Game Theory with Application in Economics and Finance
Magistère BFA 2 - April 2021
Final Exam

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90mn. No documents, no calculators allowed.

Regulating Facebook's planned crypto-currency (16 pts)

We are at the end of 2019. At that time, the blockchain-based payment system *Diem* was called *Libra*...

Libra is a blockchain digital currency proposed by the American social media company, Facebook. The launch of the digital and privately owned currency is planned for 2020. U.S. regulators and politicians expressed concerns closely following the mid-2019 announcement. The U.S. House Committee on Financial Services Democrats sent a letter to Facebook asking the company to stop development of *Libra*, citing concerns of financial stability, money laundering, customers' privacy, and monetary policy.

Several regulating agencies propose heavy regulation regarding several aspects of the project. Among them, the Financial Stability Oversight Council is looking into whether the *Libra* Association should be regulated as a systemically important bank that could become "too big to fail". The U.S. Financial Crimes Enforcement Network would like the *Libra* Association to be asked to work with law enforcement to inspect the blockchain data worldwide, helping the FBI hunt cybercriminals and detect money-laundering. Antitrust authorities are concerned about the potential for abuse of market dominance, where the account holder's transaction history is combined with his or her Facebook account. The Fed has concerns about the threat to the monetary sovereignty of U.S.

On the contrary, many U.S. senators are willing to keep big tech companies out of tough regulation in order to encourage innovation and ensure that the US leads in technology.

The crypto-currency market currently lacks a clear regulatory framework. Should *Libra*, Facebook's planned blockchain-based crypto-currency, be heavily regulated?

Part A. The United States regulates Facebook's currency in a closed economy (6 pts)

Consider two players, United States regulators, denoted as US, and Facebook, denoted as FB.

To simplify the analysis, we assume there are only three possible levels of regulation from US: high, denoted as H, medium, denoted as M, and low, denoted as L. We also assume there are only two possible decisions from FB regarding the development of the crypto-currency project *Libra*: continuing it, denoted as C, and stopping it, denoted as S.

For U.S. regulators, as long as *Libra* is developed, the more regulated it is, the better. If *Libra* is stopped, the regulatory agencies fear being publicly blamed for having discouraged the firm to develop its innovation. As such, so the less it would have been supposedly regulated, the better. Also, US regulators prefer FB to develop *Libra* rather than to stop it (no matter the level of regulation).

For Facebook, the less *Libra* is regulated, the more profitable it is. In case of medium and low levels of regulation, profits are positive. However, a high level of regulation would be so harsh that the firm's profit would be negative. In any case, the firm can secure a zero profit by simply stopping the development of its crypto-currency.

We normalize the payoff associated to the pair of moves (S, L) to zero.

A1. (**3 pts**) Depict the corresponding strategic interaction in a context of simultaneous moves with a 2×3 matrix payoff where FB (resp. US) is the row (resp. column) player. Fill the payoffs with numbers that fit the order of players' preferences. Characterize both the (possibly empty) set of pure strategy Nash equilibria and the set of Pareto-efficient outcomes.

A2. (**3 pts**) We assume now that US regulatory institutions exclude the high level of regulation and restrict themselves to medium and low levels only. Depict the new corresponding strategic interaction with a 2×2 matrix payoff. Characterize both the (possibly empty) set of pure strategy Nash equilibria and the set of Pareto-efficient outcomes.

Part B. The United States regulates Facebook's currency with China as a competitor (10 pts)

Now we consider the previous 2×2 matrix payoff to which we add a third player, China, denoted as CH. China can either accommodate (A) the American crypto-currency by opening its market to it or fight (F) by denying its access to it and promoting its own state-run digital currency.

In case of a halt on the *Libra* development, the US and FB's payoff are the same as in Part A. Otherwise (under *Libra* development), the US and FB's payoffs are higher (resp. lower) than in Part A when CH accommodates (resp. fight).

In case of a Chinese fight, FB's profit would decrease to the point where it would become negative under medium level of regulation. When *Libra* is not developed, CH's payoff is maximal and does not depend on US's regulation. Otherwise (under *Libra* development), CH

is in favor of a U.S. tough regulation of *Libra*. CH prefers to fight a low regulated *Libra* than to accommodate a medium regulated American crypto-currency.

B1. (**2 pts**) Depict the corresponding strategic interaction in a context of simultaneous moves with a $2 \times 2 \times 2$ matrix payoff where FB (resp. US) is the row (resp. column) player, and CH selects which of the two 2×2 matrix is played.

Consider first that CH's behavior is fixed.

B2. (**1 pts**) Characterize the (possibly empty) set of pure strategy Nash equilibria in the (simultaneous) subgame where CH accommodates.

B3. (**3 pts**) Is there any pure strategy Nash equilibrium in the (simultaneous) subgame where CH fights? If not, characterize the set of mixed strategy Nash equilibria. How do the likelihoods at stake vary with the parameters of the model?

Second, consider CH is strategic as well.

B4. (**2 pts**) Write the players' best responses. Is there any pure strategy equilibrium? Characterize the set of strategy Nash equilibria.

B5. (**1 pt**) Compute the resulting equilibrium expected payoffs.

B6. (**1 pt**) Is the equilibrium Pareto optimal? Why?

Dilemme du prisonnier répété (4 pts)

On considère la forme normale du dilemme du prisonnier avec des incitations à la déviation de coopération modifiées à l'aide du paramètre $\alpha \geq 0$ de la manière suivante.

		Joueur 2	
		t_2	c_2
Joueur 1	t_1	$(1, 1)$	$(4+\alpha, 0)$
	c_1	$(0, 4+\alpha)$	$(3, 3)$

1. (**1 pt**) En quoi consiste ici une stratégie « grim trigger » pour le joueur i ?

2. (**2 pts**) Caractérisez le plus petit seuil $\bar{\delta}$ au-delà duquel la coopération mutuelle est soutenable à l'équilibre du jeu répété infini à l'aide d'une stratégie « grim trigger ».

3. (**1 pt**) Comment varie ce seuil avec α ? Interprétez.