the number employed in each of the ten occupation classes. In the latter case all ten occupation variables can be included in the regression because there is no separate control for the number of household members who are income earners.

large number of positive and significant coefficients which appear fairly robust across columns 2-5. Moreover, there are no durables for which roscas have a significant negative effect, only cases for which we cannot reject the effect being zero. Of the latter, we are most surprised by the results for automobiles for which we would have anticipated an effect; this appears to go away after controlling for income.[29] Ignoring the first three rows, there are sixty-four estimates of α in columns 2-5 (rows 4-19), of which only two are negative and not significantly different from zero, and of the rest, all are positive with forty-three significantly different from zero (p-value $<$ .10). Hence more than two thirds of the estimates show a strong positive association between rosca participation and the rate of durables accumulation (among those durables that exhibit greater diffusion). One might also note that a majority of the point estimates in Table 2 are greater than .10, with a large number lying in the .30 to .50 range. This implies that, for most durables, the use of a rosca increases the rate of accumulation by more than ten percent, and for some durables by thirty to fifty percent. This confirms the idea that roscas may play an economically important role.

Column 6 adds a set of year dummies. At first sight, this appears to weaken our results. We find that electric fans, which hardly diffuse at all, have a large and positively significant coefficient for rosca participation. Of the remaining durables, we are able to find a positive and significant effect only on food mixers and motorcycles. This is perhaps not too surprising; identification of the effect of rosca participation comes solely from the deviation of the cohort/age

[29] In a set of results not reported here, we used nondurable consumption rather than income as a right hand side variable. This makes sense if the latter provides a better proxy for permanent income than current income does. In that case the rosca effect on automobiles was positive and significant. The basic results using nondurable consumption were broadly similar to those where income was used.

mean from the aggregate time mean. Hence on purely statistical grounds we are not surprised to see little effect of roscas on durables accumulation in column 6: the only unexplained variation in rosca participation arises from differences in mean participation rates over time within each cohort that are independent of both life cycle influences (*i.e.* the age effects) and any aggregate movements in rosca participation (*i.e.* the time effects). This concern is amplified by recalling from Table 1.1, that there is a pronounced pattern in rosca participation through time, including a dramatic fall in rosca participation in 1983-85, whose reasons we discussed above. The year effects absorb a great deal of this year-to-year variation in aggregate rosca participation. The main reason to include year effects is to pick up the influence of any macroeconomic shocks on durables accumulation apart from their influence on aggregate rosca participation. Since we have already controlled for inter temporal differences in cohort income in columns 3-5, we have accounted for shocks coming from this source. While there may be other year-to-year shocks that we do not capture in the absence of year effects, the fact that we may be absorbing a great deal of variation that is really attributable to rosca participation is quite a significant price to pay for including them. Hence, we regard the results in column 5 as perhaps the most defensible specification for our purposes.

5.2 Durables Accumulation and Other Household Characteristics

Here we discuss other determinants of durable goods accumulation. Our discussion is based on Tables 1-19 in Appendix B.[30] Note the lack of a consistent link between income and the rate of accumulation. Income has a positive and significant effect on accumulation only for air conditioner/heaters, automobiles, motorcycles and washing machines; while for every other

[30] All of these regressions have age and cohort dummies which are not reported.

durable there is either no significant effect at all, or it is not consistently positive throughout. In fact for vcr's, income and the rate of accumulation are *negatively* correlated. The overall lack of a strong link between income and the rate of accumulation is surprising given the important role attributed to income by previous authors.[31] Of course, one story is that permanent rather than current income is more important in explaining durables acquisition and that the between cohort variation in this is well represented by cohort effects; so that mean cohort income has very little explanatory power on top of the pure cohort effect. This is indeed the case: excluding the cohort dummies causes the coefficient on income to be positive and significant for eleven of the durables, including vcr's. Of the remaining durables, which include all of the slowest diffusers, the income effect is insignificantly different from zero ($p < .05$).[32]

Holding income and age constant, one might expect that older generations should have slower rates of accumulation because of differences in taste. This is represented by the commonly held view that these generations are the last to acquire newly available consumer durables. If this story is true in Taiwan, then we should observe coefficient estimates for the cohort dummies that decrease linearly in cohort age. We do not report the entire set of coefficients for each regression. However, this pattern across cohorts does hold for air conditioner/heaters, cameras, color televisions, computers, food mixers, gas heaters, kitchen fans, stereo equipment and vcr's. For some of these the pattern is quite weak; and for all the other durables accumulation among older generations was not measurably slower at all. In fact, for automobiles, gas stoves and motorcycles, the opposite was true: the rate of accumulation was *faster* for each generation than

[31] See, for example, Deaton and Muellbauer (1980), and Bonus (1973).

[32] We do not report these results in the interest of brevity. The specification we used included income, the rosca varible, a constant, and the full set of age dummies as regressors.

the one following it (*i.e.* the one born a year later).

The relationship between accumulation and age is virtually opposite that between accumulation and cohort. In almost every single case, if accumulation is slower for older cohorts, it is faster at older ages. Hence for the nine durables listed above for which accumulation and cohort are negatively related, accumulation and age are positively correlated. If the pattern by age is dictated by life cycle considerations, our results suggest that higher per capita durables purchase may be more important not when households are initially formed, but rather as the children within those households are born and age.

Beyond these effects, there is little systematic relationship between the other household demographics and durables accumulation.[33] The coefficients on children, adults, the mainlander variables and the occupation controls are rarely significant; and when they are there is no consistent pattern across durables. While it may not be surprising to find that such household demographics do not register as significant for those durables with little change in aggregate diffusion; even within the subset of durables with large increases in diffusion there is no consistent pattern in the coefficient estimates for these variables.

6 Concluding Remarks

This paper has investigated the role of a common informal financial institution on the pattern of 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

[33] We include these regressors in part to address a potential omitted variable bias problem for the rosca coefficient. Rosca use is correlated with these variables. Hence if they are important in explaining durables diffusion, excluding them would force the rosca coefficient to pick up their influence on diffusion.

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 been better appreciated. Our study confirms the importance of informal finance, even in an economy that is undergoing significant modernization. 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 significant. 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 frequently observed, even in developed countries, where access to capital markets is limited.

Our analysis also gives pause for thought about the potential policy implications of a government crackdown on the informal financial markets in Taiwan. If roscas do serve a function in consumer demand for durables, as our analysis suggests, then attempts to force movement of savings toward the formal sector should take account of the productive role that the informal sector plays. While funds in the hands of the formal banking system may be put to more productive use than they would have been in the informal financial sector, this requires an act of faith. Moreover, it is the *relative* efficiency of the sectors that matters and one cannot assume that the funds located in the informal sector have no economic value.

Thus, overall, our analysis reinforces the view that the informal sector may play an important productive role, allowing individuals to reap gains from inter temporal trade and, thereby, increasing capital accumulation. Hence informal, non-market institutions can indeed be vital to the process of economic development.

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Table 1.1

Household Rosca Participation by Year

Year	Mean
1977	.240
1978	.265
1979	.308
1980	.290
1981	.260
1982	.267
1983	.219
1984	.120
1985	.053
1986	.179
1987	.162
1988	.163
1989	.180
1990	.199
1991	.225

The sample size is 212,046.

Table 1.2

Mean Household Rosca Participation by Occupation and Government Worker Status of the Head

Head's occupation	Private sector	Government Enterprise	Government Agency
Professional/technical	.241 (.006) [5941]	.319 (.011) [1962]	.320 (.006) [5442]
Administrator/manager	.259 (.004) [9730]	.264 (.020) [496]	.250 (.017) [677]
Clerical	.239 (.004) [13583]	.284 (.006) [6024]	.286 (.005) [7737]
Sales	.211 (.002) [29067]	.299 (.027) [281]	.172 (.071) [29]
Service	.175 (.004) [9926]	.216 (.014) [844]	.219 (.007) [3854]
Manufacturing	.191 (.002) [50300]	.273 (.007) [4195]	.251 (.014) [913]
Transportation	.226 (.004) [10218]	.272 (.012) [1361]	.195 (.015) [739]
Laborer/apprentice	.152 (.005) [5178]	.210 (.018) [524]	.139 (.020) [302]
Military	.00 (.00) [0]	.500 (.500) [2]	.250 (.007) [4106]
Unemployed	.045 (.003) [5233]	.00 (.00) [0]	.00 (.00) [0]
Agriculture/forestry/fishing	.126 (.002) [31155]	.228 (.026) [267]	.213 (.034) [145]

Standard errors in parentheses; sample sizes in brackets. The base sample is the same used in the following tables. Excluded occupations are other/unclassifiable (all years) and teacher (enumerated only in 1989-91).

Table 2: Rosca Participation Regressions (Linear Probability Models)

	(1)	(2)	(3)	(4)	(5)	(6)
Age of household head	-.002	-.010	-.020	-.020		-.019
	(24.9)	(45.5)	(82.0)	(81.8)		(71.3)
30<=age<=39					-.065	
					(19.7)	
40<=age<=49					-.150	
					(34.7)	
50<=age<=59					-.252	
					(45.7)	
60<=age<=65					-.366	
					(51.4)	
Cohort (age of head in 1977)		.008	.018	.019		.018
		(39.0)	(78.7)	(82.0)		(71.2)
20<=cohort<=29					.084	
					(22.1)	
30<=cohort<=39					.161	
					(34.8)	
40<=cohort<=49					.253	
					(44.9)	
50<=cohort<=59					.348	
					(50.7)	
60<=cohort<=65					.459	
					(37.2)	
Log(Income)			.161	.182	.147	.156
			(102.)	(105.)	(88.7)	(69.7)
Number of children				.002	.008	.003
				(2.50)	(10.8)	(2.69)
Number of adults				-.019	-.014	-.018
				(29.7)	(21.1)	(17.5)
Additional controls	no	no	no	no	no	yes
Constant	.292	.352	-1.62	-1.85	-1.66	-1.53
	(81.1)	(90.2)	(82.5)	(88.0)	(79.7)	(56.3)
Adjusted R^2	.003	.010	.057	.061	.044	.082

o Absolute values of *t* statistics in parentheses. Each regression has 212,046 observations. Children are those household members age 14 and younger; adults are those age 15 and older. The additional controls in the final column are a dummy variable for whether the head is female; the number of other household members who are female; the number of housewives in the household; two dummy variables for whether the head is a government enterprise or agency worker; nine dummy variables for head's occupation; two variables for the numbers of other household income earners who are government enterprise workers and who are government agency workers; ten variables for the number of other household income earners falling into the various occupation groupings; and year dummies which were restricted to sum to zero and be orthogonal to a time trend. The final column is the same specification as the regression reported in the third column of Table A.1.

Table 3: Summary Statistics

Durable	(1) Years	(2) Number of nonowners ($\Sigma_{c,t} not_{ct-1}$)	(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 %	.049 (.354)
Rice cookers	1977-90	8,040	520	92.7	97.2	4.5	.064 (.351)
Gas stoves	1977-90	5,504	518	91.6	98.4	6.8	.132 (.463)
Pianos	1977-91	181,889	560	2.5	11.0	8.5	.008 (.022)
Computers	1982-91	129,825	360	0.0 1982 1.5 1983	9.7	9.7 1982 8.2 1983	.012 (.018) 1982-91
Food mixers	1977-91	123,238	560	30.8	41.0	10.2	.011 (.065)
Refrigerators	1977-91	9,477	558	82.0	99.3	17.3	.213 (.327)
Microwaves	1983-91	108,961	320	0.0 1983 4.6 1984	22.5	22.5 1983 17.9 1984	.032 (.027) 1983-91
Stereo equipment	1977-91	61,423	560	54.8	83.7	28.9	.061 (.130)
Motorcycles	1977-91	56,350	560	51.4	82.7	31.3	.052 (.116)
Automobiles	1977-91	170,418	560	2.1	36.1	34.0	.028 (.038)
Cameras	1977-91	125,417	560	19.1	56.6	37.5	.042 (.060)
Clothes washers	1977-91	48,598	560	47.8	90.8	43.0	.107 (.135)
Air con/heaters	1977-91	148,553	560	5.2	52.0	46.8	.046 (.054)
Gas heaters	1977-91	73,630	560	32.7	88.3	55.6	.099 (.100)
Kitchen fans	1977-91	79,466	560	21.0	85.3	64.3	.109 (.093)
Color tvs	1977-91	32,540	559	35.0	99.5	64.5	.242 (.149)
Telephones	1977-91	53,876	560	28.0	95.7	67.7	.165 (.124)
VCRs	1981-91	104,070	400	0.0 1981 6.1 1982	70.7	70.7 1981 64.6 1982	.099 (.072) 1981-91

o 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.

o The number of nonowners 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.

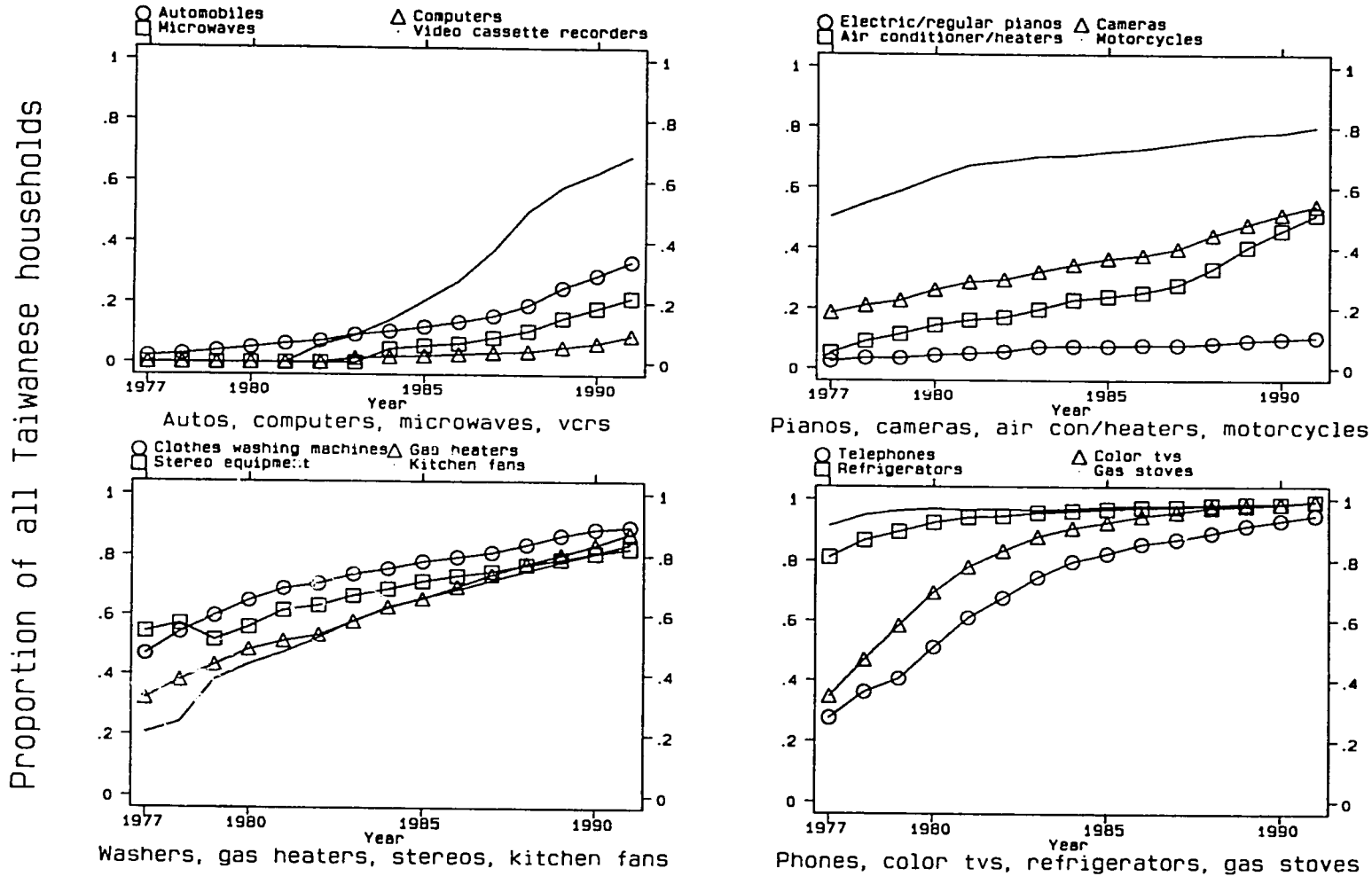
o The means in column seven are weighted by the number of nonowners (column two).

Table 4: The Effect of Roscas on Durables Diffusion: Estimates of α

Dependent variable = Hazard rate (Fraction of cohort "at risk" that acquires the durable)
Weighted Least Squares results (Weight = Number of people at risk in the cohort)

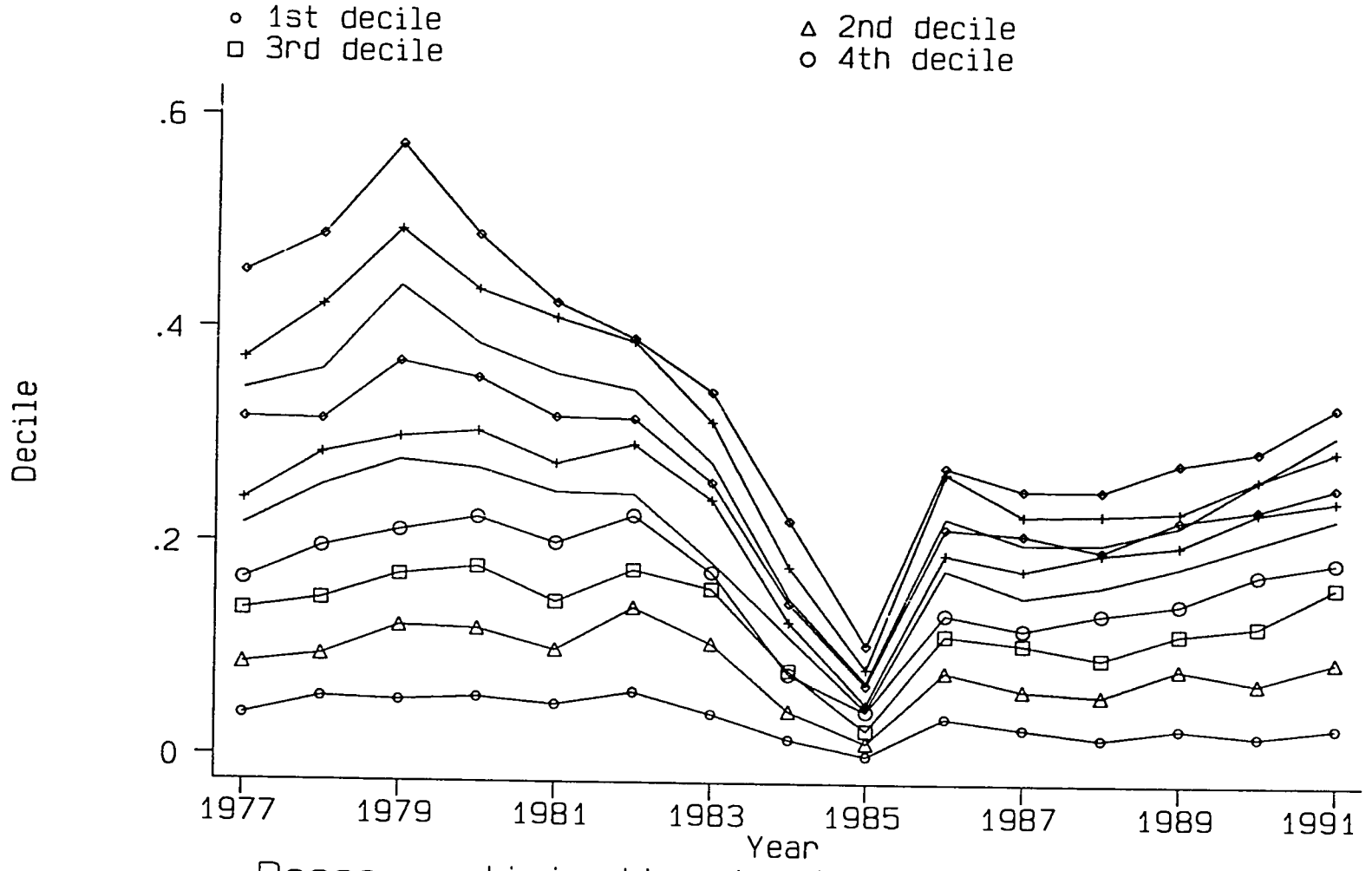
Durable	(1) Rosca only	(2) Adding Age, Cohort dummies	(3) Adding income	(4) Adding demogs	(5) Adding occupation controls	(6) Adding time dummies
Electric fans	.205	.162	.211	.215	.301	.476 **
	(1.27)	(0.81)	(1.02)	(1.03)	(1.40)	(2.02)
Rice cookers	-0.51	-.239	-.208	-.186	-.169	-.109
	(0.35)	(1.31)	(1.12)	(1.00)	(0.86)	(0.54)
Gas stoves	.119	-.088	-.154	-.116	-.063	.266
	(0.73)	(0.46)	(0.76)	(0.56)	(0.30)	(1.19)
Pianos	.042 ***	.030 *	.040 **	.039 **	.027	-.002
	(3.48)	(1.84)	(2.13)	(2.03)	(1.24)	(0.05)
Computers	.046 ***	.060 ***	.042 **	.049 ***	.047 **	.079
	(3.21)	(3.76)	(2.41)	(2.74)	(2.31)	(1.45)
Food mixers	.152 ***	.123 **	.147 **	.149 **	.101	.194 *
	(3.91)	(2.28)	(2.35)	(2.36)	(1.50)	(1.66)
Refrigerators	.331 **	.062	-.001	-.055	.050	.018
	(2.04)	(0.30)	(0.00)	(0.26)	(0.23)	(0.08)
Microwaves	.203 ***	.191 ***	.183 ***	.175 ***	.177 ***	-.002
	(8.80)	(6.67)	(6.04)	(5.60)	(4.78)	(0.02)
Stereo equipment	.060	.258 **	.253 **	.324 **	.372 ***	.187
	(0.80)	(2.45)	(2.22)	(2.77)	(3.00)	(1.13)
Motorcycles	.268 ***	.277 ***	.216 **	.219 **	.160	.286 *
	(4.99)	(2.89)	(2.09)	(2.07)	(1.44)	(1.78)
Automobiles	-.063 ***	.079 ***	.041	.025	.043	.026
	(3.09)	(3.24)	(1.53)	(0.93)	(1.39)	(0.38)
Cameras	.046	.125 ***	.111 **	.117 **	.135 **	-.015
	(1.34)	(2.62)	(2.11)	(2.17)	(2.29)	(0.14)
Clothes washers	.331 ***	.144	.083	.092	.141	.080
	(4.12)	(1.21)	(0.67)	(0.73)	(1.07)	(0.45)
Air con/heaters	-.015	.200 ***	.139 ***	.129 ***	.176 ***	.128
	(0.49)	(5.52)	(3.51)	(3.23)	(3.93)	(1.39)
Gas heaters	-.065	.123	.118	.105	.253 ***	.224
	(1.15)	(1.54)	(1.40)	(1.22)	(2.67)	(1.45)
Kitchen fans	.116 **	.147 *	.107	.096	.199 **	-.049
	(2.26)	(1.85)	(1.27)	(1.13)	(2.11)	(0.33)
Color tvs	.082	.414 ***	.370 **	.345 **	.242	.061
	(0.91)	(2.94)	(2.46)	(2.27)	(1.54)	(0.33)
Telephones	.096	.421 ***	.416 ***	.395 ***	.243 **	.093
	(1.40)	(3.87)	(3.61)	(3.40)	(1.94)	(0.55)
VCRs	-.217 ***	.054	.096 *	.151 ***	.173 ***	.128
	(4.91)	(1.05)	(1.81)	(2.68)	(2.90)	(1.03)

o Absolute values of t statistics in parentheses. Each regression contains a constant. The regressions in each succeeding column contain all the regressors in the previous column. The four demographic controls are the 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. The occupation controls consist of (i) a set of variables for the head indicating the proportion of the (cohort's) household heads employed in nine occupation classes (the base group is those who are unemployed), and (ii) a set of variables for the other household members indicating the number of income earners employed in each of the ten occupation classes.



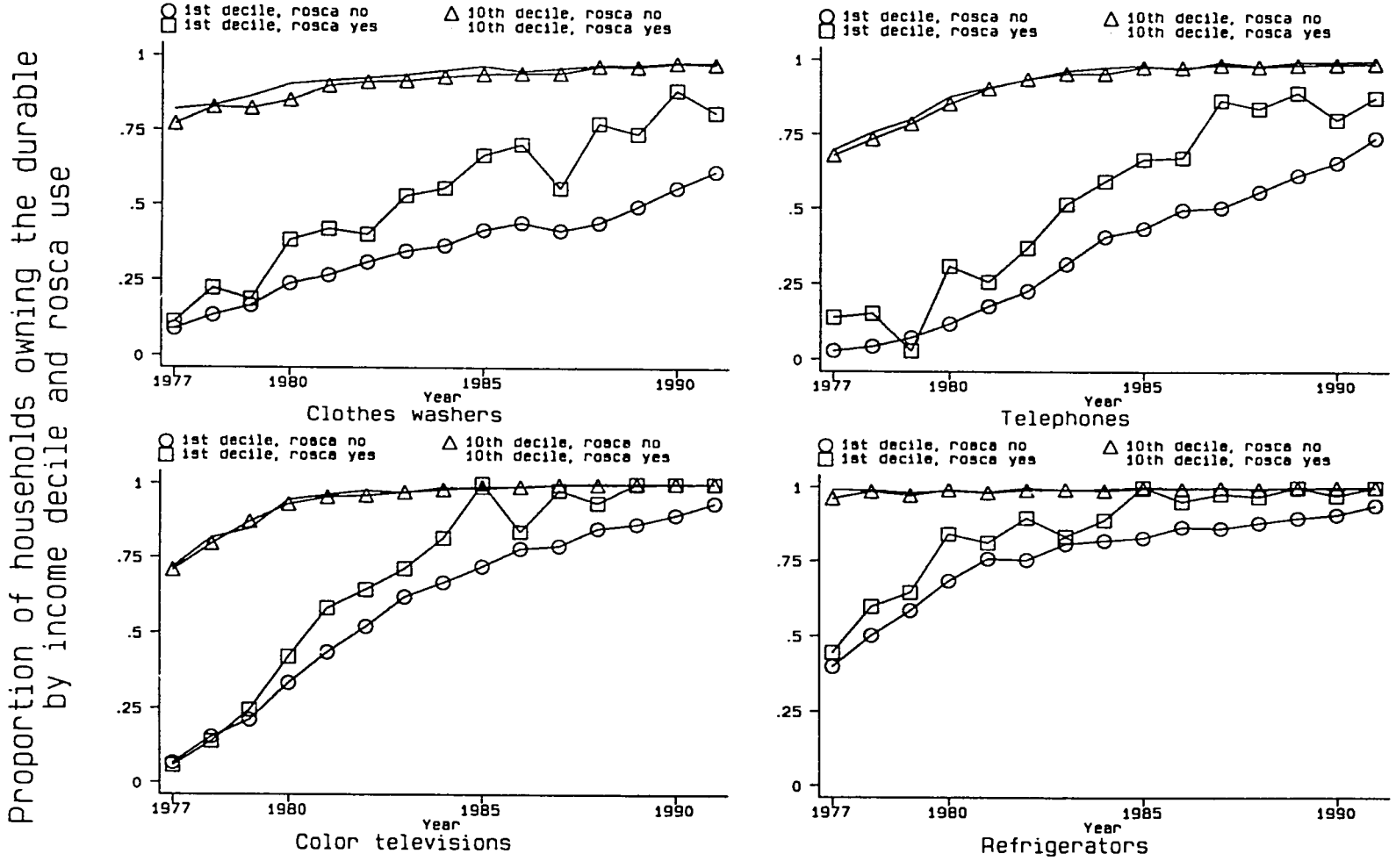
Diffusion of various durables

Figure 1



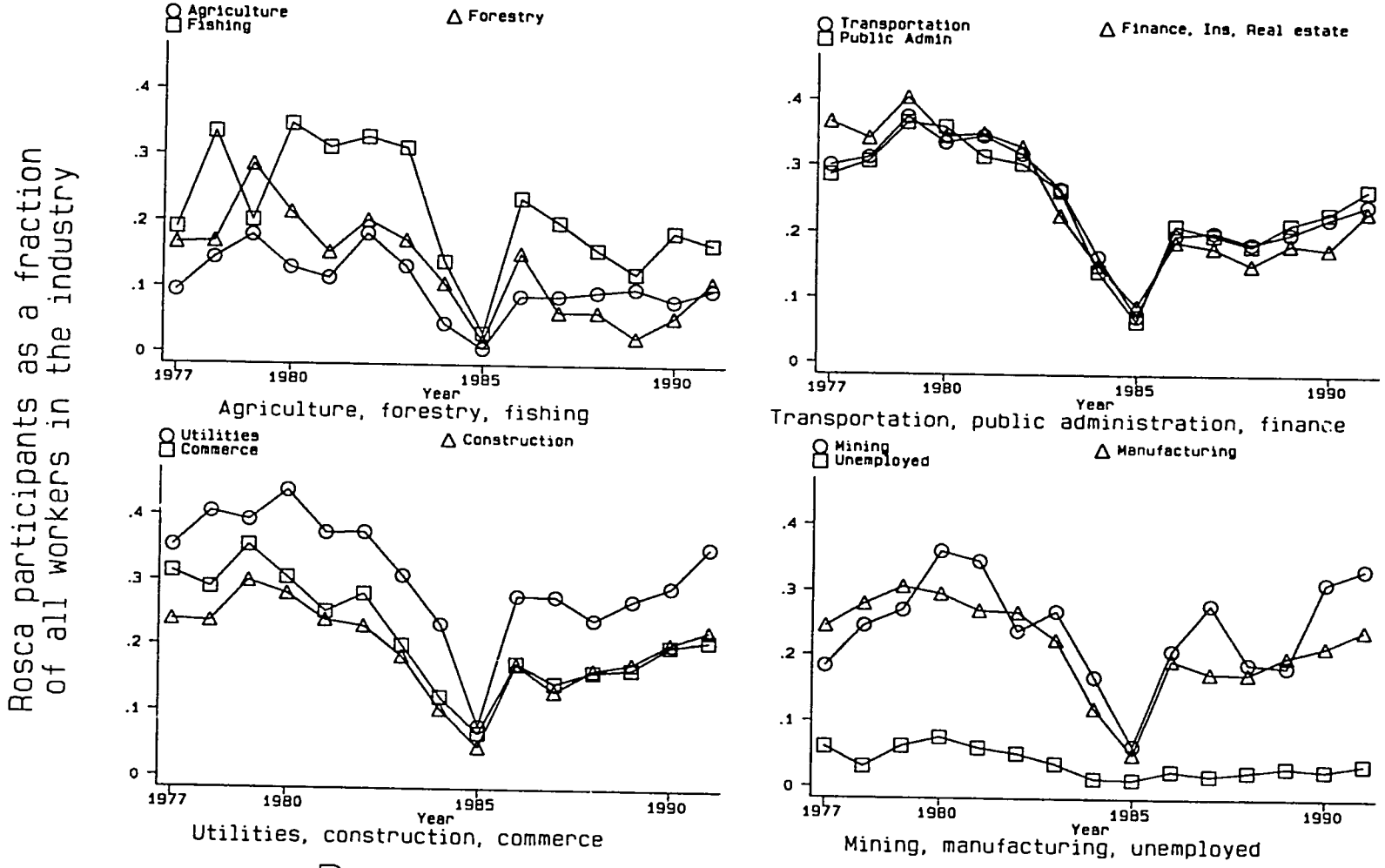
Rosca participation by income decile

Figure 2



Diffusion of selected durables by income decile & rosca

Figure 3



Rosca participation by industry

Figure 4

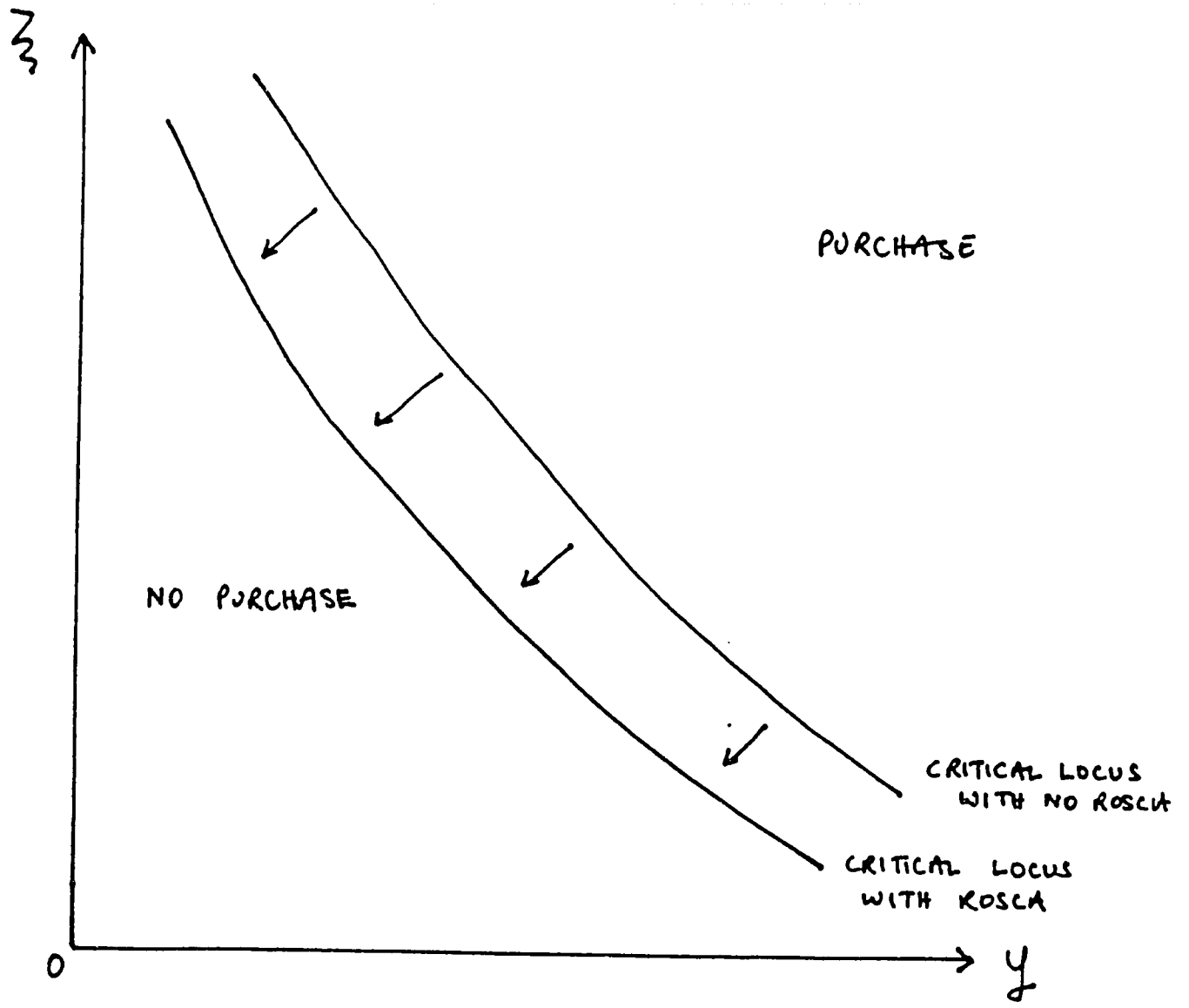
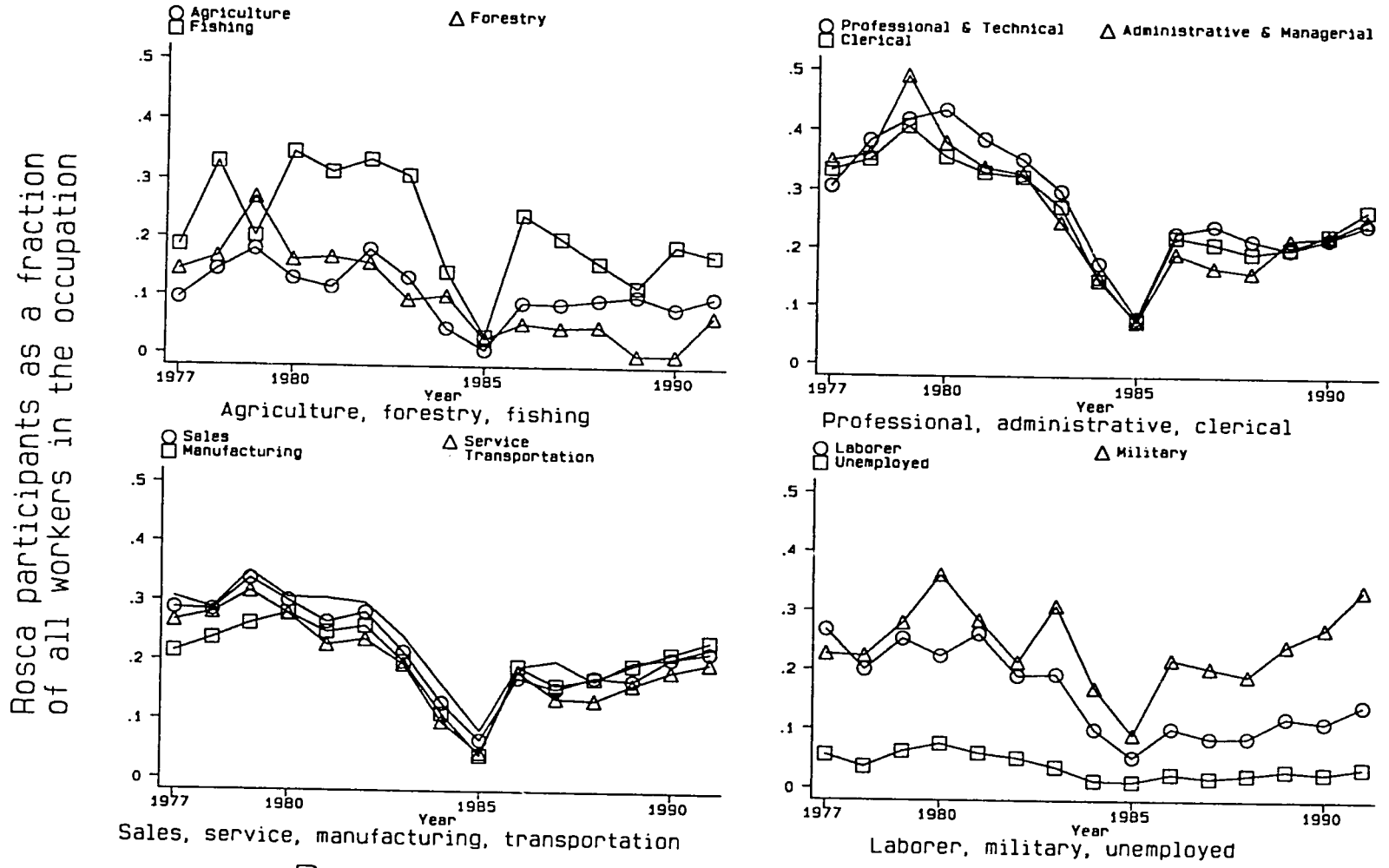


Figure 6

The effect of joining a Rosca on durables purchasing.



Rosca participation by occupation

Figure 5