Essay on Revenue Component of Business Models at Data Marketplaces

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This essay highlights the scholarly contributions dedicated to identifying revenue streams embedded in the business model of the data marketplaces. It compiles the experiences of the surveys and syntheses reported in the literature and the practices employed at the existing data marketplaces. This further summarises strategies of the AWS Data Exchange and AWS Marketplace as a case study. In brief, the current contribution deals with revenue management at data exchange platforms.

Introduction

Globally, it has been accepted that data can be a source of wealth generation. Leading companies such as GAFA, i.e., Google, Apple, Facebook, and Amazon, have proved that by riding on the data waves, including personal and non-personal data. On the other hand, governments worldwide are exploring a newer way of data-driven e-governance, smart cities, digital marketplaces, centralised digital markets, etc. However, there is a great challenge that they are trying to circumvent, that is, data monetisation. There are various hurdles on the way, such as

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identifying revenue streams, formalizing them into revenue models, and backing them using appropriate pricing models or strategies therein.

Developing such revenue models or pricing models is neither a straightforward job as it depends on several aspects ranging from the operationalisation costs of data marketplaces, types of data and its services, association with multiple stakeholders, rules and regulations of the national agencies, mutual benefits across stakeholders such as data providers and consumers, technological advancements, and anti-trust/competition aspects among others. However, there is a scarcity of scholarly literature dedicated solely to the data marketplaces. Some articles address a larger sphere of ideas, such as data-driven services. On the other hand, non-scholarly articles or the grey literature on revenue-related aspects lack empirical backing or evidence-based approaches. The present study tries to address some of the elements mentioned above while overcoming objections.

The essay is classified into four sections to address maximum facets across revenue streams. The foremost *Section 1* addresses the method of revenue management, which is at the core of desired data monetisation. They enlist a range of functionalities to be adopted in the data marketplace, whereas the API tools are necessary for the said functionalities. stringent patent eligibility requirements to refrain from evergreening patents by excluding *Section 2* deals with the types of revenue and pricing models. *Section 3* illustrates a revenue-sharing rule in the form of mathematical derivation and definitions or conditions behind it. In the final Section 4, the case of AWS Marketplace and AWS Data Exchange is illustrated about the data transacted at the platform of Amazon Web Services.

Section 1: Methods of Revenue Management

Revenue management is an essential component of the business model adopted by data marketplaces. Based on different types of adoption of pricing strategies, marketplace providers have to assimilate certain practices which will facilitate data exchange and establish certainty across the platform (Gaglione, A. et al., 2018). These practices are described below:

i. Four main functionalities in revenue management:

1. Charging management
    a. Methods or actions required to charge the data consumers for purchasing data offerings, e.g., system integration with PayPal or others
2. Management of data usage specification
    a. Facility to monitor data usage by customers at marketplace supporting adopted pricing models, e.g., Mbytes, seconds, number of calls, or others
3. Revenue sharing management
    a. Defining revenue sharing models to distribute revenues among stakeholders, e.g., transaction fee to be given by data provider to a data marketplace operator
4. Billing management
    a. Creation of invoices after completion of purchasing order to the customers, e.g., for real-time data, invoicing can be done through time-triggered transaction

ii. Six types of APIs required for revenue management:

To realise the functionalities mentioned above, various APIs need to be embedded in the platform, which includes the interfaces for retrieving a list of the usage specifications and for creating a new usage specification, for retrieving a list of the usages, and for creating a further use; and for retrieving a list of the usages and for creating a new usage among others (Gaglione, A. et al., 2018).

1. Usage specification management
    a. Usage specification collection
    b. Usage specification entry
2. Usage management
    a. Usage collection
    b. Usage entry
3. Revenue sharing model management
    a. Revenue sharing model collection
4. Transaction management
    a. Transaction collection
    b. Settlement collection
5. Billing charges management
    a. Billing charge collection
    b. Billing charge entry

6. Billing account management
    a. Billing account collection
    b. Billing account entry

Section 2: Types of Revenue & Pricing Models

The revenue model stands for the overall approach of the data marketplace operator to bring an influx of money from the stakeholders to keep the marketplace active. In simple words, the revenue model suggests how the marketplace operator earns money, and the price model suggests the method of collecting the money.

i. Revenue generation models by data marketplace operator:

A. Traditional licensing:
- Perpetual or one-off deals

B. Transactional models:
- On-demand
- Subscription services

C. Give and take models:
- Incentivising stakeholders with additional non-monetary benefits

D. Gain sharing models
- Payments based on savings

E. Brokerage models

A. Traditional licensing:

Licensing, leasing, and renting digital goods, including data products, can be a monetisation model where companies collect fees or royalties from the consumers through contracts against either perpetual or one-off deals. The study has reported that data providers can collect fees considering fixed fees and run times, renegotiate expired contracts, or earn revenues at the time of sale [Deichmann et al., 2016]. It's been advised that the revenue generation approach at the time of sale might lead to less stability in revenue forecasting.

- Perpetual or one-off deals
- Customer fees collection:
    - sign contracts with fixed fees and run times
    - renegotiate expired contracts
    - earn revenues at the time of sale

B. Transactional model:

The next set of monetisation models can be transactional that are adopted for on-demand or subscription services. On-demand services allow consumers to pay on the go or ask to choose volume pricing. Such volume pricing use metrics such as usage volume, the number of incidents, or hardware-related fees. Similarly, subscriptions use the framework of flat fees on a monthly, yearly basis, or freemium-basis [Deichmann et al., 2016].

- On-demand
    - Pay as use or volume pricing – charges based on metrics
        - usage volume
        - number of incidents
        - hardware-related fees
- Subscription services
    - flat fees (monthly or yearly basis)
    - free/premium, i.e., freemium offers (basics: free of charge; additional features: for a flat fee)

C. 'Give-and-take' model:

This innovative model incentivizes stakeholders in the data marketplace with additional non-monetary benefits. Data marketplace operators might share the information or data of the data consumers with data providers (Deichmann et al., 2016). Such consumer data might be aggregated or masked data that can benefit data providers in achieving high standards or improving their services. Notably, companies offering subscription models can benefit from continuous data collection, aggregation of the data, and using it to improve customer service (Schüritz et al., 2017).

Examples (Deichmann et al., 2016):

1. Internet-based service gives geolocated real-time aircraft flight information; Receive free radio equipment collecting and transmitting aircraft data and free business-level membership to the service (worth $500 a year)
2. Services give information related to banking activities, credit, and leasing agreements, and payment defaults; Returning – giving credit-ranking data for individuals or businesses

3. Data suppliers give crowdsourced data (useful to generate mobile-network coverage maps revealing a mobile operator's performance by region and technology, e.g., 3G or 4G) and receive apps and coverage information

D. Gain sharing models:

Such models are primarily seen in data-driven services such as IT services or procurement, where data providers might receive payments based on savings or gains of the customers (Satzger & Kieninger, 2011 & Schüritz et al., 2017).

E. Brokerage models:

This monetisation model category refers to a brokerage fee, commission, or transaction cut on a successful transaction (Schüritz et al., 2017).

ii. Price model for revenue generation:

A. Free:

Some data-driven services are referred to as free, where services are offered free of charge to customers or without direct costs. Primarily data generated from public administrations, government bodies, or non-government organizations are availed freely to data consumers (Spiekermann, M. 2019). Previously, it has also been argued that the free service has to be paid for by someone somewhere (Berman, S. 2011), and as the 'free model' is not self-sufficient, it works in conjunction with other revenue models (Schüritz et al. 2017). It is observed that free data offer to help the data marketplace attract new users to the platform (Spiekermann, M. 2019), e.g., as used in the cases of freemium models.

B. Freemium:

This kind of service is based on a composite of free-premium services. Under this category, the consumers or users are offered essential services at no cost but have to pay a fee for an extended or full range of functions (Spiekermann, M, 2019). These practices have been observed to attract customers through word-of-mouth, while some might prefer to upgrade to a premium service (Schüritz et al. 2017). Such a plan is most popular in the cases of personal data platforms where the essential platform services are offered free of cost (Kemppainen et al., 2018).

C. Flat rate:

A flat rate largely deals with lump-sum payments and might be irrespective of the scope of the use of services. Such cases are observed at marketplaces hosted by public authorities and non-profit organisations (Spiekermann, M. 2019). One of the studies has reported that an online marketplace involved in trading real-time datasets might charge consumers recurring prices or a flat periodic subscription fee (Gaglione, A. et al., 2018).

D. Progressive:

These pricing strategies are based on the demand for data products under consideration and adopted if the product access needs to be restricted. In these cases, if the market for the product increases, the price also increases (Spiekermann, M. 2019).

E. Fee:

Another mode of collection of revenues involves a range of fee frameworks, such as listing fees or connection fees. The service providers pay these to the data marketplace operator to allow enlisting of data products. Some marketplaces might seek one-time membership fees or service fees at the time of registration or annually. Along similar lines, marketplace operators can also charge transaction, usage, or storage fees. (Spiekermann, M. 2019; Kemppainen et al. 2018).

iii. Revenue models of existing data marketplaces: an excerpt from a study:

Spiekermann (2019) classified data marketplaces based on revenue models. This classification entails the transacted data types, pricing, revenue models, and their current status, whether active or closed. Marketplace operators generally adopt revenue models such as commission per transaction, membership fees, data listing or usage fees, and data storage

fees, among others. Freemium models provide restricted access to services at free cost and charge for premium services. For flat-rate tariffs, lump-sum amounts are paid by customers irrespective of the scope of the use of services. The study also suggests that the price model comprises the final price paid by the data buyer for the data product.

- In the fixed-price or subscription price model, data is made available for a certain period of use.
- In the package-price model, differently staggered packages are offered at a fixed price such that larger packages are more expensive but comparatively cheaper per unit.
- On the other hand, the progressive-price model depends upon the demand for the data products. Such a price model can be adopted if the product use needs to be restricted. If the demand increases, the price of the data product goes up.

Section 3: Revenue distribution rule: a theoretical example

The revenue distribution rule (ζ1, ζ2):

$$\zeta = \frac{(1+\rho+\frac{1+\rho}{2\rho-1}) - \sqrt{(1+\rho+\frac{1+\rho}{2\rho-1})^2 - 8\rho\frac{1+\rho}{2\rho-1}}}{4}$$

This model applies to the two firms involved in revenue sharing. The same model has also been expanded to more than two firms derived in the article by Kazumasa et al. (2020).

Definitions, assumptions, constraints, and conditions related to the model:

1. In D_j, D stands for the data, and j stands for the firm.
2. Revenue produced using the data = $\theta_j D_j$
3. Cost to produce the data = $(c_j/2)\,(D_j)^2$
4. Share data that firm j has = d_j
5. Assumption: $d_j \leq D_j$
6. Cost to share the data = $(m_j/2)\,(d_j)^2$
7. Data that are mutually shared = d_{ik}
8. In d_{ik}, i stands for the firm that possesses data, and k is a number of the firm.

Data marketplace	Data transformation	Price model	Revenue Model	Status	Founded	Closed
Dawex	Raw Data	Fixed-price	Freemium	Active	2015	-
IOTA	Raw Data	Progressive	Transaction Fee	Beta	2017	-
Databroker DAO	Raw Data	Progressive	n/a	Beta	2017	-
Streamr	Aggregation	Progressive	n/a	Active	2017	-
Data Intelligence Hub	Raw Data	Multiple	Transaction Fee	Active	2018	-
Advaneo	Raw Data	Fixed-price	Transaction Fee	Active	2018	-
Otonomo	Aggregation	Fixed-price	Transaction Fee	Active	2015	-
Datafairplay	Normalisation	Progressive	Transaction Fee	Withdrew	2014	2018
InfoChimps	Raw Data	Fixed-price	Transaction Fee	Withdrew	2009	2013
Qlik	Raw Data	Package	Freemium	Active	2017	-
xDayta	Raw Data	Fixed-price	n/a	Withdrew	2013	2015
Kasabi	Normalisation	Fixed-price	Freemium	Withdrew	2010	2012
Here OLP	Aggregation	Multiple	Freemium	Active	2018	-
Azure Data Marketplace	Raw Data	Fixed-price	Transaction Fee	Withdrew	2010	2017
International Data Spaces	Raw Data	Multiple	Transaction Fee	Proof of Concept	2016	-
Caruso Dataplace	Aggregation	Multiple	Membership Fee	Active	2017	-

Table 1: Compilation of data pricing and revenue models of few data marketplaces

3. Data suppliers give crowdsourced data (useful to generate mobile-network coverage maps revealing a mobile operator's performance by region and technology, e.g., 3G or 4G) and receive apps and coverage information

D. Gain sharing models:

Such models are primarily seen in data-driven services such as IT services or procurement, where data providers might receive payments based on savings or gains of the customers (Satzger & Kieninger, 2011 & Schüritz et al., 2017).

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9. Additional revenue produced by the combination of data sharing =

$$\gamma \prod_{k=1}^{m} {d_{i_k}}^{\rho_{i_k}}$$

10. Rate of distribution of revenue = ζ_{ik}

11. Assumption: $\zeta_{ik} = \sum_{k=1}^{m} \zeta_{i_k} = 1$

12. Profit for the firm = π_j

13. Profit of the firm:
$\pi_1 = \theta_1 D_1 + \zeta_1 \gamma {d_1}^{\rho_1} {d_2}^{\rho_2} - \frac{c_1}{2} {D_1}^2 - \frac{m_1}{2} {d_1}^2$
: similar for firm number 2 will be π_2

14. Revenue distribution rule of data sharing (ζ1,ζ2)

15. Profit maximization condition for each firm producing data D1 can be $D_1 = \theta_1 / c_1$.

16. Profit of the firm:
$\pi_1 = \frac{{\theta_1}^2}{2c_1} + \zeta_1 \gamma {d_1}^{\rho_1} {d_2}^{\rho_2} - \frac{m_1}{2} {d_1}^2$
: similar to firm number 2, it will be π_2

17. Assumptions/constraint: $d_j \leq D_j$ and $\rho_1 + \rho_2 = 1$

18. Profit maximization condition in the decentralized economy for profits and data

$$\zeta_1 \gamma \rho_1 \left(\frac{d_2}{d_1}\right)^{\rho_2} = m_1 d_1 \quad \text{and} \quad \zeta_2 \gamma \rho_2 \left(\frac{d_1}{d_2}\right)^{\rho_1} = m_2 d_2$$

Further substitutions & rearrangements occur in the derivation leading to a model which has not a condition maximizing social welfare:

$\pi_1 = \frac{{\theta_1}^2}{2c_1} + \frac{1}{2}(2\zeta_1 - \zeta_1 \rho_1) \tau {\zeta_1}^{\rho_1} {\zeta_2}^{\rho_2}$

Similar π_2 for firm 2

19. Assumption: $\zeta_1 = \zeta$ and $\zeta_2 = 1 - \zeta$

20. Condition to maximize social welfare: $\Pi = \pi_1 + \pi_2$

21. Total profit: $\Pi = \pi_1 + \pi_2 =$

$$\frac{{\theta_1}^2}{2c_1} + \frac{{\theta_2}^2}{2c_2} + \frac{1}{2}(2 - (\zeta\rho_1 + (1-\zeta)\rho_2)) \tau \zeta^{\rho_1} (1-\zeta)^{\rho_2}$$

22. Assumption: $\rho_1 = \rho$ and $\rho_2 = 1 - \rho$

23. Total profit maximizing condition:

$$\frac{\rho}{\zeta} - \frac{1-\rho}{1-\zeta} - \frac{2\rho - 1}{2 - (\zeta\rho + (1-\zeta)(1-\rho))} = 0$$

This way, if the number of firms is two (N=2), then the revenue distribution rule (ζ1, ζ2) can be $\zeta_1 = \zeta$ and $\zeta_2 = 1 - \zeta$, where ζ is

$$\zeta = \frac{(1+\rho+\frac{1+\rho}{2\rho-1}) - \sqrt{(1+\rho+\frac{1+\rho}{2\rho-1})^2 - 8\rho\frac{1+\rho}{2\rho-1}}}{4}$$

Section 4: Case Study: AWS Marketplace and AWS Data Exchange

In brief about AWS (Amazon Web Services) – *AWS Marketplace and AWS Data Exchange:*

- curated digital catalogue or online software store
- catalogue to find, buy, deploy, and manage third-party software, data, and services
- enables qualified partners to market and sell their data/software to AWS Customers

Other than data set providers and consumers, these services are designed for Independent Software Vendors (ISVs), Value-Added Resellers (VARs), and Systems Integrators (SIs). Various software types need to be availed, including software infrastructure, developer tools, business software, IoT, and desktop apps. They can be availed as either Amazon Machine Images (AMIs) or Software as a Service (SaaS).

The following case study is developed using the resources and documents availed on AWS's website.

Revenue management:

AWS Data Exchange is a service to exchange file-based data sets in the AWS Cloud securely. It avails facilities such as data delivery, entitlement, or billing technology. Any stakeholder can become an AWS Data Exchange provider by helping with product details, product offers, and data sets.

- *Product details:* name, descriptions (both short and long), a logo image, and support contact information
- *Product offers*: public offers including prices and durations, data subscription agreement, refund policy, and the option to create custom offers
- *Data sets:* either one or more; dynamic; versioned before revisions

These three components facilitate a smooth transaction between data providers and data customers.

Product offers are terms to be agreed upon by a prospective subscriber before purchasing a

Product offers are terms to be agreed upon by a prospective subscriber before purchasing a subscription

- It includes data subscription agreement, available pricing and duration combinations, details about US tax collection, and refund policy & subscription verification information.

Offer pricing has a total price and duration of the subscription

- It can be specified for five periods such as 1 month, 6 months, 12 months, 24 months, and 36 months in a single offer

AWS adopts a 'pay-as-you-go approach' for pricing, where customers are charged for the individual services that they use without signing long-term contracts or complex licensing. It has no upfront fees or no minimum commitments. It does not charge termination fees or additional charges if customers stop using its services. It offers tiered pricing and charges less for increasing usage, as seen in progressive price models. It has provisions of discounts based on volume usage, reserved instances, or larger upfront payments.

Customers have to pay as per the prices listed by data providers detailed on the product details page, and these are known as 'subscription fees' at AWS Marketplace. As previously mentioned, these prices are listed for at least five durations, e.g., 1, 6, 12, 24, or 36 months (s) in a single offer. Mainly, AWS Data Exchange charges 'storage fees' to store data while loading the data to the services offered at the platform, measured in the 'byte-hours' unit. These are charged at the month-end, dynamically based on data sizes, and the region where it is stored.

The pricing example quoted by the AWS Data Exchange is shared here. Suppose the customer stores 100GB of data in the US East (N. Virginia) for 31 days and publishes another 100TB to that dataset with 16 days remaining in the month. In that case, the customer accumulates 42.3 quadrillion Byte-Hours of usage. The monthly storage charges for the given situations are $0.023/GB/month.

> *Total storage: ([100GB x 31 days x (24 hours/day)] + [100TB x 16 days x (24 hours/day)] = 42.3 quadrillion Byte-Hours of usage = $1,217.89 in monthly storage = Total storage charges*

Another set of fees applicable to data providers is 'tiered fulfilment fees' (TFF), where AWS charges data providers for revenue collections made by AWS for all new subscriptions to their data products. However, if data providers want to migrate and fulfil pre-existing subscriptions, AWS allows it at no additional cost under the 'bring your own subscription' (BYOS) feature.

So, customers can purchase AWS products at multiple pricing models such as On-Demand Instance, Reserved Instance, and Spot Instance. On-demand instances allow payment per usage hour without minimum commitments. Reserved instances are advised for long-term savings with discounts up to 60% compared to on-demand instances. For certain services such as Amazon EC2, i.e., Amazon Elastic Compute Cloud, unused capacity can be bided by the customer where instances are charged under spot instances depending on demand and supply.

	No Upfront	Partial Upfront	All Upfront	On Demand
1 Year	$876	$876	$751	$751
3 Years	-	$1461.40	$1373	$3679.20
Savings 1 Year	29%	37%	39%	-
Savings 3 Years	-	60%	63%	-

Table 2: Illustrative table demonstrating user's long term benefits. The figures are based on pricing as of January 2015 on an m3.large Linux instance type in the US East (N. Virginia) region

A report released by AWS emphasized the cost drivers and reduction in costs and complexity with the advantage of cloud technologies employed at AWS. It elucidated that typical data centre costs include server costs, storage costs, network costs, and IT labour costs other than overhead costs such as space, power, or cooling-related costs.

On the other hand, they publish usage data comparing one-year and three-year savings across reserved instances to demonstrate the user's long-term benefits of reserved instances over the on-demand instances. The figures (in Table 2) are based on pricing as of January 2015 on an m3.large Linux instance type in the US East (N. Virginia) region.

In this way, AWS claims its price model philosophy is driven by a virtuous cycle (as shown in Figure 1).

Interestingly, AWS Marketplace and AWS Data Exchange are examples of platforms that use the 'give and take' model, where AWS gives buyer information to select AWS Marketplace sellers.

- On a daily or monthly basis
- Shared information constitutes Amazon's Confidential Information
- Shared after a nondisclosure agreement between Amazon and sellers at a marketplace

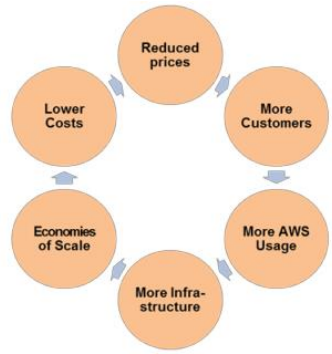

Figure 1: AWS Virtuous Circle

- Shared information includes buyer email domain, AWS account ID, location, monthly billed revenue information, usage information, and disbursed funds information by buyer
- Aim is to provide a framework for sellers to compensate their sales teams for AWS Marketplace subscription revenue. That is to provide customer data assisting in analysing, growing, and compensating sales teams for AWS Marketplace sell-through or to provide data to evaluate the effectiveness of seller's marketing campaigns and communicate commission payments to their employees.

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