

Fundamentals of the MakerDAO Governance Token

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Abstract

We study the fundamentals governing the price of the MakerDAO governance token MKR. Governance tokens are minted in response to liquidations, and burned in response to growth in the system surplus. MKR tokens appreciate with an increase in system surplus and depreciate with a rise in systemic risk due to DAI liquidation spirals. We discuss incentive compatibility conditions that need to be satisfied for the protocol to maintain the DAI stablecoin peg.

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1 Introduction and Motivation

Decentralized stablecoins are led by MakerDAO's DAI token, in which the issuance of new tokens is decentralized through using autonomous smart contracts on the Ethereum blockchain.¹ DAI tokens are generated when an investor deposits a set amount of collateral, typically Ethereum (ETH), into a collateralized debt position (CDP).

Empirical work on DAI has focused on understanding the role of collateral risk and peg stability, the fundamental sources of peg-price deviations and demand for DAI in DeFi applications. [5, 2, 3, 7]. Theoretical contributions of DAI include a study of liquidations, the incentive compatibility of governance structures, and the use of a reserve buffer as a solution to peg instability [4, 6, 1].

In this paper, we discuss the fundamentals of the governance token price, the supply mechanism of mints and burns, and the incentive compatibility conditions that need to be met for peg stability. In our empirical analysis, we find the MKR governance token appreciates when MKR tokens are burned due to growth in the system surplus. MKR tokens are minted in response to debt auctions to cover losses on liquidating DAI loans. Finally, we discuss the role of the voting mechanism used in governance. The governance protocol can lead to inefficient outcomes if MKR token holdings are concentrated with a single investor. The remainder of the paper is structured as follows. In section 2 we outline fundamentals of the MKR token. Section 3 discusses issues in mechanism design and whether the governance protocol is incentive compatible. Section 4 concludes.

¹ A smart contract is a set of instructions, written in computer code, that defines the conditions of the contract for each counterparty under different scenarios (default etc). Being managed by computer code and visible on the blockchain, it can be verified publicly by all nodes in the blockchain.



2 Fundamentals of Governance Token Valuation

The Maker Governance protocol is in charge of adding new collateral types, the regulation of the smart contracts enforcing collateralize debt positions, and adjusting risk parameters of the protocol, such as the liquidation ratio, debt ceilings and the stability and savings rate. Panel A of Figure 1 illustrates the MKR price. In panel B, the MakerDAO token launched with a supply of 1 million MKR. In panel C, we plot the net redemptions of MKR tokens. In panel D, the system surplus is the amount of DAI generated from system fees, including Stability Fees and Liquidation Fees set by Maker governance. In panel E, we plot the ratio of the MKR price to the system surplus per unit of the MKR token.² In Panel F, we show that Systemic risk in ETH is strongly correlated with volatility in MKR. We now outline our three hypotheses of fundamentals of MKR token valuation.

► **Hypothesis 1.** *System surplus* $\uparrow \implies$ *MKR tokens burned* \implies *MKR prices* \uparrow

When the system surplus exceeds the safety buffer, any additional DAI is auctioned off for MKR, the governance token of the Maker Protocol, in lots of 10,000 DAI in a Surplus Auction. The system then burns the MKR it receives in the Surplus Auction, reducing the total supply. In 2021, strong growth in the system surplus due to stability and liquidation fees has led to a net reduction of MKR tokens through surplus auctions. We hypothesize that growth in the system surplus leads to a net burning of MKR tokens and an increase in the valuation of the MKR token.

► **Hypothesis 2.** *Liquidations* $\uparrow \implies$ *MKR tokens minted* \implies *MKR prices* \downarrow

During the *Black Thursday Crypto crash* on March 12th 2020, MKR tokens were minted to pay off the DAI debt triggered by liquidations. If the sale of collateral is not sufficient to pay off the DAI loans triggered in liquidation, the Protocol triggers a MKR Debt Auction. MKR is minted by the system, increasing the amount of MKR in circulation, and then sold to bidders for DAI. We hypothesize that the minting of MKR tokens devalues the MKR token.

► **Hypothesis 3.** *Volatility of ETH* $\uparrow \implies$ *Volatility of MKR* \uparrow and *MKR prices* \downarrow

ETH volatility can translate to MKR volatility through (i) an increase in gas fees and congestion on the blockchain, (ii) more volatile demand for ERC-20 tokens and decentralized finance applications, and (iii) increased systemic risk of vaults that hold ETH collateral. We empirically test the three fundamentals of MKR prices in Equation (1):

$$Y_t = \beta_0 + \beta_1 \frac{\Delta \text{Surplus}_{t-1}}{\text{MKR}} + \beta_2 \sigma_{ETH,t} + \beta_3 \text{Liquidation}_t + u_t \quad (1)$$

Here, the outcome variable Y_t is the MKR return and the intra-day volatility. Intra-day volatility is calculated as the square root of the average sum of squared hourly returns over the trading day. Explanatory variables include the growth in the system surplus normalized by MKR tokens in circulation, ETH intra-day volatility, and liquidations (millions DAI).

² The valuation of the MKR token is analogous to a dividend that is paid to MKR stakeholders for supporting the governance protocol in maintaining the DAI peg. The valuation of a MKR token per unit of system surplus fluctuates between 100 to 500.

The results are summarized in Table 1. Consistent with our proposed hypotheses, MKR returns correlate positively with system surplus and negatively with liquidations. In column (IV), a 1 per cent increase in the ratio of system surplus to MKR tokens results in a 4.7 basis point increase in MKR returns, and a 1 million increase in DAI liquidations is associated with a 1.07 per cent decline in MKR returns. MKR volatility correlates significantly with ETH volatility with an estimated elasticity of 0.82 in column (VIII).

3 Governance and Incentive Compatibility Conditions

The MKR governance token is used for voting on the management of the protocol and setting many of the parameters of the DAI stablecoin peg. For example, to change the stability rate, each user places a vote on their preferred stability rate by staking their MKR tokens. Each MKR token equals one vote when locked in a voting contract. Users commit their Maker tokens to a proposal, with the outcome being decided by the number of MKR tokens it receives.

A rational user has the following objective function: to maximize the system surplus subject to the constraint of the DAI peg stability. Setting parameters that move the DAI price away from the peg can have adverse effects on system surplus if it causes DAI users to switch toward other stablecoins. For illustration, suppose that MKR holders decide to set a high debt ceiling for risky collateral types like ETH, and lower the debt ceiling for safe collateral types like USDC. While this policy change may increase short-run revenues, this increases systemic risk due to negative valuations of ETH. Therefore MKR holders need to internalize the setting of policy parameters impact on the DAI peg and to set parameters to minimize systemic risk to the protocol.

Governance voting protocols can lead to inefficient outcomes if tokens are concentrated with one user. An example is the vote on the stability fee on October 28th, 2019, in which an individual MKR holder staked up to 94% of the vote to change the stability fee from 9 % to 5%.³ Such outcomes can be sub-optimal if they conflict with the target of peg stability. A concentration of MKR tokens with one user can also lead to inefficient prices of MKR auctions. The MakerDAO system burns MKR tokens when the system surplus exceeds the reserve buffer. The burning of MKR tokens takes place in an auction when users make bids for DAI tokens in return for selling their MKR tokens. If all MKR tokens are concentrated with one investor, they will be able to sell their MKR tokens at a high valuation, leading to significant losses for the protocol.

4 Conclusion

In this paper, we discuss the fundamentals of the governance token price and the incentive compatibility conditions that need to be met for peg stability. The MKR token typically appreciates in response to an increase in the system surplus, and depreciates when MKR tokens are minted in response to MKR debt auctions and to cover losses on liquidating DAI loans. While MKR holders have an incentive to set parameters to minimize systemic risk to the DAI peg and governance protocol, there are potential vulnerabilities when there is concentration of MKR tokens. A potential solution to the governance protocol is to set caps on the MKR staked to prevent a single user from being able to alter the outcome of policy parameters.

³ <https://cryptoslate.com/makerdao-whale-with-94-voting-power-reduces-dai-stability-fee-by-4/>

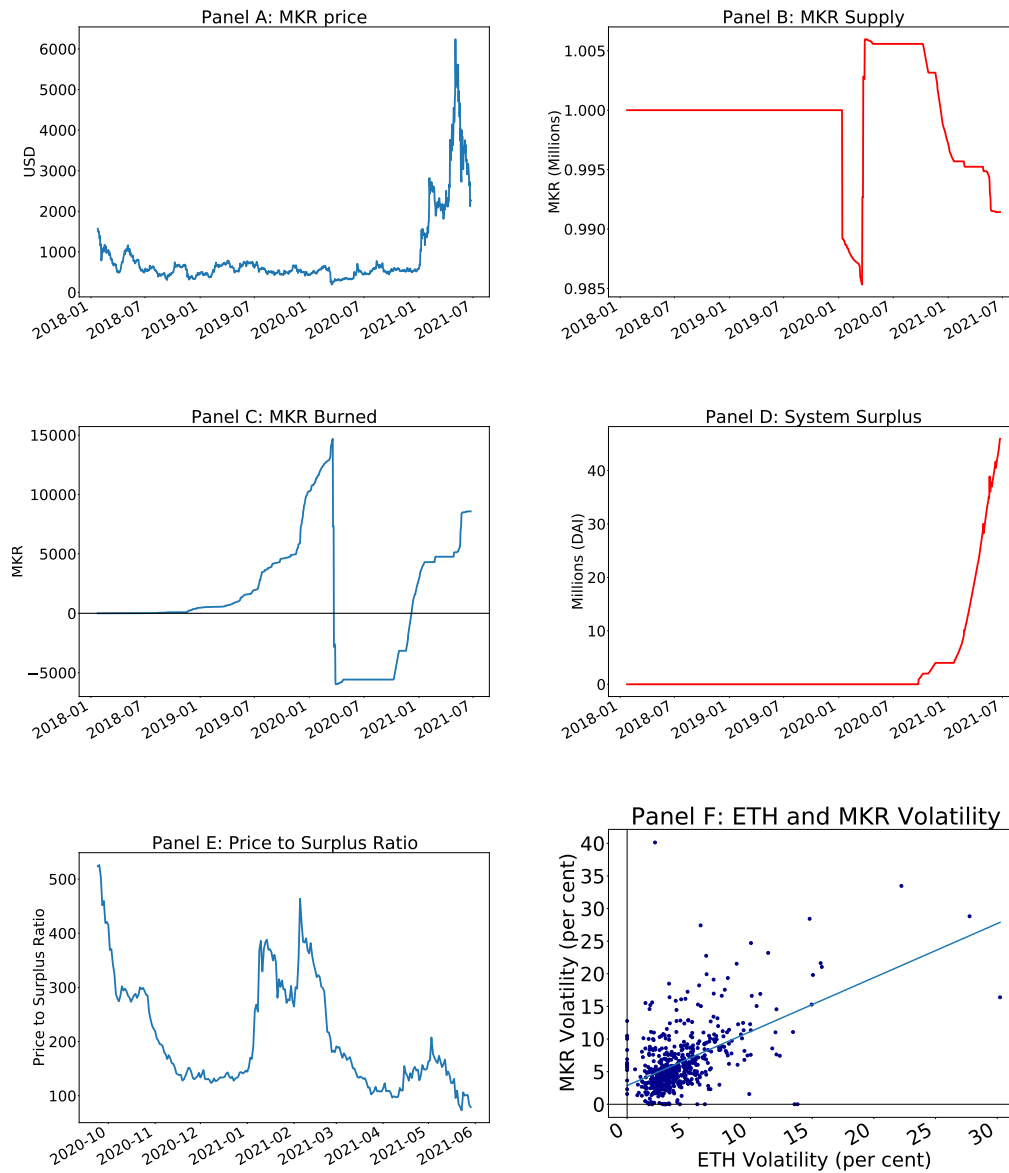
■ **Table 1** MKR Price Fundamentals: Liquidations.

	I	II	III	IV	V	VI	VII	VIII
	R_{MKR}	R_{MKR}	R_{MKR}	R_{MKR}	σ_{MKR}	σ_{MKR}	σ_{MKR}	σ_{MKR}
Surplus	0.0442*** (0.0126)			0.0474*** (0.0124)	0.0255*** (0.0080)			0.0211*** (0.0069)
σ_{ETH}		-0.2828*** (0.1049)		-0.1760 (0.1108)		0.8285*** (0.0573)		0.8283*** (0.0612)
Liquidation			-1.2039*** (0.3297)	-1.0691*** (0.3504)			0.9301*** (0.2088)	-0.0671 (0.1936)
Intercept	0.2581 (0.3265)	1.7793*** (0.5528)	0.6902** (0.3170)	1.1143** (0.5642)	6.2645*** (0.2083)	2.8575*** (0.3018)	6.3346*** (0.2007)	2.7228*** (0.3117)
R-squared	0.02	0.01	0.02	0.05	0.02	0.27	0.03	0.29
No. observations	555	555	555	555	555	555	555	555

Note: This table regresses MKR returns and volatility on ETH volatility, system surplus and liquidations. The dependent variable R_{MKR} measures the daily MKR return. The dependent variable σ_{MKR} measures the intra-day volatility of MKR prices. The sample runs from November 18th, 2019 to March 31st, 2021, corresponding to the period of Multi Collateral DAI. White heteroscedasticity-robust standard errors are reported in parentheses. *** denotes significance at the 1 percent level, ** at the 5 percent level, and * at the 10 percent level.

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Note: This figure plots Panel A: MKR price, Panel B: MKR Supply Panel C: MKR Burned, Panel D: System Surplus, Panel E: Ratio of MKR Price to Unit Surplus, Panel F: ETH and MKR Volatility. Sample period is from April 13th, 2018 to March 31st, 2020.

■ **Figure 1** MKR price, MKR Supply, Burned/Minted Tokens and System Surplus.