Business Analytics
for PAYG Companies

A TOOLKIT
OF PERFORMANCE INDICATORS AND RISK METRICS

Contents

Introduction

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This paper presents a Business Analytics Toolkit that provides a methodology to assess the performance of a pay-as-you-go (PAYG) solar company's portfolio of consumer receivables.

This methodology is a tool for a financial business analyst. It can be used to understand the performance of a PAYG company but it may differ significantly from a methodology used for tax and reporting purposes. The metrics calculated here are all based upon individual accounts we would find in a company's official reports, but may differ substantially due to the focus on performance.

The Business Analytics Toolkit framework for analysis of a PAYG portfolio of consumer receivables builds on the KPI framework developed by GOGLA in collaboration with the IFC and WorldBank.[1] It goes further than the KPI framework in proposing specific metrics which focus on financial performance.[2] The Toolkit enables the measurement of financial performance of any PAYG business evaluating outputs (i.e., return) in relation to inputs (i.e., capital) . As such, it enables management, investors and others to compare any PAYG businesses.

The Business Analytics Toolkit is based on the recognition that traditional financial sector indicators of portfolio health and overall performance by banks and other lenders – default rate, Portfolio VaR, delinquency rate – may not apply to a PAYG company due to differences between PAYG companies' assets and traditional loan portfolios.

There are three aspects of PAYG companies that make the analysis of their performance unique/different from the analysis of a financial institution providing loans:

I. Solar Home Systems (or, more generally, the underlying assets sold to customers) represent collateral that can be repossessed or returned.

2. The underlying assets depreciate in value.

3. PAYG customers are typically permitted to skip at least a certain number of payments without the requirement to catch up or lose the asset in foreclosure (in contrast to a typical fixed payment timetable for a loan).

While 1 and 2 are common to other consumer finance portfolios (such as an auto loan/lease finance company), 3 is unique PAYG companies and it is quite an essential part of the PAYG model. We believe the Business Analytics Toolkit can be a fundamental tool to enable users to compare the financial performance and health of PAYG and similar mass consumer goods companies with one another.

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[1] See also "Key Performance Indicators (KPIs) for the Off-Grid Pay-As-You-Go Solar Sector, KPI Technical Guide, V. 1.0", January 2018

[2] "Performance" in financial analysis is a subjective measure of how well a business can use assets to generate revenue or profit. Strictly speaking revenue, return, systems sold, average revenue per user (ARPU), etc. are incomplete as financial key

Summary

The advantages of the Business Analytics Toolkit are:

- We can assess the **performance of a PAYG portfolio** of consumer receivables over a given period by dividing the gross and net return over the assets in circulation and we can look at the changes from period to period to identify a trend.

- We can **compare two PAYG companies' portfolios**, independent of average product size, pay-plan duration, collection and repossession strategy etc. This evaluation method is business model neutral.

- We can **analyze the risk of a PAYG company's portfolio** by considering the total return potential, the length of the weighted average life of receivables (WALR), trends and the variance of monthly return measures.

New in our methodology is that we propose to consider assets in circulation and suggest a simple method to calculate depreciation of PAYG company assets. We discuss and clarify the meaning of churn and utilization rates. And we point out that a default risk premium which is added to an interest rate does not apply to PAYG portfolio's in the same way as it does to a portfolio of financial loans. Instead, we suggest using a utilization factor (collection rate) for the adjustment of the value of receivables[3].

CATEGORY	KPI	ABBREV
VALUE OF RECEIVABLES	Face value of receivables	*FVR*
	Present value of receivables	*PVR*
	Risk adjusted present value of receivables	*radjPVR*
NUMBER OF ASSETS	Assets in circulation	
	Installed assets	
VALUE (COST) OF ASSETS	Value of assets in circulation	*VAC*
	Depreciated value of assets in circulation	*dVAC*
UTILIZATION RATE OF ASSETS	Utilization of assets in circulation [cash basis]	
	Utilization of installed assets [cash basis] or collection rate	
	Utilization of assets	
	Churn	
PERFORMANCE	Growth rate	
	Gross profit run rate	
	EBIT run rate	
	Gross return on assets	*RoA*
	Net return on assets	*net RoA*
RISK	Gross return potential	
	Weighted average life of receivables	
	Standard deviation of gross profit or EBIT run rate	
	Slope of performance	

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[3] References in this white paper to the "KPI framework" refer to the KPI framework developed by GOGLA, IFC and the World Bank.

Key metrics

1. Value of receivables

A PAYG company provides assets to customers in return for an expected stream of cashflows (receivables) from the customer. We can calculate the face value of receivables (FVR), the present value of receivables (PVR) and the risk adjusted present value of receivables (radjPVR).

See also "Average total expected revenue" in the KPI framework; the FVR is basically the "average total expected revenue [per unit]" x "number of active units". Moving beyond the current KPI framework we differentiate between face value of receivables and present value of receivables.

Face value of receivables
The face value of receivables (FVR) is simply the sum of all expected payments from all customers.

$$FVR = \sum_{i=0}^{n} FV_t$$

FVR = face value of all receivables [i to n];
FV(t) = face value of a specific receivable / cashflow [i] at time t;

Present value of receivables
The present value of receivables (PVR) is the discounted value of all expected payments [i to n] from all customers. The discount factor is a function of time and the benchmark interest rate curve in the given market.

$$PVR = \sum_{i=0}^{n} df_t \times FV_t$$

PVR = present value of all receivables [i to n];
df(t) = discount factor of a cash flow occurring at time t;
FV(t) = face value of a specific receivable / cashflow [i] at time t;

Risk adjusted present value of receivables
We suggest calculating the risk adjusted PVR by multiplying the PVR with a risk adjustment factor that could best be interpreted as the collection rate.

$$radjPVR = cr \times \sum_{i=0}^{n} df_t \times FV_t$$

radjPVR = present value of all receivables [i to n];
cr = collection rate (or utilization rate of installed systems);
df(t) = discount factor of a cash flow occurring at time t;
FV(t) = face value of a specific receivable / cashflow [i] at time t;

To calculate the risk adjusted present value of a single cash flow that is part of a fixed income product it is common to add a risk premium to the 'risk free benchmark' interest rate.

$$df_t = \frac{1}{(1 + r + \text{def})^t}$$

df(t) = discount factor of a cash flow at time t;
r = risk free benchmark interest rate;
def = risk premium or default rate;
t = units of time (i.e. 4 years).

> The risk premium in an PAYG portfolio cannot be easily expressed as a risk premium over the interest rate, rather it should be expressed as constant, average factor on all cash flows. In contrast to a financial loan the probability of receiving payment p(t2) under a PAYG contract is independent from the probability of receiving payment p(t1). The assumption in a financial loan is generally that payment p(t2) is **only** received if payment p(t1) was received before – i.e. they are dependent. In PAYG, customers usually can skip payments without the requirement to catch-up versus a fixed time-table. Consider also that in a PAYG portfolio the risk of a customer stopping payments over a period declines as the customer comes close to having paid the full amount required for her to own the system. In a typical financial loan, the probability of default remains constant or increases from period to period.

2. Number of assets

Assets in circulation
All products that where once sold, leased or rented to the customer, including assets that have been repossessed or returned but excluding assets which have been written off as they were stolen, lost or don't function any longer.

assets in circulation (t)

Most PAYG or consumer finance companies repossess assets for which customers have failed to make scheduled payments beyond a certain grace period. While most consumer finance companies must resell these assets in a liquidation sale, often repossessed assets of a PAYG company are in good enough condition (or can be reconditioned so) that they can re-enter the company's inventory and resold, leased or rented to a different customer. The metric "Assets in circulation" captures the value of such assets to the company.

We believe it is important to calculate the performance of the company based on assets in circulation. For example company A may need a total asset pool of 100 systems to have 90 systems installed at any given point in time, while another company B may need a pool of 120 systems to have 90 systems installed at any given point in time. Clearly, company A is performing better – it needs less assets (and therefore needs to invest less capital) to serve the same number of customers – than company B. If we were only looking at installed systems, the effect of churn would not be appropriately captured.

Once an asset has been installed for the first time, the company should start to depreciate its value. The depreciation process should not stop, even if the asset is re-possessed – even if it is in good enough condition to re-enter inventory. See also *Installed Assets*. Assets that are not repossessed, and are considered 'lost' should be written off.

Installed assets
Number of assets currently provided to customers.

installed assets (t)

3. Value (cost to company) of assets

Value of assets in circulation

The value of assets in circulation (VAC) is the sum of the cost to the company of all assets in circulation.

$$VAC\ (t) = \sum assets\ installed - less\ assets\ written\ off$$

Sum of cost of active units, inclusive of hardware, international and in-country transportation and installation, import taxes and stock insurance, but exclusive of customer acquisition and maintenance. Sum of the amounts by which the Inventory Account is reduced (debited) as systems move out of such account upon installation.

Note that the KPI #2: "Average unit cost" is equal to the value of assets in circulation divided by number of assets in circulation.

Depreciated value of assets in circulation

The assets installed by the PAYG company lose their value to the PAYG company over time. The company should reflect this cost – the lost value – to assess its real-time performance[4].

The depreciation of the asset starts as soon as it is provided to the first customer. We suggest tracking this value as it enables the calculation of important performance statistics such as "realized gross profit" and "return on assets in circulation".

$$dVAC\ (t) = VAC(t) - \sum accumulated\ depreciation$$

Consider a PAYG company which installs SHS that cost USD 200 on an installed basis. Further assume the company allows its customers to repay such assets over the next 24 months. We suggest that the company depreciates the asset on a straight line basis over a period of 24 months starting at the day installation. The monthly depreciation of the asset would be equal to USD 200 / 24 months = USD 8.34 per month. Accordingly, 12 months after first installation this asset would be worth only 100, and so on.

4. Utilization rate of assets

This can be calculated on a cash basis [realized receivables divided by max potential receivables] or on a system basis [installed systems divided by systems in circulation].

Utilization of assets in circulation [cash basis]

The utilization of assets in circulation compares the actual collected revenue with the total potential of all assets in circulation.

$$\frac{actual\ revenue\ [t, t1]}{assets\ in\ circulation\ [t] \ \times\ average\ expected\ revenue\ period\ [t, t1]}$$

Average expected revenue period [t,t1] = ARPU or average revenue per user between t and t1;
see also KPI framework definition of ARPU: https://tinyurl.com/KPIframework.

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[4] This analysis focuses on the performance of the company, not necessarily on optimizing accounting and tax issues.

Utilization of installed assets [cash basis] or collection rate

The utilization rate of installed assets is also often referred to as the collection rate. It measures how much of the expected cash flow, calculated on the basis of installed assets, was actually collected over a given period.

$$\frac{actual\ revenue\ [t, t1]}{installed\ assets[t]\ \times\ average\ expected\ revenue\ period\ [t, t1]}$$

Average expected revenue period [t,t1] = ARPU or average revenue per user between t and t1; see also KPI framework definition of ARPU: https://tinyurl.com/KPIframework.

Utilization of assets

$$\frac{installed\ assets[t]}{assets\ in\ circulation\ [t]}$$

Churn

In the KPI framework Churn is defined as *"Fraction of units that have gone inactive over the previous 90 days. [Churn is] used to denote customers dropping out of the portfolio."*

We suggest measuring churn as:

$$Churn = \frac{\#\ repossessed\ (t, t1) + \#\ written\ off\ (t, t1) + \#\ lost\ (t, t1)}{installed\ systems\ (t)}$$

\# denotes 'number of'

This is slightly different to the KPI framework as **we don't prescribe a cut-off of 90 days**. A company may choose to leave systems with customers and neither write these off nor repossess them. However, while leaving non-paying systems would lead to more installed systems it would ultimately show in lower utilization rates and lower profitability, with profitability being the relevant performance measure.

A *high churn rate may indicate lower profitability* of the business – operational costs increase as systems need to be reclaimed and costs increase if many products are written off – but it could also indicate a good use of assets in circulation – systems that are repossessed can be re-installed and generate revenue from a different customer. At the same time a low churn may indicate that the company doesn't repossess systems and utilizes the assets in circulation inefficiently. Ultimately, we believe churn alone is not a very good indicator of performance.

A *high churn generally indicates a low utilization rate* but it is not directly linked as customers may skip a payment (leading to a low utilization rate in that period) but retain the system and therefore not impact churn. In other words this would lead to a low utilization rate despite a low churn.

5. Performance

Growth rate

It is important to see that many PAYG companies are in full growth mode. Amongst other things this means that they may be running an operation that is much larger than the operation that would be needed to simply generate the revenue from the current assets in circulation.

Accordingly, performance metrics that are a function of operational expenses (i.e. "EBIT run rate" or "net return on assets") need to be considered in the context of the company's growth rate.

Growth rate can be calculated on a systems or value basis. Growth of FVR, PVR and riskadjPVR are as meaningful as growth of installed assets. In fact these growth rates should be very similar, if not identical in most situations.

Gross profit run rate

The gross profit over period [t1 – t2] is the difference between the cash received over the period [t1 – t2] and the depreciation over that same period of assets in circulation at time t1.

$$Gross\ profit\ (t, t1) = \ Cash\ revenue\ (t, t1) - depreciation_{assets\ in\ circulation}$$

EBIT run rate

The EBIT run rate is the gross profit run rate less the operational expenses of the company over the period [t1 – t2].

$$EBIT\ (t, t1) = \ Gross\ profit\ (t, t1) - OPEX\ (t, t1)$$

Gross return on assets

Gross return on assets for a PAYG company would be the realized gross profit run rate for a given period [t1-t2] over assets in circulation at time t1.

$$RoA = \frac{Gross\ profit\ (t, t1)}{depreciated\ value\ of\ assets\ in\ circulation\ (t)}$$

Net return on assets

Net return on assets would be the realized EBIT run rate for a given period [t1-t2] over assets in circulation at time t1.

$$RoA = \frac{EBIT\ (t, t1)}{depreciated\ value\ of\ assets\ in\ circulation(t)}$$

6. Risk

Gross return potential

The gross return potential can be expressed as the face value of receivables over assets in circulation, the present value of receivables over assets in circulation or the risk adjusted present value of receivables over assets in circulation.

$$Gross\ return\ potential = \frac{FVR(t)}{depreciated\ value\ of\ assets\ in\ circulation(t)}$$

Weighted average life of receivables

The weighted average life of receivables is the timing (in days, weeks or months) of each receivable cashflow multiplied by its value divided by the face value of all receivables.

$$WALR = \frac{\sum \ t \ \times \ FV_t}{\sum \ FV_t}$$

Where t = time in days/weeks/months from today; FV = cash flow face value; n = total number of cash flows.

Note that this can be calculated on a per customer basis and added together to get a portfolio WALR.

$$WALR_{portfolio} = \frac{\sum \ [WALR_{cust \ i} \ \times \ \sum FV_{cust \ i}]}{\sum \ [\sum FV_{cust \ i}]}$$

Standard deviation of gross profit or EBIT run rate

The higher the standard deviation the higher the risk (uncertainty of future performance).

$$StDev \ return \ (t) = \sqrt{\frac{\sum \ (return \ (ti) - average \ return \ (t0, tn))}{n-1}}$$

Slope of performance

A trend in the performance can indicate an increasing problem.

7. Further considerations

Portfolio health versus portfolio performance

Any analyst of a PAYG company would of course like to predict how the company and its receivables portfolio will perform in the future. She would like to understand the 'health of the portfolio' or the chances that the company will be able to realize the profit potential (i.e. risk adjusted present value of receivables or gross profit potential).

While this urge is understandable it may do more harm than good to pursue it. In general, we can only use experience to predict future outcomes:

- We could assume that the observed of the parameter we seek to predict is in fact the best predictor of the parameter in the future. For example, if we observe a realized utilization rate of 80% over the last n periods, then the best guess is that we will observe a similar collection rate over the next m periods.

- We could observe past relationships between the parameter we seek to predict and other factors, then use a prediction of the other factors to predict the parameter we are interested in based on the established relationship. For example, we observe that customers who use their mobile phones a lot skip fewer payments then customers who don't use their mobile phones. We could then conclude that the collection rate of a portfolio full of customers who have used their mobile phones a lot in the past will perform better than a portfolio full of customers that rarely use their phones. This is essentially what a credit score is. The credit scoring company collects all kinds of information and data series on a borrower and adds an assumed relationship between these factors and a borrower's default to calculate a credit score.

While there can be value in this kind of analysis, there are also substantial risks to consider. First and foremost, the past is a poor predictor of the future, especially in finance.

"I am not concerned about the prospects of the housing market, house prices in the United States have never fallen more than 1% since we started tracking them" said many financial analysts before 2008. New factors affected the housing market that financial analysts did not take into account.

There are many more issues to worry about:

- Observed relationships may be co-incidental rather than fundamental. While the decline in pirates is inversely linked to the increase in global average temperatures, it would be wrong to predict future warming based on this "relationship"[5].

- Relationships that are based observations over a short period of time are being used to predict events that go out far into the future. I.e. using a 3 months history to predict 3 years into the future.

- Observed performance of X is used to predict the performance of Y. It would be concerning to use the performance of a consumer loan portfolio in one region (East Africa) to predict the performance of completely different loan portfolio in another region (West Africa). It would also be concerning to use the observed performance of current customers to estimate the performance of a different, new set of customers[6].

- Complex models are hiding the fact that they use the past to predict the future and make a common-sense check of the relationships nearly impossible. For example, we are concerned when we see machine learning applied to loan portfolios as machine learning essentially establishes relationships that are not transparent [7].

We are therefore skeptical when it comes to approaches that promise to give a reasonable view on portfolio health and can thereby predict the future. We think the better approach would be to analyze historical performance in a transparent way and consider many scenarios instead of focusing too much on predicting one outcome.

In sum, the Toolkit presented in this framework analyzes realized performance of a PAYG or similar company. It says little about the current portfolio health and the future performance. Nonetheless, we believe the clearer understanding of a PAYG or similar company provided by this Toolkit will provide a deeper level of insight to investors, lenders and management. In the end, all three groups must apply their judgment based on the analysis available. The Toolkit provides a new, higher level of analysis to bring to bear in applying those judgments to the sector.

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[5] See also Forbes: https://tinyurl.com/forbeslink

[6] Note that a credit score is fundamentally different. It uses the information about a specific borrower to predict the performance of such borrower in the future. It is also worth noting that it will take many more years before the information that is beginning to be collected in the PAYG sector will be 'long enough' to be meaningful as a credit score for any particular person or household.

[7] Machine learning is [...] prediction-making through the use of computers. [M]achine learning is a method used to devise complex models and algorithms that lend themselves to prediction; in commercial use, this is known as predictive analytics. Since 2016 machine learning has become a buzzword and, according to the Gartner hype cycle of 2016, at its peak of inflated expectations.

8. Appendix A

A sample analysis of two very different PAYG companies: one company offers systems that costs $55 on a 3 year pay plan to its customers; the other offers systems that cost $1,000 on a 9 month pay plan.

This simple case study may help to find value in the proposed KPI framework.

METRIC	ABBREV	COMPANY A	COMPANY B
Average unit costs	AIPU	55	1.000
Depreciation period	depr_mths	36	12
Number of assets in circulation (t)	AiC	24.000	2.500
Number of assets in circulation (t1)		26.000	3.000
Total number of installations (t,t1)	AiC_period	2.000	500
Growth rate (assets in circulation, t, t1)	AiC_growth	8,33 %	20,00 %
Value of assets in circulation (t)	VAC	1.320.000	2.500.000
WALR (t)	WALR	30	9
Accumulated depreciation (t)	depr_acc	220.000	625.000
Depreciated value of assets in circulation (t)	VAC_depr	1.100.000	1.875.000
Depreciation amount (t,t1)	depr_period	36.667	208.333
Number of installed assets (t)	IA	21.600	2.450
Number of installed assets (t1)		23.400	2.900
Net increase installed assets (t,t1)	IA_period	1.800	450
Growth rate (installed assets, t, t1)	IA_growth	8,33 %	18,37 %
Utilization rate (systems)	UR_systems	90 %	98 %
Churn (t, t1)		-0,93 %	-2,04 %
ARPU (t)	ARPU	5,60	120,00
FVR (t)	FVR	3.628.800	2.646.000
Interest rate	Interest	10 %	14 %
PVR (t,r)	PVR	3.199.034	2.498.028
Cash received	cash_per	83.220	255.780
Utilization of assets in circulation (cash basis)	UR_AiC	62 %	85 %
Utilization of installed assets (cash basis)	UR_IA	69 %	87 %
riskadjPVR(t,r,utilization rate)	radjPVR	2.200.936	2.173.285
Gross profit realized (t,t1)	GP_period	46.554	47.447
Realized gross return on assets in circulation (t,t1)	GR_AiC	4,23 %	2,53 %
Gross profit potential	GP_total	1.100.936	298.285
Return potential on assets in circulation		100 %	16 %
Operational expenses		105,000	175,000
Cash breakeven factor		-26,17 %	31,58 %
EBIT run rate		(58.446)	(127,553)
Profitability per period		-5,31 %	-6,80 %

UNIT	COMMENT
CCY	Units of currency
months	Company specific; ideally the depreciation period of an asset should be in line with the pay plan duration
#	Every system ever sold/installed
#	
#	
%	
CCY	Sum of the cost of all systems sold
months	
CCY	Approximated or actual
CCY	
CCY	Straight line depreciation in line with payplan period
#	
#	
#	
%	
	Observed or contractual average
	Face value of receivables
	Benchmark interest rate, country specific
CCY	Observed
	The company collected this percentage amount of potential cash flows (based on assets in **circulation** and ARPU).
	The company collected this precentage amount of expected cash flows (based on **installed** assets and ARPU)
CCY	
%	Currently expressed over the period from t to t1; could be annualized
CCY	Scaled unit economics
%	Can be calculated using FVR, PVR or riskadjPVR
CCY	Observed
%	The company generates cash or requires cash to operate
CCY	
%	

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