Measuring Saving

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Abstract

Development depends on saving. But what exactly is saving, and how is it measured? This paper defines *saving* and describes several measures of financial savings in the context of Individual Development Accounts, a new policy idea that provides matches for poor people who save for home purchase, post-secondary education, and microenterprise. The proposed measures of savings take into account the passage of time and the three stages of saving: putting in (depositing), keeping in (maintaining a balance), and taking out (withdrawing). Together, the measures help describe how people move financial resources through time.

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Measuring Saving

1. Introduction

Production requires natural resources, tools, and human capital. These factors of production come from *saving*, the choice to move resources through time rather than to use them up now. Without saving, people are hunters and gatherers who live hand-to-mouth. With saving, people can build steadily on the past to improve the future. In short, saving drives development.

Although saving is required for long-term improvement in well-being, measures of saving are rudimentary. For example, the most important form of savings is human capital (Schultz, 1979), but measures of the quantity of human capital such as age, education, or job experience are but oblique proxies. Measures of quality are also imperfect and usually boil down to wages, a proxy available only for people who work for pay.

Measuring financial savings is more straightforward. Dollars are quantified, have uniform quality, and change forms at known times. Even if measuring financial savings is simple in relative terms, however, it is still complex in absolute terms.

How to measure saving? And what is *saving* in the first place? This paper proposes a definition—*saving* is the movement of resources through time—and a series of measures that account for the passage of time and for the three stages

of saving: putting in (depositing), keeping in (maintaining a balance), and taking out (withdrawing). The measures are illustrated in the context of Individual Development Accounts, a new policy idea that provides matches for savings used by poor people for home purchase, post-secondary education, and microenterprise (Sherraden, 1991). The concepts, however, are general, and so they may be applied to the measurement of almost any form of financial savings.

The paper proceeds as follows. Section 2 defines *saving* and other basic concepts and presents some background on Individual Development Accounts. Section 3 proposes a series of measures of financial savings. Section 4 wraps up.

2. Basic concepts

This section defines *saving*, discusses the three stages of saving, and explains why measures of saving must account explicitly for time. It also provides background on Individual Development Accounts.

2.1 Income, assets, saving, and asset accumulation

Resources received in a given time period are *income*; resources controlled at a point in time are *assets* or *savings*. Both *income* and *assets* refer to resources; they differ only in the frame of reference. If resources received as income are not immediately consumed, then they become assets.

Moving resources through time is *saving*. The definition includes both conscious and unconscious failure to consume. Thus, examples of saving include putting cash in a bank rather than buying hamburgers as well as failing to take cash out of a bank account to buy hamburgers. People usually think of only the first example as saving, but both examples move resources through time.

The use of resources (consumption) is *dissaving*. If, in a long time frame, saving exceeds dissaving, then the result is *asset accumulation*.

Everyone saves, and everyone dissaves. For example, a person may use a paycheck to pay bills over time. The person first saves (even if the paycheck is not immediately deposited or cashed) and then dissaves. From a high-frequency point of view (pay-day until the next day, for example), almost all income is saved. Of course, almost all assets are soon dissaved.

Asset accumulation occurs if saving consistently exceeds dissaving. Small changes in high-frequency saving behavior can lead to large changes in asset accumulation. For example, suppose that two people each earn $100 per day but that one saves $2 more per day than the other. With a 3 percent annual return, the difference in asset accumulation in 20 years is about $20,000.

Furthermore, accumulation gaps tend to grow because assets beget assets (Schreiner *et al.*, 2001). That is, greater assets—be they physical, social, financial, or human—lead to greater production, greater income, and thus greater resources. Once assets put people ahead, they tend to stay ahead.

2.2 Stages of financial saving

Moving money (termed "dollars" for convenience) through time is *financial saving*. Financial saving has three stages (Beverly, Moore McBride, and Schreiner, 2003). The first is "putting in". This changes non-financial resources into dollars or—when "putting in" means "depositing"—changes cash into bank-account balances. Although many people equate "depositing" with "saving", "saving" is a far broader concept than just "depositing".

The second stage of financial saving is maintaining balances, or "keeping in". Although not always recognized as saving, failure to consume assets does move resources through time.

The third stage is "taking out". Resources "taken out" may be consumed (dissaved) or kept in another form (saved). For bank accounts, "taking out" means making withdrawals.

Each stage is a distinct aspect of financial saving. Savings might be high in one stage but low in another, so measurement should look at all three stages. For example, savers with large deposits may have high saving in terms of "putting in", but, if they make quick withdrawals, they may have low saving in terms of "keeping in". Likewise, savers with low deposits might nonetheless maintain balances for a long time. Finally, savers with high savings in terms of "putting in" and/or "keeping in" might—if withdrawals are consumed rather than converted to other assets—have low saving in terms of "taking out".

Measurement should cover all three stages because a narrow focus on one or two stages would miss some facets of behavior. For example, when workers in the United States switch jobs, about half of them cash-out their employee-directed retirement savings (Samwick and Skinner, 1997; Poterba, Venti, and Wise, 1995). What does this mean for saving? In terms of "taking out", about half the amount cashed-out is converted into some other form of assets. For "putting in", people who do not cash-out their retirement savings usually had smaller deposits in the first place. For "keeping in", most people who do not cash-out their retirement savings are young and have small balances. Measures of savings that omit any of the three stages miss important parts of the story.

2.3 Saving and time

Saving moves resources through time, so measures of financial saving must explicitly include time. Changes in resources in a period of time are *flows*, and resources at a point in time are *stocks*. Stocks and flows describe two stages of financial saving, "putting in" as flows of deposits and "taking out" as flows of withdrawals (or "keeping in" as stocks of balances to be withdrawn later).

Stocks and flows, however, describe "keeping in" inadequately. Measuring the resources held through time requires a "flowified stock". With units of dollar-months, such a measure is the "Average Balance".

For example, suppose a saver deposits $10 on the first day of each month for a year and then withdraws it all for consumption at year's end. What is savings? Deposits "put in" are $120; withdrawals "taken out" are $120. The average balance "kept in" is 65 dollar-months. That is, the saver moved resources through time equivalent to $65 per month.

2.4 Individual Development Accounts

Individual Development Accounts (IDAs) are subsidized savings accounts. Unlike other subsidized savings accounts in high-income countries (examples in the United States include Individual Retirement Accounts and 401(k) plans), IDAs are targeted to the poor, provide subsidies through matches rather than through tax breaks, require participants to attend financial education, offer social support and financial counseling, and may be withdrawn for use before the saver

reaches retirement age. IDA savings are matched if used to build assets that improve long-term well-being, usually home purchase, post-secondary education, and microenterprise. The IDAs themselves are held as passbook accounts in regulated, insured financial institutions, and the account holder can make unmatched withdrawals at any time for any reason (but matches are available only for home purchase, post-secondary education, and microenterprise). The deposits that are eligible to be matched are capped each year, usually between $500 to $1,000. Match rates commonly range from 0.5:1 to 2:1, and match funds may come from public or private sources. In principle, IDAs can be opened at birth and can remain open for a lifetime. Thus, IDAs are a flexible policy tool that almost anyone—the government, employers, or development organizations—can plug into. So far, IDAs are mostly in high-income countries, but they could be just as well in low-income countries. Vonderlack and Schreiner (2002) discuss the idea of IDAs for women in low-income countries, and Johnson and Kidder (1999) describe an IDA-like program aimed at poor women in Mexico. Sherraden (1998) proposed IDAs as an example of asset-based development.

IDAs have attracted broad political support. Bill Clinton supported IDAs in his 1992 campaign and later proposed a large matched-savings program (Wayne, 1999). In 2000, both George W. Bush and Al Gore had IDA proposals in their platforms (Bush, 2000; Kessler, 2000). In the United States, about 34 of the 50 states have IDA legislation (Edwards and Mason, 2003), and the Assets

for Independence Act authorized $250 million for IDAs in 1999–2009. Furthermore, the Savings for Working Families Act—if passed—would provide $450 million for 300,000 IDAs over 10 years. Outside the United States, Taiwan has an IDA-like demonstration, and Canada is sponsoring a randomized IDA experiment. In the United Kingdom, the Savings Gateway resembles IDAs (Kempson, McKay, and Collard, 2003), and the new Child Trust Fund will give each newborn an account and a deposit, with larger deposits for poor children (H.M. Treasury, 2003).

3. Measures of financial savings

This section describes measures of financial savings with explicit reference to time and to all three stages of saving. All the measures can be derived from data on monthly deposits and withdrawals. They are framed in terms of IDAs, but they would apply just as well to any similar subsidized savings scheme.

3.1 Savings measures

3.1.1 Gross deposits

"Gross Deposits" in an IDA by saver i in month t are denoted as g_{it}. (From now on, the subscript i is suppressed.) The sum of "Gross Deposits" through month t is "Cumulative Gross Deposits" G_t:

$$G_t = \sum_{j=1}^{t} g_j .$$

"Cumulative Gross Deposits" G_t should not be compared across people who have been saving for different lengths of time. A measure that adjusts for time is "Gross Deposits per Month" $\overline{G_t}$:

$$\overline{G_t} = \frac{G_t}{t} .$$

The principal measure of saving should not focus on the first step of "putting in". First, IDAs (like other similar saving incentives) match deposits only up to an annual cap c. Excess deposits above the cap are still savings, but they are not matchable IDA savings. (To keep things simple, this paper ignores

excess deposits.) Second, deposits may be withdrawn to finance consumption or to be converted into other forms of assets. Third, people might treat their IDAs like checking accounts, making frequent deposits and withdrawals without plans for long-term accumulation. This churning leads to high "putting in" but low "keeping in" and low "taking out". Thus, the best measures of saving look at both deposits and withdrawals together.

3.1.2 Withdrawals

"Gross Withdrawals" w_t are the sum of "Matched Withdrawals" m_t plus "Unmatched Withdrawals" u_t:

$$w_t = m_t + u_t.$$

IDAs have two types of withdrawals—matched and unmatched—because not all uses of savings qualify for matches.

"Cumulative Unmatched Withdrawals" U_t measure resources "taken out". Unmatched withdrawals are assumed to be consumed and so are not included in measures of asset accumulation at a point in time:

$$U_t = \sum_{j=1}^{t} u_j.$$

"Cumulative Matched Withdrawals" M_t measure resources "taken out" of IDAs and used for matched purposes. The assumption is that matched withdrawals are converted into other forms of assets (physical capital through

home purchase, human capital through post-secondary education, or business capital through microenterprise):

$$M_t = \sum_{j=1}^{t} m_j.$$

As a measure of saving, matched withdrawals "taken out" is useful but incomplete. First, at a given point in time, some IDA balances are still in the bank, waiting to be taken out as matched withdrawals. Second, resources are fungible, so the assumption that people save all matched withdrawals and that they consume all unmatched withdrawals is not completely correct.

3.1.3 Participant accumulation

IDAs Participants may accumulate resources in three forms. The first form are balances that may be "taken out" in future matched withdrawals. The second are resources already "taken out" in matched withdrawals and assumed to have been converted to assets in another form. The third are matches.

Account balances and matched withdrawals are "kept in" by participants and so are included in the measure of "Participant Accumulation" P_t. Matches are excluded because they do not come from the participant. Assuming that the match cap c never binds, "Participant Accumulation" P_t is equal to "Cumulative Gross Deposits" G_t minus "Cumulative Unmatched Withdrawals" U_t:

$$\begin{aligned} P_t &= G_t - U_t, \\ &= \sum_{j=1}^{t} (g_j - u_j). \end{aligned}$$

Accumulation depends in part on the length of participation. To control for this, "Participant Accumulation per Month" $\overline{P_t}$ is defined as "Participant Accumulation" P_t divided by months t:

$$\overline{P_t} = \frac{G_t - U_t}{t}.$$

"Participant Accumulation per Month" $\overline{P_t}$ shows how fast resources accumulate. It is a better measure of savings than "Gross Deposits per Month" $\overline{G_t}$ because it accounts for "Cumulative Unmatched Withdrawals" U_t. It is also better than "Cumulative Matched Withdrawals" M_t because it counts both matched withdrawals and current balances that may be matched in the future. And it is better than "Participant Accumulation" P_t because it controls for the length of participation. "Participant Accumulation per Month" $\overline{P_t}$ is the best summary measure of saving in the stages of "putting in" deposits and "taking out" withdrawals.

3.1.4 Total accumulation

For two reasons, "Participant Accumulation" $\overline{P_t}$ does not include matches. First, participants do not own the match until after a matched withdrawal. Second, the match rate is determined not by the participant but by the program. If "Participant Accumulation" $\overline{P_t}$ included the match, then arbitrary program choices would affect measures of participant behavior.

Although "Participant Accumulation" $\overline{P_t}$ does not include matches, "Total Accumulation" A_t does include matches. It is the sum of "Participant Accumulation" P_t and "Cumulative Matched Withdrawals" M_t:

$$A_t = P_t + M_t.$$

"Total Accumulation" A_t is useful as a measure of assets built through IDAs after all stages of financial saving have been completed.

3.1.5 Dollar-months saved

Suppose two people open an IDA on January 1. The first deposits $10 on the first day of each month for a year, and the second makes a single deposit of $120 on December 1. Neither makes any withdrawals. Who saved more?

Although intuition suggests that the slow-and-steady person saved more, the savings measures described so far are identical for each saver. Each has "Cumulative Gross Deposits" G_t of $120, "Gross Deposits per Month" $\overline{G_t}$ of $10, "Cumulative Unmatched Withdrawals" U_t of 0, "Cumulative Matched Withdrawals" M_t of $0, "Participant Accumulation" P_t of $120, "Participant Accumulation per Month" $\overline{P_t}$ of $10, and "Total Accumulation" A_t of $120.

The measures are the same because they look at only the "putting in" and "taking out" stages and ignore the "keeping in" stage. Measuring the movement

of resources through time requires a "flowified stock" such as the sum of "Participant Accumulation" P_t in all months, called "Dollar-Months Saved" D_t:

$$\begin{aligned} D_t &= \sum_{j=1}^{t} P_j, \\ &= \sum_{j=1}^{t} \sum_{k=1}^{j} (g_k - u_k). \end{aligned}$$

In the example, the first person saved 780 dollar-months: 10 dollar-months in the first month, 20 dollar-months in the second month, and so on. The second person saved 120 dollar-months, all in December. Consistent with intuition, "Dollar-Months Saved" D_t suggests that the first person saved more.

"Dollar-Months Saved" D_t distinguishes between the two savers because it looks at both the size and the timing of deposits and withdrawals and thus accounts for "keeping in". In contrast, other measures look at only size via "putting in" and "taking out".

"Dollar-Months Saved" D_t is especially useful for savers who make unmatched withdrawals. (Some savers will even remove all their deposits as unmatched withdrawals.) Measures of saving that ignore "keeping in" count resources removed in unmatched withdrawals as if they were never saved at all. Even people who never make a matched withdrawal, however, did move some resources through time, and "Dollar-Months Saved" D_t reflects this fact.

3.1.6 Dollar-months per month

Comparisons of "Dollar-Months Saved" D_t between savers work best when both savers have been saving for the same length of time. To control for time, one approach is to divide "Dollar-Months Saved" D_t by months of participation t to get "Dollar-Months per Month" $\overline{D_t}$:

$$\overline{D_t} = \frac{D_t}{t}.$$

Of course, this is just the average balance. Compared with the term "Average Balance", the term "Dollar-Months per Month" shows better that the measure is a "flowified stock", but either term can be used.

3.1.7 Dollar-months saved ratio

"Dollar-Months per Month" $\overline{D_t}$ still depends on the length of participation. For example, saving \$10 a month for one year gives an average balance of \$65, but saving \$10 a month for two years gives an average balance of \$125. Another way to control for length of participation is to compare actual "Dollar-Months Saved" D_t with what it would be if deposits were $c/12$ each month. (These equal-sized monthly deposits would add up to the annual match cap c.) This is the "Dollar-Months Saved Ratio" $\overline{D_t^r}$:

$$\begin{aligned}\overline{D_t^r} &= \frac{D_t}{\sum_{j=1}^{t}\sum_{k=1}^{j}\frac{c}{12}}, \\ &= \frac{D_t \cdot 24}{c \cdot t \cdot (t+1)}.\end{aligned}$$

In Figure 1, the "Dollar-Months Saved Ratio" $\overline{D_t^r}$ is the area under line A (D_t·24) divided by the area under line B (c·t·(t+1)). In the figure, the ratio is 0.6. With no excess deposits, the maximum "Dollar-Months Saved Ratio" $\overline{D_t^r}$ is 2 (a single deposit in the first month equal to (t·c)/12). The minimum of 0 obtains if there are never any deposits. The ratio is 1 if the pattern of the sizes and timings of cash flows produces "Dollar-Months Saved" D_t equal to what it would be with equal, consistent deposits of c/12 each month. (A rate of 1 is possible even if deposits are not c/12 in each month.)

In the earlier example of two savers, suppose the annual match cap c is $120. The slow-and-steady saver saved $10 a month and reached the match cap by year-end. Accordingly, the "Dollar-Months Saved Ratio" $\overline{D_t^r}$ is ($780·24) / ($120·12·13) = 1. For the saver who made only one deposit of $120 in December, $\overline{D_t^r}$ is much lower, ($120·24) / ($120·12·13) = 0.154.

3.1.8 Summary

Why bother with so many savings measures? First, the effects of asset *use* (such as a down payment on a house) depend on "Total Accumulation" A_t. In turn, "Total Accumulation" depends on the match rate and on "Participant Accumulation" P_t and thus on months of participation t and "Participant Accumulation per Month" $\overline{P_t}$. To capture all this requires measuring not only "putting in" but also "taking out".

Second, the social/psychological/behavioral effects of asset *ownership*—what Sherraden (1991) calls "asset effects"—depend on moving resources through time. When people think about their assets and how they will use them—when they savor their savings—they may be happier and make healthier choices (Schreiner *et al.*, 2001). A measure of the amount of assets "kept in" is "Dollar-Months Saved" D_t.

3.2 Comparisons with benchmarks

This section describes measures that compare "Participant Accumulation" P_t with two benchmarks, participant income y and the match cap c.

3.2.1 Saving rate

Deposits as a share of income is the *saving rate*. As suggested by the concepts discussed so far, this traditional term is a bit of a misnomer, as most saving in a period come not from newly acquired resources (income) but existing assets left unconsumed.

The saving rate $\overline{r_t}$ is the ratio of annualized "Participant Accumulation per Month" $\overline{P_t}$ divided by annual income y:

$$\overline{r_t} = \frac{\overline{P_t} \cdot 12}{y}.$$

The greatest difficulty is measuring income y. As defined earlier, *income* is resources received in a period. Income is thus more than just financial resources;

for example, the main form of income for most people is time to live. This paper, however, follows convention and counts as income only financial inflows.

Still, some issues remain. Should income include in-cash public assistance? What about in-kind public assistance? Although public assistance is indeed part of income, it is very difficult to measure.

Should measures use income before or after taxes? Because the goal is to measure disposable resources that might be saved, the best measure is probably after-tax income.

For what time period should income be measured? Because income fluctuates from month to month and because there are no official records of monthly income, measurement should use past-year tax returns, if they exist.

3.2.2 Match use

Do participants save all the way up to the match cap? "Participant Accumulation" P_t divided by the match cap c (pro-rated for months of participation t) is "Match Use" $\overline{X_t}$:

$$\overline{X_t} = \frac{P_t}{(c \cdot t)/12}.$$

"Match Use" $\overline{X_t}$ shows the pace of saving relative to the pace that would take advantage of all potential matches. Someone on pace to use exactly all of their match eligibility has a ratio of 1. Someone behind this pace is below 1, and someone ahead of this pace is above 1.

3.3 Deposit consistency

Savings incentives such as IDAs aim to promote asset accumulation and healthy saving habits. Although there is little concrete evidence, many people believe that slow-and-steady wins the race, that is, consistent savers both become better savers and end up accumulating more. This section presents two measures of deposit consistency, one that focuses on the presence of monthly deposits and one that focuses on distribution of the value deposited.

3.3.1 Deposit frequency

The share of months with a deposit is "Deposit Frequency" $\overline{f}_t$. (Interest earned is not counted as a deposit; otherwise, all months would have a deposit.) If the indicator function $\mathbf{I}(g_t)$ is 1 if "Gross Deposits" g_t is positive and 0 if g_t is 0, then "Deposit Frequency" $\overline{f}_t$ is the ratio of the number of months with a deposit divided by the number of months t:

$$\overline{f}_t = \frac{\sum_{j=1}^{t} \mathbf{I}(g_j)}{t}.$$

Higher frequencies indicate greater consistency. If a saver makes a deposit in all months (maximum frequency), then "Deposit Frequency" $\overline{f}_t$ is 1. The minimum (no deposits at all) is 0.

The strength of "Deposit Frequency" $\overline{f}_t$ is its simplicity. Unfortunately, this simplicity is also its weakness; for example, the measure is the same whether

someone deposits $10 each month for four months or whether they deposit $1, $19, $15, and then $4. This weakness may be unimportant if, for learning to save, what matters is not the size of the deposits but their mere presence.

3.3.2 Deposit entropy

A measure of the distribution of the value of deposits through time is "Deposit Entropy" $\overline{e_t}$. (As noted above, earned interest is not counted as a "deposit" for the purposes of this measure.) Based on the classic entropy measure (Golan, Judge, and Miller, 1996), "Deposit Entropy" $\overline{e_t}$ is closer to 0 as deposits are more concentrated (less consistent) through time and is closer to 1 as deposits are more uniform (more consistent) through time. The formula is:

$$\overline{e}_t = 1 + \left(\frac{1}{\ln t}\right) \cdot \sum_{j=1}^{t} \overline{g}_j \cdot \ln \overline{g}_j,$$

$$\text{where} \quad \overline{g}_j = \frac{g_j}{\sum_{k=1}^{t} g_k}.$$

The weaknesses of the entropy measure is its newness and its difficult-to-interpret units. For example, 0.8 is a more-uniform deposit pattern than 0.6, but the intuitive meaning of the 0.2 difference is not clear.

The strength of the entropy measure is that it summarizes the entire distribution of deposits. Unlike other summary measures of the uniformity of distributions (such as variance or coefficient of variation), entropy is bounded between 0 and 1 and depends only on the distribution's shape, not its "height".

For example, suppose a saver deposits \$10 and \$20. The deposit shares are $\overline{g_1} = 10/30 = 0.333$ and $\overline{g_2} = 20/30 = 0.666$. "Deposit Entropy" $\overline{e_t}$ is then:

$$\overline{e_t} = 1 + \left(\frac{1}{\ln 2}\right) \cdot (0.33 \cdot \ln 0.33 + 0.66 \cdot \ln 0.66) = 1 + 1.443 \cdot (-0.637) = 0.082.$$

For comparison, the variance is $[(10 - 15)^2 + (20 - 5)^2] / 1 = 50$. With a mean of $(10 + 20) / 2 = 15$, the coefficient of variation is $50 / 15 = 3.33$.

What if deposits were \$1 and \$2 instead of \$10 and \$20? "Deposit Entropy" $\overline{e_t}$ is unchanged, as only "height" of the histogram of deposits through time changes, not its shape. The variance and coefficient of variation, however, are now 0.5 and 0.33. Unlike these two common summary measures, the entropy measure is invariant to the scale of units.

5. Conclusion

Saving is moving resources through time. Saving has three stages: putting in, keeping in, and taking out. Each stage matters because saving can break down in any of the three stages. This paper has proposed various measures of savings in all three stages and illustrated their use in the context of Individual Development Accounts.

The basic measure of resources "put in" is "Gross Deposits per Month". The measure "Participant Accumulation per Month" recognizes that some deposits are consumed and that different people save for different lengths of time. To measure resources "kept in" and "taken out" through time, the appropriate measures are "Dollar-Months Saved" and the "Dollar-Months Saved Ratio". The "Savings Rate" compares "Participant Accumulation" with income, and "Match Use" compares "Participant Accumulation" with the match cap. Savings consistency is indicated by "Deposit Frequency" and "Deposit Entropy".

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Figure 1: The "Dollar-Months Saved Ratio"