Market and Non-Market Exchange and Market-Supporting Institutions

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October 4, 2024

Abstract

Does market exchange reduce participation in non-market exchange thus reducing overall welfare? Some have argued that markets strengthen the conditions for a vibrant non-market exchange. Others contend that markets crowd out non-market exchange by promoting individualism, alienating individuals, and displacing social ties. This paper argues that having access to market and non-market exchange is welfare-enhancing despite crowding out occurring. Furthermore, improvements in the quality of market-supporting institutions increase welfare and induce more non-market exchange in middle-income and low-patience communities. The paper's results shed light on the process of development.

Keywords: Market Exchange, Non-Market Exchange, Market-supporting Institutions, Ostracism, Development Process.

JEL-Classification: D2, D3, C72, C73, D23, D73, H11, K12, O17, P48, P51, Z12

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†Thanks the financial support of The Nucleus Labor Market Mismatch: Causes and Consequences, grant NCS 2022-045, the Institute for Engineering Complex Systems, grants ICM P05-004F and Institute for Research in Market Imperfections and Public Policy, MIPP, grant ICM IS130002.

"The market community is the most impersonal relationship of practical life into which humans can enter with one another." And, "where the market is allowed to follow its own autonomous tendencies, its participants do not look toward the persons of each other... there are no obligations of brotherliness or reverence, and none of those spontaneous human relations that are sustained by personal unions" (Weber, 1921, p. 76)

1 Introduction

There is a long-standing debate about whether well-functioning market exchange crowds-out non-market exchange.[1] Coase (1937) and Williamson (1985) contend that market-supporting institutions serve to limit transaction costs; that is, they save time and money spent locating trading partners, facilitate price and quality comparisons, enforce trade agreements, and permit efficient settling of controversies. In short, they make markets more efficient.[2] McCloskey (2006) sustains that these also boost trust and social capital and, therefore, non-market exchange. Writers such as Paine, Hume, Montesquieu, and Condorcet have argued that markets reinforce durable and peaceful relations that favor non-market exchange. However, since Karl Marx argued that markets promote individualism and corrode traditional values, scholars such as Weber (1921), Polanyi (1944), Anderson (1995), Sandel (2012), and Satz (2010) have advanced that the pervasive presence of markets changes moral values, culture, and institutions in a way that displace social ties and, thereby, non-market exchange.[3] The empirical and anecdotal evidence is mixed.[4]

This paper focuses on the coexistence and interaction between market and non-market exchanges when the participation choice is endogenous and payoffs are independent. We explore a mechanism that links the two types of exchange with market-supporting institutions and investigate the welfare effects of this mechanism. The paper's main argument is that when individuals' resource endowments are below a given threshold, more efficient market exchange softens non-market exchange incentive constraints and thereby non-market exchange rises when market exchange efficiency improves. Furthermore, even though some crowding out may occur, this crowding out is welfare-enhancing.

Consider a setting in which individuals, endowed with limited resources, within a community repeat-

[1]Non-market exchange refers to the exchange of goods and services outside the market. This can include bartering, gift-giving, and sharing economy transactions. These types of exchanges are often based on social relationships. They can also be found in traditional, subsistence-based societies where a market economy does not exist. Market-supporting institutions are organizations that provide the rules and regulations necessary to ensure the efficient operation of markets. They include regulatory bodies, market infrastructure, and financial intermediaries. Regulatory bodies are responsible for setting rules and regulations that ensure the safety of markets and protect investors. Market infrastructure refers to the physical and technological infrastructure necessary for markets to function, such as exchanges, clearinghouses, and depositories.

[2]See, e.g., McMillan (2002) for a detailed discussion on this.

[3]See, Besley (2013) for criticism of Sandel's (2012) arguments, and Hirschman's (1982) for the so-called self-destruction thesis, which asserts that markets, with their strong emphasis on individual self-interest, undermine traditional values including those based on which the market itself is working and, thereby, result in self-destruction.

[4]See, for instance, Gagnon and Goyal (2017) for real life examples.

edly choose to participate in both market and non- market exchanges. Market exchanges are governed by market-supporting institutions (the legal system) in the sense that contracts are complete and fully enforced and participating in it requires paying a fixed cost. On the other hand, non-market exchanges are governed by community actions and deviations are punished by permanent ostracism, thus capturing both the personalized and reciprocal nature of non-market exchange.[5] This implies that the payoff to non-market exchange depends strategically on the actions chosen by other actors and the payoff to market exchange depends only on individual actions and the quality of market-supporting institutions.[6]

In this setting, market exchange and the quality of market-supporting institutions do not directly affect the payoff of non-market exchange but they could do it indirectly as they alter the payoff to deviation in non-market exchange. Furthermore, individuals who renege in non-market exchange can continue their activity in the market without punishment, which insulates the market-exchange payoff from non-market activity. However, they get linked when the resource constraint binds.

How do market-supporting institutions then affect non-market exchange? In a purely non-market exchange economy, individuals choose between the largest self-sustainable non-market expenditure and the welfare-maximizing market expenditure whenever endowments allow it. This equilibrium is supported by permanent ostracism. Otherwise, they invest all their resources in it. In this economy, market-supporting institutions have no bearing on the equilibrium.

When market exchange co-exist with non-market exchange, it can harm non-market exchange by making the punishment for not reciprocating agents less severe than that when the market exchange is not available since this provides non-reciprocators with a better fall-back position and because market exchange, when the resource constraint binds, crowds-out non-market exchange.

When looking at initial endowments, interesting parameter regions arise. There are two thresholds; a low and a high threshold. When the initial endowment is higher than the upper one (the wealthy income case), individuals participate in both market and non-market exchange. There is no crowding out because the resource constraint does not bind and incentives to participate, at a given intensity, in non-market exchange are not harmed by the possibility to engage in market exchange after reneging. This is not particularly revealing because the interaction between the two exchanges is not constrained and strategic interaction between them does not arise. This happens even when the non-market exchange incentive compatibility constraint binds.

When the initial endowment is lower than the lower threshold (the lower income case), individuals only engage in non-market exchange as the fixed cost from participating in market exchange makes it undesirable.

[5]In models where a social network determines trade possibilities and information flows, under specific network architectures, the result holds, but introducing these complexities may not offer additional intuition. See Wolitzky (2013).

[6]The results are robust to making the payoff of market exchange dependent on other actors' actions as in non-competitive markets.

In terms of welfare, individuals are better off than in a purely market exchange economy, since non-market exchange provides an expenditure alternative to market exchange and they are equally well-off than in a non-market exchange economy. Thus, in a market and non-market exchange economy, the latter provides a better fallback position when opting out of market exchange.

When the initial endowment falls between the two thresholds (the middle-income case), individuals participate in both exchanges, and crowding out occurs.[7] First, a sufficient endowment makes participation in the market exchange profitable as individuals are wealthy enough to pay the fixed cost of doing so and to benefit from the market exchange. Because resources are limited, market exchange crowds out non-market exchange. However, this crowding out is welfare-improving because it allows for substitution towards market exchange with a higher marginal utility at the margin. Thus, introducing market exchange into a purely non-market exchange economy is welfare-enhancing despite the independence between the payoffs from non-market and market exchange since they become linked through the incentive-compatibility constraint regarding non-market exchange or/and the resource constraint.

These results show that when both the resource and the incentive constraint bind and opting out of market exchange is not optimal, an improvement in market institutions increases the involvement in non-market exchange. This happens because better market-supporting institutions soften the incentive constraint and the expenditure in market exchange is larger than optimality requires when the incentive constraint does not bind but the resource constraint does. Thus, institutions that improve the efficiency of market exchange have positive spillovers in non-market exchanges and enhance overall welfare. Furthermore, as the endowment rises the incentive constraint softens since the market exchange payoff when both exchanges co-exist increases with it faster than that after a deviation; i.e., the market exchange payoff in a purely market-exchange economy. This happens because when the market and non-market exchange co exist, the expenditure in market exchange is smaller than that in a purely market-exchange economy.

Our results provide insights into long-term economic development and the relevance of market-supporting institutions for it. Given the complementarity highlighted in our analysis, strong markets enhance non-market exchange rather than impede it for impatient and middle-income communities. Furthermore, market-supporting institutions elevate welfare in communities that do not opt out of the market exchange and reduce the income threshold below which communities opt out of market exchange. Therefore, investing in robust market-supporting institutions is beneficial for more effective economic modernization and efficient levels of non-market exchange despite the high fixed costs and high taxes they entail.

The rest of the paper is structured as follows. The next Section briefly discusses the related literature. Section 3 presents the model. Section 4 presents two benchmarks: the equilibrium in a purely non-market exchange economy and the equilibrium in a purely market-exchange economy. In Section 5, we derive

[7] Crowding out here refers to the level of participation in the case where both exchanges are active relative to that in the case where only one of the markets is available.

the sub-game perfect equilibrium of the repeated game when both exchanges are available. In addition, we study the comparative statics regarding the equilibrium and welfare and market-supporting institutions, endowments, and patience. In Section 6, we compare welfare across economies and endogenize the quality of market-supporting institutions . In the next Section, we discuss the robustness of the results. Section 8 concludes.

2 Related Literature

There is a theoretical literature studying the relationship between formal and community enforcement. For instance, Kranton (1996), Dixit (2003a,b), Acemoglu and Jackson (2017), and Jackson and Xing (2021), Wolitzky (2013), Acemoglu and Wolitzky (2020, 2021). Most of these papers introduce a type of formal enforcement in repeated game models and study how the introduction of a particular type of formal enforcement crowds out community enforcement. For instance, Acemoglu and Wolitzky (2020, 2021) add agents specialized in coercive enforcement to a standard community enforcement repeated game model. The first one studies what sub-game perfect equilibrium maximizes cooperation and shows that grim-trigger strategies fail to do so because they do not induce enforcement by specialized agents. The second uses the same model to study the emergence of legal equality. Dixit (2003a) shows that community enforcement can do worse than formal government enforcement in large-size communities, the opposite occurs in small communities, and mid-size communities fare worst.[8]

Kranton (1996) shows that introducing market exchange undermines reciprocal exchange since opportunities for market exchange reduce the punishment for breaching a reciprocal-exchange agreement and provide access to new and different goods, which lowers search costs when the majority choose anonymous markets and raises them when few engage in them.[9] The fact that a more efficient market exchange undermines non-market exchange is also present in our model. However, Kranton's (1996) rests on search costs, goods variety, and the fact that both types of exchange are mutually exclusive, while our mechanism depends on anonymous markets increasing income generative capacity that can be spent in both, in either, or neither type of exchange.

Jackson and Xing (2021) in a repeated-task model with market and community tasks show that community and formal enforcement are complements.[10] This stems from the fact that the news that someone

[8]There is a growing theoretical and empirical literature that explores the interaction between formal and relational contracting asking whether informal and formal contracting are either substitutes or complements. This literature shows that the complementarity between formal and informal enforcement depends on the institutional setting studied at both the theoretical and empirical levels. See, Corts (2018) for a detailed review of this literature.

[9]In her model the participation in reciprocal exchange is random and fixed at the beginning of the game and individuals cannot participate in both market and non-market exchange.

[10]Agents are randomly assigned to either community task or market task and thereby they can never choose to participate in both.

was found cheating on a market task results in a community punishment consisting of ostracism, which strengths incentives to comply with the market task and gives rise to the complementarity between formal and informal enforcement.[11]

As we do, they study the welfare maximizing institutions and, as in Kranton (1996), participating in the market or community task are mutually exclusive. However, in our model, individuals can simultaneously participate in market and non-market exchange. In contrast, ostracism in market exchange plays no role in our complementarity result in the sense that behavior in market exchange cannot be punished. Thus, these two papers propose different economic mechanisms than the one studied here and as such we see them as complementarity to ours.

Gagnon and Goyal (2017) ask a similar question but in a static network game where neither community self-enforcing punishment nor resource scarcity plays a role. The game considers a market and non-market task in which individuals decide whether to engage in one of the two. The individual payoff of the non-market expenditure depends on how many others choose the non-market exchange and whether or not they undertake a market exchange. The equilibrium depends on whether the network and market exchange are complements or substitutes. The model assumes this to be exogenous. They discuss several real-life interesting examples regarding when actions are complements or substitutes.

Macchiavello and Morjaria (2021), find, using Rwanda's coffee industry, that competition hinders relational contracting directly by increasing farmers' temptation to default on the relational contract and indirectly by reducing mill's profits. Lowes, Nunn, Robinson, and Weigel (2017) find that centralized formal institutions are associated with weaker norms of rule-following and a greater propensity to cheat for material gains. This is consistent with having a less severe punishment for reneging in non-market exchange. Greif and Tabellini (2017) also argue in favor of substitution in their study of China versus Europe. They conclude that the European system has a comparative advantage in supporting impersonal exchange, in contrast to the Chinese system, which has a comparative advantage in economic activities in which personal relations are more important. In contrast, Poppo and Zenger (2002) find evidence, using data from a sample of information service exchanges, supporting the complementarity between formal and informal enforcement. Namely, managers appear to couple their increasingly customized contracts with high levels of relational governance and vice versa. Again these potentially contradictory predictions could be explained within the confines of our model in light of the different institutional settings in which they happen.

There is plenty of evidence of how formal enforcement, formal markets, and states can function well on a large scale under the proper circumstances (Acemoglu, Johnson, and Robinson (2001b), Persson (2002), Tabellini (2010), and Besley and Persson (2010)), and those institutions can be either enhanced or hampered by culture understood as beliefs and values (Bisin and Verdier (2017) and Alesina and Giuliano (2015)) or

[11] In the papers of Ali and Miller (2022) and Acemoglu and Wolitzky (2024), ostracism also plays a crucial role.

co-evolve with culture (see Aghion, Algan, Cahuc, and Shleifer (2010), Pinotti (2012), and Bidner and Francois (2011)). Acemoglu, Johnson, and Robinson (2001a) argue that the roots of development are based on the role of formal institutions. Greif (2006) studies the process of institution formation in European history. Aghion, Alesina, and Trebbi (2004) look at the formation of political institutions and its distributional effect. Becker, Boeckh, Hainz, and Woessmann (2016) find that the Habsburg Empire, with its well-respected administration, increased the citizens' trust in local public services.

Our paper differs from the previous literature in that it provides a different strategic link between market and non-market exchange and market-supporting institutions in a setting where they are independent of each other and both types of exchanges generate benefits and compete for funds, rather than looking at circumstances under which either of them flourishes. The strength of this mechanism rests on the quality of market-supporting institutions and individuals' income levels–observable variables that are empirically important determinants of the degree of development of different economies–.

3 The Model

We consider a society composed of N individuals, each having a common discount factor δ and an endowment w. The society is partitioned among multiple communities. Let $l \subset N$ denotes a representative community and $l(i)$ denotes individual i's community ($i \in l(i)$). Each community has at least two agents. Society offers the possibility of engaging in market and non-market exchange.

In every period $t = 0, 1, 2, \ldots$, individuals participate in the following sequential game: first, all individuals are matched randomly in pairs inside their community, and second, they choose how to allocate their endowments between non-market and market exchange.

Non-market Exchange When individual i chooses a non-market expenditure $x_i \in \Re_+$ in his partnership with the current partner, say player j, he incurs in a cost $-x_i$ and his expenditure benefits partner j with a utility $u(x_i)$, where $u : \Re_+ \rightarrow \Re_+$ is an increasing, strictly concave, bounded, and differentiable function satisfying $u(0) = 0$ and $u_1(0) > 1$, where u_1 denotes the partial derivative of u with respect to x_i. If partner $j \in l(i)$ reciprocates with an expenditure x_j, partner i will get a utility $u(x_j)$. This game's only static Nash equilibrium is one in which each member i chooses $x_i = 0$. Thus, as in Ghosh and Ray (1996), the game can be understood as a Prisoner's Dilemma game with variable stakes.

If a partner does not reciprocate, the non-deviating community members permanently ostracize the deviator by not reciprocating in any future encounter with the deviating member. This is a class of social norms in which "innocent" individuals cooperate and reveal their entire histories with each other, but permanently punish those who are "guilty" of not reciprocating in the past. Thus, ostracism is an automatic part of the matching process as in Jackson and Xing (2021) since when two individuals are matched they automatically learn their histories of reciprocation. One could model this explicitly as a central authority within the community that realizes the matches, collects the information about deviations, and provides that information to all community members. Alternatively, matching and ostracism could be modeled as a random matching process in which each individual is matched with another one at each time t and they freely choose whether or not to reveal their behavior in past encounters or any information they have regarding other members' behavior, for instance, in Ali and Miller (2016) and Ali and Miller (2022). As shown by Ali and Miller (2016) in this case if guilty individuals are going to be permanently ostracized, non-reciprocation is so tempting that cooperation in any relationship cannot be more than what the partners could obtain through bilateral enforcement. However, they show that temporary ostracism can improve upon bilateral enforcement.[12]

Market exchanges In each period t, individual i can also participate in market exchange. Doing so demands to pay a fixed cost $f \in [0, w]$ in each period he chooses to participate. If he pays the fixed cost f, he chooses his market expenditure z_i and gets a utility $u(z_i; \phi)$, where $\phi \in \Re_+$ measures the quality of market-supporting institutions. They are institutions ensuring that property rights are respected, that people can be trusted to live up to their promises, that externalities are held in check, that competition is fostered, and that information flows smoothly (see, McMillan (2005))

The utility function is strictly increasing in z_i, twice-continuously differentiable, strictly concave, and satisfies the following: $u(0; \phi) = 0$, $u_1(0; \phi) > 1$, where u_1 denotes the partial derivative of u with respect to z_i.

Thus, the utility of individual i in any given period t is given by the quasi-linear utility function

$$U(x_i^t, x_j^t, z_i^t, \mathbb{1}_i^t) = \mathbb{1}_i(u(z_i^t; \phi) - z_i^t - f) + u(x_j^t) + w - x_i^t,$$

where $\mathbb{1}_i^t = 1$ when individual i participates in market exchange and $\mathbb{1}_i^t = 0$ otherwise. Thus, the marginal utility from market consumption is independent of non-market consumption's utility. This is meant to avoid any mechanical connection between market and non-market consumption. We will discuss the role of complementarities/substitutability in the robustness section.

In summary, the main difference between market and non-market exchange is that in the latter enforcement is informal and exercised by means of ostracism. In contrast, in market exchange, this is formally enforced by institutions. For instance, if an individual buys a good of a given quality but this is not delivered as agreed upon, he can use the warranty to get the right quality or ask for a reimbursement. If this fails, he can use the legal system to get what the explicit or implicit contract promised.

An individual's history at time τ consists of the public history and a private history, $h_i^\tau = (h_c^\tau, h_{p,i}^\tau)$ specified as follows. $h_c^\tau = (\mathbb{1}^\tau, O^\tau)$, where O^τ is the list of ostracized individuals by the end of period τ

[12] We discuss the potential effects of this for our results in section 7

within the community.

An individual's private history, at the end of period τ, includes their past actions $h_{p,i}^{\tau} = (x_i^{\tau}, z_i^{\tau}, U_i^{\tau})$. This includes, i's expenditures and the payoff from the exchanges. Their history does not explicitly include whether they have been ostracized, since that can be deduced from their action and the public history. Let $h_i^0 =$ so that histories are well defined for the initial period. Let $\mathcal{H}_i = (h_c^{\tau}, h_{p,i}^{\tau})$. $\mathcal{H}_c$ be the set of all finite public histories.

A strategy $\sigma_i : \mathcal{H}_i \times \Re_+^2 \times \{0,1\} \longrightarrow \Re_+^2 \times \{0,1\}$ is a function that maps every possible history of i to actions, $\sigma_i(h_i^{\tau-1}) \in \Re_+^2 \times \{0,1\}$. Let σ denote a strategy profile for all individuals.

A strategy profile σ^* is a perfect public equilibrium if σ^* is a public strategy profile and is a Nash Equilibrium at every $h_p^{\tau-1}$. Thus, $\sigma_i(h_c^{\tau-1}, h_{pi}^{\tau-1}) = \sigma_i(h_c^{\tau-1}, \tilde{h}_{p,i}^{\tau-1})$ for all $\tilde{h}_{p,i}^{\tau-1}$. We focus on perfect public equilibrium in which non-reciprocators are immediately and permanently ostracized.

Main Features of the Model Firstly, the model is a highly stylized representation of a community, where non-market exchange is structured like a Prisoner Dilemma game with variable stakes, introduced by Ghosh and Ray (1996), and limited resources. This provides a realistic depiction of many relationships, where players can choose how much effort to exert or hours to dedicate in a joint venture, or how much to trade in a contractual relationship, or how much of their limited wealth to transfer in a risk-sharing arrangement.

The variable stakes setting allows individuals to adapt their relationship to the set of players being ostracized, the dynamics of cooperation within the community, and the different opportunities that market exchange offers under different institutional settings. Were players instead constrained to play a fixed-stakes prisoner' dilemma, it would be mechanically true that market exchange crowd-out non-market exchange and vice-versa: either the fixed stakes would be too high for individuals to engage in both or too little that engage in both is optimal. Also, variable stakes offer a convenient metric to compare equilibria at a fixed discount rate for different market-supporting institutions' quality.

An interesting model example is one in which the endowment corresponds to time available for work and individuals can spend it working on joint projects for with other community members and/or working in the labor market for formal firms or as formal contractors. If individual i spends x_i hours working for community member j, he expects to be paid with x_j hours of work by partner j, which delivers a payoff $u(x_j)$. One needs to repair a fence and the other to fix the roof. If he spends z_i hours working in the formal market, he receives a wage $u(z_i; \phi)$, where ϕ measures the quality of the labor relationship regulation, the antitrust regulation, or the legal system. Thus, the wage depends on labor market power or on the legal system's ability to sanction shirking or contract terms. If he does not work in either market, he uses his hours to work at home.

Secondly, non-market exchange doesn't emerge from inherent characteristics of individuals, such as trustworthiness; rather, it results from individuals' self-interested enforcement mechanisms made possible by repeated interactions. This definition aligns with the perspectives of Coleman (1990) and Putnam (2000), wherein non-market exchange involves investments in non-contractible actions motivated by self-interest and enforced through community sanctions.

Thirdly, the payoff from the non-market expenditure is independent of the payoff from the market expenditure to avoid establishing a mechanical relationship between non-market exchange, market exchange, and market-supporting institutions. However, as the subsequent analysis will reveal, a strategic relationship between them will emerge in the dynamic game.

Fourthly, we have assumed identical individuals. This simplification was made to streamline the analysis. Introducing heterogeneity in various dimensions, such as initial endowments and different payoffs, could add realism. However, this would significantly complicate the algebra without necessarily enhancing economic intuition. While it could reflect a more realistic scenario with individuals participating in both markets and none, others participating exclusively in either market or non-market exchange, the complexity introduced might outweigh the additional insights gained.

These modeling choices contribute to a simplified albeit insightful framework for examining the dynamics between market and non-market exchange, and their interaction with market-supporting institutions.

4 Benchmarks

4.1 A Non-Market Exchange Economy

4.1.1 The Equilibrium

In a non-market exchange economy, market exchange is not available, and the allocation of resources is determined solely through non-market interactions within the community. This scenario represents a system where formal market mechanisms and external institutions do not play a role in resource allocation, and individuals rely on ostracism to enforce reciprocity.

Because an individual is ostracized when he does not reciprocate and the payoff is the same for any deviation, an optimal deviation entails not reciprocating. Suppose individual i does not reciprocate in the current period and abides in the future at all histories, then he is automatically ostracized since when matched with future partners, they automatically learn that individual i did not reciprocate in the past encounter. Thus, future partners do not cooperate with individual i, which implies he gets his autarkic payoff w in any future interaction. Thus, an individual's expenditure in the non-market expenditure $x_i \in \Re_+$ is incentive compatible in each period, provided that that partner j chooses x_j, if and only if agent i prefers expenditure

x_i than zero expenditure; that is,

$$u(x_j) + w - x_i \geq (1-\delta)(u(x_j) + w) + \delta w \implies x_i \leq \delta u(x_j).$$

Let's define $x(\delta)$ as the largest solution to the incentive constraint when the resource constraint is ignored and x^{fb} as the expenditure that maximizes the joint payoff. Because payoffs are symmetric, $x^{fb} \equiv \text{argmax}_{x_i \in \Re_+} \{u(x_i) - x_i\}$.[13] Observe that $x(\delta)$ rises with δ and therefore there is a threshold δ^{fb} such that $x(\delta) \leq x^{fb}$ for all $\delta \leq \delta^{fb}$.

From here onwards, we will assume that δ is such that there is a strictly positive self-sustainable non-market expenditure. This demands the following assumption.

Assumption 1. *The discount factor δ is such that $\delta u_1(0) > 1$.*

As is in any repeated game, there are multiple equilibria, among which the repetition of the static equilibrium is one of them, the welfare-maximizing equilibrium and the Pareto dominant equilibrium are others.[14]

Following, Ghosh and Ray (1996), we focus on the highest incentive-compatible joint payoff. Because payoffs and endowments are symmetric, the non-market expenditure solves the following problem

$$\begin{aligned}
&\max_{x \in \Re_+} \left\{u(x_i) - x_i\right\} \\
&\text{subject to} \\
&x_i \leq \min\{w, x(\delta), x^{fb}\}.
\end{aligned}$$

When individuals face no resource constraint, the non-market expenditure that maximizes the joint payoff involves selecting the minimum expenditure between the unconstrained joint-maximizing amount and the largest incentive-compatible amount. Conversely, when the endowment is insufficient to finance this amount, the full endowment is allocated to the non-market expenditure. From this, we deduce the following result.

Proposition 1. *The perfect public equilibrium when the market exchange is not available is $x^n = \min\{w, x^{fb}, x(\delta)\}$. This is non-decreasing in (δ, w).*

[13]The concavity of u and the Inada-type conditions ensures that a unique interior solution exists.

[14]For instance, Balmaceda and Escobar (2017) study both the welfare and Pareto in a repeated network game, Wolitzky (2013) studies the welfare-maximizing strategy profile in a repeated network game (see, also, Acemoglu and Wolitzky (2019) and Acemoglu and Wolitzky (2020, 2021)). Gagnon and Goyal (2017) study the Pareto equilibrium of a static network game. The collusion literature focuses mainly on sustaining the highest possible price, which is the monopoly price, and it is the welfare-maximizing equilibrium when welfare is defined as the sum of firms' profits (players' payoffs).

4.1.2 Welfare

Let's define the endowment level $w^n(\delta) = \min\{x^{fb}, x(\delta)\}$.[15] Whenever $w < w^n(\delta)$, $x^n = w$. Thus, the equilibrium payoff is

$$V^n = \begin{cases} u(\min\{x^{fb}, x(\delta)\}) + w - \min\{x^{fb}, x(\delta)\} & \text{if } w \geq w^n(\delta), \\ u(w) & \text{if } w < w^n(\delta). \end{cases} \tag{1}$$

It is straightforward to see that the equilibrium payoff increases monotonically with the endowment and is non-decreasing in δ. In fact, $V^n_w \geq 1$. In addition, the endowment threshold $w^n(\delta)$ is non-decreasing in δ. The intuition is quite straight-forward.

4.2 A Market-Exchange Economy

4.2.1 The Equilibrium

In this subsection, we derive the equilibrium when non-market exchange is unavailable. This equilibrium payoff will be the one individuals receive when being ostracized in an economy in which both market and non-market exchange co-exist since ostracism does not preclude them from using the market in the same terms as cooperators do.

In each period t, individual i solves the following problem

$$\max_{z_i \in \Re_+} \left\{ \mathbb{1}_i(u(z_i; \phi) - z_i - f) + w \right\} \text{ subject to } z_i \leq w - f$$

It is straightforward to check that if individual i chooses to participate in the market, his expenditure is z_i^{mu}, where this is the unique solution to $u_1(z_i; \phi) - 1 = 0$, whenever $z_i^{mu} \leq w - f$ and the expenditure is the full endowment otherwise. Let $z_i(w) \equiv \min\{z_i^{mu}, w - f\}$. Observe that $z_i(w)$ is non-decreasing in w. Let's define $w^{mu} \equiv z^{mu} + f$. Whenever $w \geq w^{mu}$, the unconstrained market expenditure is feasible.

He chooses to participate whenever the utility from doing so is higher than or equal to the payoff from autarky; that is, $u(z_i(w); \phi) + w - z_i(w) - f \geq w$. From here onwards, to make market exchange relevant, we will assume that fixed cost of market participation is such that the unconstrained individual's utility is higher than the utility from autarky. Thus,

Assumption 2. $u(z_i^{mu}; \phi) - z_i^{mu} - f \geq 0$.

Because $f \leq w$, assumption 2, and the properties of the utility function, there is a threshold w^{mc} such that the individual participates in market exchange whenever $w \geq w^{mc}$, where this is the lowest endowment

[15] The superscript n stands for non-market exchange.

level satisfying the following: $u(w - f; \phi) \geq w$. Hence, the individual opts out of the market whenever $w < w^{mc}$.[16]

From the preceding discussion and results, we deduce that the equilibrium is given by

Proposition 2.

$$(z^m, \mathbb{1}^m) = \begin{cases} (z^{mu}, 1) & \text{if } w \geq w^{mu}, \\ (w - f, 1) & \text{if } w^{mc} \leq w < w^{mu}, \\ (0, 0) & \text{if } w < w^{mc} \end{cases}$$

When the endowment is lower than w^{mc}, individuals opt out of market exchange because the fixed cost represents a large share of the endowment and the utility from market exchange does not compensate paying the fixed cost. Otherwise, they participate in market exchange and choose z^{mu} when $w \geq w^{mu}$, whereas their expenditure is equal to the total endowment minus the fixed cost when $w \in [w^{mc}, w^{mu})$.

4.2.2 Comparative Statics

Next, we derive the comparative statics concerning (ϕ, w, f).[17]

Proposition 3.

i. If $w \geq w^{mu}$, z^m increases with ϕ and is independent of (w, f).

ii. If $w \in [w^{mc}, w^{mu})$, z^m increases with w, falls with f, and is independent of ϕ.

iii. If $w < w^{mc}$, z^m is independent of (ϕ, f, w).

The results with regard to ϕ follow from the concavity of u and $u_{1\phi} > 0$ for all $z > 0$. Hence, market expenditure raises with ϕ whenever the endowment allows it since it raises the marginal utility of z. A rise in $w - f$ raise the expenditure when constrained since marginal utility exceeds marginal cost and leaves the expenditure unchanged when unconstrained.

4.2.3 Welfare

It readily follows from Proposition 2 that the static equilibrium payoff is

$$V^m = \begin{cases} u(z^{mu}; \phi) + w - f - z^{mu} & \text{if } w \geq w^{mu}, \\ u(z^{mc}; \phi) & \text{if } w \in [w^{mc}, w^{mu}), \\ w & \text{if } w \in [0, w^{mc}). \end{cases}$$

[16] The superscript mc stands for market constrained.

[17] Formal proofs can be found in the Appendix.

Then, we have the following result.

Proposition 4.

i. When $w \geq w^{mc}$, V^m increases with (w, ϕ) and falls with f.

ii. When $w \in [0, w^{mc})$, V^m rises with w and is independent of (ϕ, f).

An increase in w raises the equilibrium payoff because it allows a larger expenditure when constrained, a larger utility when unconstrained, and a larger autarky payoff when opting out of market exchange. The opposite happens with an increase in f.

An increase in ϕ raises the utility and the marginal utility of the expenditure and therefore, ceteris-paribus, increases the equilibrium payoff whenever participation in market exchange is optimal. When the individual is unconstrained, this results also in a larger consumption of the z good.

Hence, in a purely market-exchange economy, the equilibrium payoff is non-decreasing with the quality of any market-supporting institutions $(\phi, -f)$. The threshold below which individuals are resource-constrained and the one below which they opt out of the market exchange are both non-increasing with them.

5 A Market and Non-market Exchange Economy

5.1 The Equilibrium

In this section, we study the repeated game when both market and non-market exchanges are available.

The non-market exchange amount $x_i \in \Re_+$ is incentive-compatible in each period, provided that he chooses market expenditure z_i, the endowment is w, and the strategy profile of the other individuals is $(x_{-i}, z_{-i,-i})$ if and only if individual i prefers the expenditure x_i than any other expenditure. Because a deviating individual i is ostracized, no future partner will cooperate with him, and when ostracized, the individual can participate in market exchange if he chooses so at no extra cost, $x_i \in \Re_+$ is incentive-compatible in each period t if the following holds:

$$\begin{aligned}
&u(x_j) - x_i + \mathbb{1}_i(u(z_i;\phi) - z_i - f) + w \geq (1-\delta)\big(u(x_j) + \mathbb{1}_i(u(z_i;\phi) - z_i - f) + w\big) + \delta V^m \\
&\implies \\
&x_i \leq \delta\Big(u(x_j) + \mathbb{1}_i(u(z_i;\phi) - z_i - f) + w - V^m\Big),
\end{aligned} \tag{2}$$

where V^m is the equilibrium payoff of a market-exchange economy.

Because a deviating individual i is ostracized, a higher equilibrium payoff for the purely market-exchange economy (V^m), ceteris paribus, crowds out non-market expenditure since not reciprocating is less costly the larger is W^m.

Because payoffs and endowments are symmetric, we could define $x(\delta, z_i, w)$ as the largest non-negative solution to the incentive constraint in equation (2). When $x(\delta, z_i, w) > 0$, this increases with z_i for all $z_i \leq z^{mu}$ since the payoff from market consumption rises. It also increases, holding V^m constant, with (δ, w) and falls with f. An increase in δ implies that the future is more valuable and therefore the loss from begin ostracized is higher. An increase in w implies, ceteris paribus, a larger expenditure. In contrast, an increase in the fixed cost f results, ceteris paribus, in the opposite.

Because payoffs and endowment are symmetric, as in the pure non-market exchange economy, each pair solves the following problem problem

$$\max_{(x_i, z_i, \mathbb{1}_i) \in \Re^2_+ \times \{0,1\}} \big\{u(x_i) - x_i + \mathbb{1}_i(u(z_i;\phi) - z_i - f) + w\big\}$$

$$\text{subject to}$$

$$x_i \leq \delta\big(u(x_i) + \mathbb{1}_i(u(z_i;\phi) - z_i - f) + w - V^m\big), \qquad IC$$

$$x_i + z_i \leq w - f. \qquad RC$$

where λ be the Lagrange multiplier for the incentive constraint and μ is Lagrange multiplier for the resource constraint.

The following first-order conditions determine optimal expenditures

$$x_i : u_1(x_i) - 1 + \mu_i(\delta u_1(x_i) - 1) - \lambda_i = 0,$$
$$z_i : u_1(z_i;\phi) - 1 + \mu_i\delta(u_1(x_i;\phi) - 1) - \lambda_i = 0,$$
$$\lambda_i \geq 0\,, \mu_i \geq 0,\ \lambda_i IC = 0, \text{ and } \mu_i RC = 0.$$

where λ_i is the Lagrange multiplier for the resource constraint and $\mu_i \geq 0$ is the Lagrange multiplier for the incentive-compatibility constraint.

When resources are abundant and the discount factor is sufficiently large; i.e, $\delta \geq \delta^{fb}$, so that neither the resources nor the incentive constraint binds, the optimal expenditures are (z^{mu}, x^{fb}), and participating in market exchange is optimal ($\mathbb{1}_i = 1$). This happens because $u(z^{mu};\phi) + w - z^{mu} - f - V^m = 0$ and thereby the incentive constraint becomes $x_i \leq \delta u(x_i)$. The endowment threshold required for this to hold, denoted by w^{fb}, is given by $x^{fb} + w^{mu} - f$.

When the resource constraint does not bind, but the incentive constraint does. The optimal market exchange expenditure is z^{mu} and the optimal non-market exchange is equal to $x(\delta)$ since $u(z^{mu};\phi) + w -$

$z^{mu} - f - V^m = 0$ again. This happens when $w \geq w^{nmu}(\delta) \equiv x(\delta) + w^{mu} - f$.[18]

Where resources are moderate so that the resource constraint binds, the optimal strategy involves equalizing the marginal utility to market expenditure to the marginal utility to non-market expenditure, provided that non-market expenditure is incentive-compatible. Otherwise, it is optimal to opt for the largest incentive-compatible non-market expenditure and to allocate the unused endowment to the market expenditure.

Observe that $\lambda > 0$, whenever $z < z^{mu}$. Thus, whenever $w < w^{nmu}(\delta)$, the resource constraint binds. Let's denote the solution to the first-order conditions when the incentive constraint does not bind by $(x_i^c(w), z_i^c(w))$ where $x_i^c(w) = w - f - z_i^c(w)$, and that when both the resource and the incentive constraint bind by $(x_i(w,\delta), z_i(w,\delta))$ where $x_i^c(w,\delta) = w - f - z_i^c(w,\delta)$. In either case, it is no longer true that $u(z^{mu};\phi) + w - z^{mu} - f - V^m = 0$ and thereby the optimal non-market expenditure depends on the difference between market payoff when part of the resources are spent on non-market exchange and the market payoff when the non-market exchange is available; i.e., V^m. Let's denote the minimum endowment able to finance this solution by $w^{nmc}(\delta)$ and $\delta(w)$ as the lowest discount factor such that $x_i^c(w) = x(\delta, z_i^c(w), w)$; that is, the lowest δ such that the incentive-compatibility constraint holds when evaluated at $x = x_i^c(w)$ and $z = z_i^c(w)$.

Finally, when $w < w^{nmc}(\delta)$, it is optimal to opt-out from the market exchange because the crowding out of the non-market exchange is sufficiently severe that it does not pay off to pay the fixed cost for participating in market exchange.

From the discussion above, we deduce the following result.

Proposition 5. *The perfect public equilibrium when both market and non-market exchanges co-exists is given by:*

$$(x^{nm}, z^{nm}, \mathbb{1}^{nm}) = \begin{cases} (x^{fb}, u(z^{mu}, 1) & \text{if } w \in [w^{fb}, \infty) \text{ and } \delta \geq \delta^{fb}, \\ (x(\delta), z^{mu}, 1) & \text{if } w \in [w^{nmu}(\delta), w^{fb}) \text{ and } \delta < \delta^{fb}, \\ (x(w,\delta), w - f - x(w,\delta), 1) & \text{if } w \in [w^{nmc}(\delta), w^{mnu}(\delta)) \text{ and } \delta < \delta(w), \\ (x(w), w - f - x(w), 1) & \text{if } w \in [w^{nmc}(\delta), w^{mnu}(\delta)) \text{ and } \delta \geq \delta(w), \\ (x^n, 0, 0) & \text{if } w \in [0, w^{nmc}(\delta)). \end{cases}$$

When individuals are rich and patient, market and non-market exchange are independent of each other, and as such market-supporting institutions do not affect non-market exchange. In this case there is no crowding-out from market exchange to non-market exchange and vice-versa.

For individuals who are not rich, two scenarios emerge. In the first scenario, their discount factor is such that it allows them to simultaneously choose the market and non-market expenditures so that the marginal

[18] The superscript n in mnu stands for non-market, the m for market exchange, and the u for unconstrained.

utility of the last dollar spent on market expenditure delivers the same marginal utility of non-market expenditure. In the second scenario, the discount factor is low enough so the above solution violates the non-market expenditure's incentive-compatibility constraint, prompting individuals to choose the highest incentive-compatible non-market expenditure. Any endowment surplus is allocated to market expenditure. Thus, the marginal utility to market expenditure is lower than the marginal utility to non-market expenditure. In both cases, market exchange crowds out non-market exchange relative to the non-market exchange economy and vice-versa. Furthermore, in this case, non-market exchange depends on the quality of market-supporting institutions.

When individuals are poor, they opt out of the market exchange and therefore this is crowded out by non-market exchange when $w \in [w^{mc}, w^{nmc}(\delta))$. This happens because in an economy where both market and non-market exchanges are available, the payoff when opting out of the market exchange is higher than the autarky payoff, which is the one an individual receives when opting out in a purely market exchange economy.

5.2 Comparative Statics

Here, we study the comparative statics concerning the main parameters of interest (ϕ, δ, w, f).

Proposition 6. *Suppose that $w \geq w^{nmu}(\delta)$. Then,*

i. x^{nm} is independent of (ϕ, f, w) and if $\delta \geq \delta^{fb}$ is independent of δ, while if $\delta < \delta^{fb}$, raises with δ.

ii. z^{nm} is independent of (f, w, δ) and raises with ϕ.

When the initial endowment is large (i.e., $w \geq w^{nmu}$) and individuals place a high weight on the future; that is, $\delta \geq \delta^{u}$, the socially optimal market and non-market expenditure are chosen. Thus, non-market expenditure is independent of market expenditure and market-supporting institutions (ϕ, ψ, f).

When individuals are not as patient, the equilibrium non-market expenditure is the largest self-sustainable non-market expenditure. This could depend on the market expenditure and the market-supporting institutions through the incentive compatibility constraint. However, because $w^{nmu}(\delta) > w^{mu}$, the payoff from market expenditure in the equilibrium of the market and non-market exchange economy; i.e. $u(z^{mu}; \phi) + w - z^{mu} - f$, is identical to that in a purely market-exchange economy V^{m}. Hence, the non-market expenditure's incentive compatibility constraint is independent of (ϕ, w, f). Because the equilibrium is such that market expenditure maximizes the market payoff, market expenditure rises with ϕ since $u_1(z; \phi)$ increases with ϕ.

Proposition 7. *Suppose that $w \in [w^{nmc}(\delta), w^{nmu}(\delta))$. Then,* *i.* x^{nm} *raises with* w *and falls with* f *and if* $\delta \geq \delta(w)$*,* x^{nm} *falls with* ϕ *and is independent of* δ*, while if* $\delta < \delta(w)$*,* x^{nm} *rises with* (ϕ, δ)*.*

ii. z^{nm} *raises with* w *and falls with* f *and if* $\delta \geq \delta(w)$*,* x^{nm} *raises with* ϕ *and is independent of* δ*, while if* $\delta < \delta(w)$*,* x^{nm} *raises falls* (ϕ, δ)*.*

When the incentive constraint does not bind, marginal utilities are equalized across exchanges. Because better market-supporting institutions increase the marginal utility of the market expenditure and the resource constraint bids, non-market exchange falls with ψ. Any institutional change that lowers the fixed cost o raises w increases both market and non-market expenditure since it softens the resource constraint so long as the incentive constraint does become binding.

When the incentive-compatibility constraint binds, an improvement in the market-supporting institutions ϕ, holding expenditures constant, has three effects: an increase in the payoff during the punishment phase, V^m, which tightens non-market expenditure's incentive constraint; an increase in the marginal utility of market-exchange which makes it more attractive, and an increase in the payoff of market exchange when both exchanges are available which, ceteris paribus, softens the incentive constraint.

Because the increase in the market payoff when both exchanges are available raises more than V^m does with ϕ since $z^{nm} < z^m$, this softens the incentive constraint. This leads to an increase in non-market exchange. However, the marginal return to market exchange rises with ϕ, individuals wish to increase market expenditure. This, the fact u is strictly concave, and non-market exchange is constrained away from the equalization of marginal utilities, implies that the increase in non-market exchange due to the incentive constraint is softened dominates the incentive to increase market exchange due to its higher marginal utility.

An increase in $w - f$ raises both exchanges since individuals are constrained, and a higher $w - f$ softens the incentive constraint since market exchange when both exchanges are available is smaller than that when only the market exchange is available. An increase in δ softens the incentive constraint which induces a large non-market exchange and a smaller market exchange since the resource constraint binds.

Proposition 8. *Suppose that* $w < w^{nmc}(\delta)$*. Then,*

i. x_s^{nm} *is independent of* (ϕ, f) *and raises with* w*.*

ii. z^{nm} *is independent of* (w, f, ϕ)*.*

This is driven by the fact that individuals opt out of market exchange and thereby the perfect public equilibrium is the same as that in a purely non-market exchange economy,

5.3 Welfare

Because the equilibrium is symmetric, the individual equilibrium payoff, denoted by V^{nm}, is given by

$$V^{nm} = \begin{cases} u(x^{fb}) + u(z^{mu};\phi) + w - f - x^{fb} - z^{mu} & \text{if } w \in [w^{fb}, \infty) \text{ and } \delta \geq \delta^{fb}, \\ u(x(\delta)) + u(z^{mu};\phi) + w - f - x(\delta) - z^{mu} & \text{if } w \in [w^{nmu}(\delta), w^{fb}) \text{ and } \delta < \delta^{fb}, \\ u(x(w,\delta)) + u(w - f - x(w,\delta);\phi) & \text{if } w \in [w^{nmc}(\delta), w^{mnu}(\delta)) \text{ and } \delta < \delta(w), \\ u(x(w)) + u(w - f - x(w);\phi) & \text{if } w \in [w^{nmc}(\delta), w^{mnu}(\delta)) \text{ and } \delta \geq \delta(w), \\ u(w) & \text{if } w \in [0, w^{nmc}(\delta)). \end{cases}$$

The next result deals with the comparative statics regarding welfare.

Proposition 9. *If $w \geq w^{nmc}(\delta)$, V^{nm} increases with (w, δ, ϕ) and falls with f, while if $w < w^{nmc}(\delta)$, V^{nm} rises with w and is independent of (f, δ, ϕ)*

As expected, welfare is always increasing in the endowment and non-increasing in the fixed cost of using the market. For the market-supporting institution ϕ, welfare is non-decreasing with it since the marginal utility of market expenditure is larger. Thus, for any endowment $w \geq w^{nmc}(\delta)$, improvements in the market-supporting institutions result in larger welfare and lower $w^{nmc}(\delta)$ and $w^{nmu}(\delta)$.

6 The Relevance of Market-Supporting Institutions

6.1 Welfare Comparisons

The next proposition readily follows from comparing the payoffs of a purely non-market exchange and that of a purely market exchange economy with that where both types of exchanges co-exist.

Proposition 10. *$V^{nm} \geq V^m$ and $V^{nm} \geq V^n$ for all w.*

The equilibrium payoff when both types of exchange co-exist is larger than or equal to that when only on type of exchange is available since the equilibrium in the latter economies is always possible when both exchanges are feasible and they are never played when $w \geq w^{nmc}(\delta)$. In contrast, when $w < w^{nmc}(\delta)$, it is optimal to opt out of the market exchange and thereby the perfect public equilibrium is identical to the one in a purely non-market exchange economy.

Hence, market exchange introduction in a non-market exchange economy results in partial crowding out of non-market exchange whenever $w \geq w^{nmc}(\delta)$ but this is welfare-enhancing. Similarly, the possibility of a non-market exchange economy where ostracism is possible in a market exchange economy results in market exchange being crowded out but again this is welfare-enhancing.

6.2 The Development Process

This sub-section delves into the implications of investing in market-supporting institutions (ϕ, f) on the development process.

Let's assume that the cost of setting up market-supporting institutions is $c(\phi, f)$ with c strictly convex, $c_\phi > 0$, $c_f < 0$, and $c(\phi, -f) > 0$ for all $(\phi, -f) \in \Re^2_+$. Thus, the society's problem consists of

$$\max_{(\phi,f)\in\Re^2_+} \left\{ \sum_l V^{nm}(\phi, f, \delta_l, w_l) - c(\phi, f) \right\}.$$

The marginal return for all communities with $w_l \geq w_l^{nmc}(\delta_l)$ is $u_\phi(z_l^{nm}; \phi)$ except for the ones in which $w_l \in [w_l^{nmc}(\delta_l), w_l^{mnu}(\delta_l))$ and $\delta_l < \delta_l(w_l)$ since their marginal return is $(u_1(x_l^{nm}) - u_1(z_l^{nm}; \phi))\frac{\partial x^{nm}}{\partial \phi} + u_\phi(z_l^{nm}; \phi)$, where the first term is positive since $u_1(x_l^{nm}) > u_1(z_l^{nm}; \phi)$ and z_l^{nm} raises with ϕ. For $w_l < w_l^{nmc}(\delta_l)$, the marginal return to is ϕ zero since individuals in community l opt out of market exchange. Similarly, for $-f$.

Rich and middle-income communities within a society benefit from an increase in ϕ and a decrease in f, whereas poor communities (i.e., those with $w_l \in [0, w_l^{nmc}(\delta_l))$ do not benefit from improved market-supporting institutions since they do not participate in market exchange.

Because establishing robust market-supporting institutions typically necessitates substantial initial investments (fixed costs), transitioning to a modern economy where both exchanges co-exist in most communities and formal market functioning well is difficult when endowments are low because there are no incentives to make marginal institutional improvements.

Escaping this poverty trap requires, first, positive income shocks and a large scale so that the economy is rich enough to cover the fixed costs of creating and running high-quality market-supporting institutions (Demsetz (1967)); and second, significant institutional investments that put the economy on the track towards a modern and efficient economy (i.e., $w \geq w^{nmc}(\delta)$). This not only allows for modernization and unconstrained expenditure, but also enhances the economy's resilience to negative shocks to the endowments since the endowment thresholds $(w^{nmc}(\delta), w^{nmu}(\delta))$ fall with the quality of market-supporting institutions.

Because the evidence points to a positive relationship between long-term goals (high δ) and mathematical skills and reciprocity and mathematical skills (Falk, Becke, Dohmen, Enke, Huffman, and Sunde (2018)), this process could be facilitated by education investments so that communities can sustain larger volumes of non-market exchange. In fact, Falk et al. (2018) find that patience positively and significantly affect GDP per-capita.

The empirical literature regarding the relationship between institutions, cultural traits, and economic variables is large. The evidence that cultural norms and beliefs affect economic behavior together with the evidence documenting the long-lasting effect of formal and informal institutions on different cultural traits, suggests that culture plays a role in explaining persistent differences in countries' economic performance. Choi and Storr (2020) design an experiment with personal exchange and anonymous exchange. They find that in the market where exchanges are more personal, previous experiences are important as determinants of future trust and reciprocity, meanwhile, in the case where interactions are more impersonal, they are not affected by the nature of previous market interactions.

Carlin, Dorobantu, and Viswanathan (2009) show that when the value of social capital is high, government regulation and trustfulness are substitutes. On the other hand, when the value of social capital is low, regulation and trust may be complements. Aghion et al. (2010) find that distrust and institutions co-evolve and distrust has an impact not only on regulation but also on the demand for regulation. Pinotti (2012) documents, holding constant the component of demand for government intervention due to trust across countries, that regulation is no longer associated with worse economic outcomes. The same result is confirmed when he uses population size as an alternative source of variation in regulation. Bidner and Francois (2011) find that trust strongly depends on the country's population size.

7 Discussion

Firstly, we could have allowed for some misbehavior in market exchange. For instance, if we focus on the labor market interpretation, individuals cannot put in the work effort they should do in exchange for the wage $u(z_i;\phi)$, where z_i is the worked hours. Firms find out if the individual shirked with probability p and the individual pays a fine s such as legal costs, damages, etc... when shirking occurs. An individual caught shirking is ostracized by firms with probability q, in which case no firm hires him.[19] Not reciprocating in the community does not result in market ostracism and shirking in the markets does not result in non-market ostracism.

In a purely market-exchange economy, individual i faces the following incentive constraint

$$u(z_i;\phi)+w-f-z_i \geq (1-\delta)(u(z_i;\phi)+w-f-ps)+\delta((1-p)(u(z_i;\phi)+w-f-z_i)+pw)$$

$$\Longrightarrow$$

$$z_i \leq \frac{p}{1-\delta(1-p)}\big(\delta(u(z_i;\phi)-f)+(1-\delta)s\big) \qquad IC^m$$

Let's define $V^m(\delta) \equiv \max_{z_i\in\Re_+}\{u(z_i;\phi)+w-f-z_i \text{ subject to } (IC^m) \text{ and } z_i \leq w-f\}$.

[19] We assume implicitly that there is a public repository that keeps workers' behavior history and that firms can freely access.

When market and non-market exchange co-exist, each individual solves the following problem

$$\max_{(x_i,z_i,\mathbb{1}_i)\in\Re_+^2\times\{0,1\}} \big\{u(x_i) - x_i + \mathbb{1}_i(u(z_i;\phi) - z_i - f) + w\big\}$$

subject to

$$(IC),\ (RC),\ (IC^m), \text{ and}$$

$$x_i + (1-\delta(1-p))\mathbb{1}_i z_i \le \delta\big(u(x_i) + p\mathbb{1}_i(u(z_i;\phi) - f) + \mathbb{1}_i(1-\delta)ps\big), \qquad IC^{nm}$$

where IC^{nm} is the incentive-compatibility constraint regarding joint deviations. We deduce from this that non-market exchange is favored by the existence of moral hazard in market exchange since the payoff after not reciprocating is lower and the individual constraints are sufficient for the joint constraint since $\mathbb{1}_i(u(z_i;\phi) - z_i - f) + w - V^m(\delta) \ge 0$. Thus, our results hold and improvements in market enforcement, measured by (s, p), favor market exchange and are welfare-enhancing.

Secondly, we assume mechanical communication within each community. We can assume imperfect mechanical communication; that is, individuals who do not reciprocate are revealed with a probability lower than 1 or consider players' incentives to reveal the history of their matches as in Ali and Miller (2016). Introducing imperfect information flows would reduce the expected loss from reneging but wouldn't fundamentally alter our conclusions. However, adding incomplete information could significantly complicate the analysis with a great deal of additional notation, and introducing other equilibria where, for instance, coordination problems could emerge, and non-permanent ostracism could sustain a larger non-market exchange than permanent ostracism. This depends on the assumptions about how information flows within the community. However, as these new equilibria do not enlarge the set of equilibrium payoffs, we decided not to deal with these difficulties, but these issues are of importance (Ali and Miller (2016) and Ali and Miller (2022)). Without information flows and when players can keep records of all past encounters, communities can implement any non-market exchange for a sufficiently large discount factor (see Deb, Sugaya, and Wolitzky (2020)). However, our question is not a folk theorem kind of question, is one about what can be self-sustained given the discount factor.

Thirdly, we have assumed that the market-exchange payoff does not entail strategic interactions among individuals. The model can easily accommodate them, without changing the main results, by assuming that $u(z;\phi)$, where $z \equiv (z_1, \ldots, z_n)$.[20] In this case, there would be inefficient market exchange even when the resource constraint does not bind since individuals will not internalize the impact on other individuals' payoff when choosing expenditures.

Fourthly, we have assumed identical individuals. This simplification was made to streamline the analysis. Introducing heterogeneity in various dimensions, such as initial endowments and different payoffs,

[20] An earlier version of this paper dealt with this case.

could add realism. However, this would complicate the algebra without necessarily enhancing economic intuition and some of the heterogeneity is captured by having different communities. However, considering individuals with other-regarding preferences is a fruitful avenue to deepening our understanding of the development process. For instance, considering that some individuals could be unconditional reciprocators, others unconditional non-reciprocators, and others homoeconomicus responding to incentives would lead to similar results under mechanical communication and permanent ostracism. However, by relaxing this new interesting equilibrium will emerge but our hunch is that the economic forces uncovered here would remain true when positive non-market exchange can be self-sustaining.

8 Conclusions

This paper argues communities with highly inpatient individuals and low incomes are better off in a purely non-market exchange economy since the marginal benefit of market exchange is outweighed by the fixed costs of using markets and market exchange provides a better fall-back position upon reneging, which reduces self-sustainable non-market exchange expenditure relative to that in non-market exchange economy. When endowments are large, the benefit from market exchange compensates for the lower non-market exchange expenditure and the fixed cost of using the market since with higher endowments, communities can take advantage of both types of exchange.

Partial crowding out of non-market exchange, relative to a non-market exchange economy, and crowding out of market exchange, relative to a market-exchange economy, occurs whenever individuals are income-constrained. However, crowding out does not decrease welfare, and more efficient market exchange raises nob-market exchange when the incentive and resource constraint bind.

These results provide insights into the ongoing debate on whether market expansion crowds out non-market exchange or enhances its benefits and suggest a reassessment of the debate in terms of which institutional settings improve welfare and for which communities

The results also offer insights into a nation's development process. Improving market-supporting institutions requires significant investments, complicated further by the need for a minimum endowment level for both market and non-market exchange to be welfare-enhancing. Poor societies may become trapped in low welfare non-market exchange equilibrium. Market-supporting institutions can facilitate escaping this by increasing the efficiency of market exchange and lowering market exchange fixed costs, which makes participating in market exchange more attractive for all communities within a country. This is more likely to happen in large societies since the fixed costs of setting up well-functioning markets since each individual's cost burden is small.

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A Appendix

Proof of Proposition 4.

$$V^m = \begin{cases} u(z^{mu};\phi) + w - f - z^{mu} & \text{if } w \geq w^{mu}, \\ u(w-f;\psi);\phi) & \text{if } w \in [w^{mc}, w^{mu}), \\ u(w;\phi) & \text{if } w \in [0, w^{mc}). \end{cases}$$

If $w \geq w^{mu}$, $V_w^m = 1$, $V_f^m = -1$, $V_\psi^m = g_\psi(y^{mu};\psi) > 0$, $V_\phi^m = u_1(z^{mu};\phi) > 0$, and $V_p^m = z^{mu} > 0$

If $w \in [w^{mc}, w^{mu})$,

$$V_w^m = u_1(z;\phi)\frac{\partial z^m}{\partial w}|_{z=z^m} > 0.$$

where $\frac{\partial z^m}{\partial w} = 1$.

$$V_f^m = u_1(z;\phi)\frac{\partial z^m}{\partial w}|_{z=z^m} > 0.$$

where $\frac{\partial z^m}{\partial f} = -1$.

$$V_\phi^m = u_\phi(z;\phi)|_{z=z^m} > 0.$$

□

Proof of Proposition 5.

Lemma 1. *There exists threshold $\delta(w)$ such that $(x_i(w), z_i(w)) = (x_i^c(w), z_i^c(w))$ for all $\delta > \delta(w)$ and $(x_i(w), z_i(w)) = (x_i(w,\delta), z_i(w,\delta)$ for all $\delta \leq \delta(w)$. $\delta(w)$ rises with w.*

Proof of Lemma 1. Recall the first-order conditions

$$x_i : u_1(x_i) - 1 + \mu_i(\delta u_1(x_i) - 1) - \lambda_i = 0,$$
$$z_i : u_1(z_i;\phi) - 1 + \mu_i\delta(u_1(z_i;\phi) - 1) - \lambda_i = 0$$

where λ_i is the Langrange multiplier for the resource constraint and $\mu_i \geq 0$ is the Lagrange multiplier for individual i's incentive compatibility constraint.

Case 1: $\lambda = \mu = 0$.

In this case neither the incentive constraint nor the resource constraint binds. Thus, the optimal expenditures are determined by

$$x_i : u_1(x_i) - 1 = 0,$$
$$z_i : u_1(z_i;\phi) - 1 = 0.$$

Thus, $(x,z) = (x^{fb}, z^{fb})$. This case takes place whenever $w \geq w^{fb} \equiv x^{fb} + z^{fb} + f$ and

$$x^{fb} \leq \delta\Big(u(x^{fb}) + u(z^{fb};\phi) + w - f - z^{fb} - V^m\Big).$$

Because in this case $V^m = u(z^{fb};\phi) + w - f - z^{fb}$ since $w >\geq w^{mu}$. This holds whenever

$$x^{fb} \leq \delta u(x^{fb}).$$

That is, $\delta \geq \delta^{fb}$.

Observe that $\lambda_i = (1+\mu_i\delta)(u_1(z_i;\phi) - 1) > 0$, whenever $z < z^{mu}$.

Case 2: $\lambda = 0$ and $\mu > 0$.

In this case the resource constraint does not bind but the incentive constraint does. The optimal expenditures are then determined by

$$x_i : u_1(x_i) - 1 + \mu_i(\delta u_1(x_i) - 1) = 0,$$
$$z_i : u_1(z_i;\phi) - 1 + \mu_i\delta(u_1(z_i;\phi) - 1) = 0.$$

Thus,

$$x_i :\ \mu_i = \frac{1 - u_1(x_i)}{\delta u_1(x_i) - 1} > 0,$$
$$z_i :\ -\big(u_1(z_i;\phi) - 1\big)\frac{1-\delta}{\delta u_1(x_i) - 1} = 0.$$

The optimal non-market exchange satisfies

$$x = \delta\Big(u(x) + u(z^{mu};\phi) + w - f - z^{mu} - V^m\Big).$$

Because $V^m = u(z^{mu};\phi) + w - f - z^{mu}$ since $w > w^{mu}$. This implies that $(x,z) = (x(\delta), z^{mu})$, with $x(\delta) < x^{mu}$. This happens when $w \geq w^{nmu}(\delta) \equiv x(\delta) + z^{mu} + f$, with $w^{nmu}(\delta) < w^{fb}$.

Case 3: $\lambda > 0$ and $\mu = 0$.

In this case the resource constraint binds but not the incentive constraint. The optimality conditions are then given by

$$x_i : u_1(x_i) - 1 - \lambda_i = 0,$$
$$z_i : u_1(z_i;\phi) - 1 - \lambda_i = 0.$$

The unique solution satisfies: $u_1(x) = u_1(w - f - x;\phi)$, and is denoted by $x^{nm}(w)$ and $z^{nm}(w) =$

$w - f - x^{nm}(w)$. This is optimal if and only if the incentive-compatibility constraint is satisfied. This requires the following

$$x^{nm}(w) \le \delta\Big(u(x^{nm}(w)) + u(w - f - x^{nm}(w); \phi) + x^{nm}(w) - V^m\Big).$$

At $\delta = 0$, this never holds, while at $\delta = 1$, always holds; otherwise, the optimal expenditure will be to spend all the resources in market consumption, in which case the LHS and RHS will be zero since $u(w - f; \phi) - V^m = 0$. Because the LHS is independent of δ and the RHS is positive and rises with it, there is a threshold $\delta(w)$ such that this solution is optimal whenever

$$\delta \ge \delta(w) \equiv \frac{x^{nm}(w)}{u(x^{nm}(w)) + u(w - f - x^{nm}(w); \phi) + x^{nm}(w) - V^m}. \tag{A1}$$

An increase in w results in that

$$\frac{\partial x(w)}{\partial w} = \frac{u_{ii}(z; \phi)}{u_{ii}(x) + u_{ii}(z; \phi)} \in (0, 1)$$

and

$$\frac{\partial z_i(w)}{\partial w} = \frac{u_{ii}(z)}{u_{ii}(x) + u_{ii}(z; \phi)} \in (0, 1)$$

Thus, $(x_i(w), z_i(w))$ raises with w.

We deduce from this and the definition of $\delta(w)$ in equation (A1) that this rises with w.

This case occurs when $\delta \ge \delta(w)$ and $w < w^{nmu}(\delta))$.

Because $u(w - f - x^{nm}(w); \phi) - V^m < 0$ since individuals are investing some share of the resources on non-market exchange and they are not investing the first-best in market exchange. This implies that $x_i(w) < x(\delta)$. If $w^{nmc} \ge w^{nmu}(\delta)$, then $z = z^{fb}$ and therefore $x_i(w)$ will be feasible if and only if is lower than or equal to $x(\delta)$. This will takes us to case 2. Thus, $w^{nmc} < w^{nmu}(\delta)$, $x_i(w) < x(\delta)$ and $x_i(w) < x^{fb}$.

Case 4: $\lambda > 0$ and $\mu > 0$. In this case, both the incentive and the resource constraint bind and, therefore, the optimality conditions are given by

$$x_i : u_1(x_i) - 1 + \mu_i(\delta u_1(x_i) - 1) - \lambda_i = 0,$$
$$z_i : u_1(z_i; \phi) - 1 + \mu_i \delta(u_1(z_i; \phi) - 1) - \lambda_i = 0$$

It follows from this that $u_1(z_i; \phi) < u_1(x_i)$ and the Lagrange's multipliers are

$$\mu_i = \frac{u_1(x) - u_1(z; \phi)}{\delta(u_1(z; \phi) - u_1(x)) + 1 - \delta} > 0.$$

and

$$\lambda_i = \frac{(1-\delta)(u_1(z;\phi)-1)}{\delta(u_1(z;\phi)-u_1(x))+1-\delta} > 0,$$

where $u_1(z;\phi)-1>0$ since $z<x^{fb}$.

The optimal expenditure, denoted by $(x(w,\delta),z(w,\delta))$, is given by the unique solution to the equations $z=w-f-x$ and

$$x = \delta\Big(u(x)+u(z;\phi)+x-V^m\Big).$$

In this case $u(z;\phi)-V^m<0$ since the firm spends the whole endowment and $z(w,\delta)<z^m(w)$. Thus, $x(w,\delta)<x(\delta)$.

Observe that

$$\frac{\partial x_i(w,\delta)}{\partial\delta} = \frac{u(x(w,\delta))+u(w-f-x(w,\delta);\phi)-V^m}{\delta(u_1(w-f-x(w,\delta);\phi)-u_1(x(w,\delta)))+1-\delta} > 0.$$

and $z_i(w,\delta)$ falls with δ since $z=w-f-x$.

In addition, an increase in w results in that

$$\frac{\partial x_i(w,\delta)}{\partial w} = \frac{\delta(u_1(z_i(w,\delta);\phi)-V_w^m)}{\delta(u_1(z_i(w,\delta);\phi)-u_1(x_i(w,\delta)))+1-\delta},$$

and

$$\frac{\partial z_i(w,\delta)}{\partial w} = \frac{\delta(V_w^m-u_1(x_i(w,\delta)))+1-\delta}{\delta(u_1(z_i(w,\delta);\phi)-u_1(x_i(w,\delta)))+1-\delta},$$

where

$$V_w^m = u_1(z^m;\phi)\frac{\partial z^m}{\partial w}+\frac{\partial(w-f-z^m)}{\partial w} > 0.$$

and $\frac{\partial z^m}{\partial w}=1$ if $w\in[w^{mc},w^{mu})$ and $\frac{\partial z^m}{\partial w}=0$ if $w\geq w^{mu}$.

Thus, $x_i(w,\delta)$ and $z_i(w,\delta)$ raise with w.

This case occurs when $\delta<\delta(w)$ and $w<w^{nmu}(\delta))$.

Last but not least, we have to find conditions under which it is optimal not to opt out of market exchange. This is never the case when $w\geq w^{nmu}(\delta)$.

When he opts out of market exchange, total welfare is

$$V^n = \begin{cases} u(\min\{x^{fb},x(\delta)\})+w-\min\{x^{fb},x(\delta)\} & \text{if } w>w^n, \\ u(w) & \text{if } w\leq w^n. \end{cases} \tag{A2}$$

where $w^n=x^{fb}$ if $\delta\geq\delta^{fn}$ and $w^n=x(\delta)$ if $\delta<\delta^{fb}$. In contrast, when participation in market exchange occurs, the payoff is

$$\tilde{V}^{nm} = \begin{cases} u(x^{fb}) + u(z^{mu};\phi) + w - f - x^{fb} - z^{mu} & \text{if } w \geq w^{fb} \text{ and } \delta \geq \delta^{fb}, \\ u(x(\delta)) + u(z^{mu};\phi) + w - f - x(\delta) - z^{mu} & \text{if } w \in [w^{nmu}(\delta), w^{fb}) \text{ and } \delta < \delta^{fb}, \\ u(x(w,\delta)) + u(w - f - x(w,\delta);\phi) & \text{if } w < w^{mnu}(\delta) \text{ and } \delta < \delta(w), \\ u(x(w)) + u(w - f - x(w);\phi) & \text{if } w < w^{mnu}(\delta) \text{ and } \delta \geq \delta(w). \end{cases} \tag{A3}$$

Observe that $\delta(w) < \delta^{fb}$ and that $V^{nm} > V^n$ whenever $w \geq w^{nmu}(\delta)$. Also, $w^{nmu})(\delta) \geq w^n$ So, let's focus on the case where $w < w^{nmu}(\delta)$. Observe that $V_w^{nm} \geq 1$ whereas $V_w^n \leq 1$. This follows from

$$\tilde{V}_w^{nm} = \begin{cases} \frac{(1-\delta)u_1(z_i(w,\delta);\phi) - \delta V_w^m)(u_1(x_i(w,\delta)) - u_1(z_i(w,\delta);\phi)}{\delta(u_1(z_i(w,\delta);\phi) - u_1(x_i(w,\delta))) + 1 - \delta} & \text{if } w < w^{mnu}(\delta) \text{ and } \delta < \delta(w), \\ u_1(w - f - x(w);\phi) & \text{if } w < w^{mnu}(\delta) \text{ and } \delta \geq \delta(w). \end{cases} \tag{A4}$$

Because $V^{nm} > V^n$ for all $w \geq w^{nmu}(\delta)$ and at $w - f = 0$, $V^{nm} < V^n$ and $V_w^{nm} - V_w^n > 0$ for all $w \leq w^{nmu}(\delta)$. Thus, by the Intermediate-value theorem, there is an endowment threshold, denoted by $w^{nmc}(\delta)$, such that opting out of the market is optimal for all $w < w^{nmc}(\delta)$.

□

Proof of Proposition 6. First, $w \geq w^{nmu}$ and $\delta \geq \delta^u$. Then, $x^{nm} = x^{fb}$ and $y^{nm} = y^{mu}$. Hence, $x_s^{nm} = 0$ for $s \in \{\phi, w, f, psi\}$ and $z_\phi^{nm} = 0$, $z_w^{nm} = z_f^{nm} = 0$, and $z_\phi^{nm} > 0$ since $u_{1\phi}(z;\phi) > 0$.

Next, let's assume that $w \geq w^{nmu}$ and $\delta < \delta^{nmu}$. Hence, $x^{nm} = x(\delta, z^{mu}, y^{mu})$ and $y^{nm} = y^{mu}$. Thus, for any $s \in \{\phi, \psi, f, w, \delta\}$,

$$\frac{\partial x^{nmu}}{\partial s} = \frac{1}{1 - \delta u_1(x)} \frac{\partial \delta\big(u(x^{nm}) + u(z^{mu};\phi) - z^{mu} + g(y^{mu};\psi) - y^{mu} - f - V^m\big)}{\partial s}$$

Because $V^m = u(z^{mu};\phi) - z^{mu} + g(y^{mu};\psi) - y^{mu} - f$, x^{nmu} is independent of (ϕ, ψ, f) and rises with δ. □

Proof of Proposition 7. First, consider the case $w \in [w^{nmb}, w^{nmu})$, In this case $(x^{nmc}, (w + g(y^{mu};\psi) - y^{mu} - f - x^{nmc}), y^{mu})$.

If $\delta \geq \delta(w + g(y^{mu};\psi) - y^{mu} - f)$, x^{nmc} satisfies the following

$$u_1(x) - 1 - u_1((w + g(y^{mu};\psi) - y^{mu} - f - x^{nm});\phi) + p = 0.$$

Thus, $z_s^{nm} > 0$ for all $s \in \{\phi, \psi, w\}$ and falls with f and $x_s^{nm} > 0$ for all $s \in \{\psi, w\}$ and falls with (f, ϕ) due the concavity of f and u.

If $\delta > \delta(w + g(y^{mu}; \psi) - y^{mu} - f)$, then x^{nmc} satisfies the following

$$x = \delta\big(u(x) + u((w + g(y^{mu}; \psi) - y^{mu} - f - x); \phi) - V^m\big)$$

Thus, for any $s \in \{\phi, \psi, f, w, \delta\}$,

$$\frac{\partial x^{nmc}}{\partial s} = \frac{1}{1 - \delta(u_1(x) - u_1(z; \phi))} \frac{\partial \delta\big(u(x) + u((w + g(y^{mu}; \psi) - y^{mu} - f - x); \phi) - V^m\big)}{\partial s}.$$

Thus, x^{nmc} rises with δ and y^{nmc} falls with it. Because $w \geq w^{nmb} \equiv y^{mu} + f$ and $w^{nmb} = w^{mb}$, $V^m = u((g(y^{mu}; \psi) + w - y^{mu} - f); \phi)$, $z^{nmc} < z^m$. This together with the concavity of u plus the complementarity between z and ϕ implies that x^{nmc} rises $\{\phi, w\}$ and falls with (f, ϕ) and z^{nmc} rises with $\{\phi, \psi, w\}$ and falls with f.

Second, consider the case $w \in [w^{nmc} w^{nmb})$. In this case $(x^{nmc}, (g(w - f; \psi) - x^{nmc}), w - f, 1)$.

If $\delta \geq \delta(g(w - f; \psi))$, x^{nmc} satisfies the following

$$u_1(x) - 1 - u_1((g(w - f; \phi) - x^{nm}); \phi) + p = 0.$$

Thus, $z_s^{nmc} > 0$ for all $s \in \{\phi, \psi, w\}$ and falls with f and $x_s^{nmc} > 0$ for all $s \in \{\psi, w\}$ and falls with (f, ϕ) due the concavity of f and u.

If $\delta < \delta(g(w - f; \psi))$, then x^{nmc} satisfies the following

$$x = \delta\big(u(x) + u((g(w - f; \psi) - x); \phi) - V^m\big)$$

Thus, for any $s \in \{\phi, \psi, f, w, \delta\}$,

$$\frac{\partial x^{nmc}}{\partial s} = \frac{1}{1 - \delta(u_1(x) - u_1(z; \phi))} \frac{\partial \delta\big(u(x^{nm}) + u((g(w - f; \psi) - x^{nmc}); \phi) - V^m\big)}{\partial s}$$

Thus, x^{nmc} rises with δ and y^{nmc} falls with it. Because $w \in [w^{nmc}, w^{nmb})$ and $w^{nmb} = w^{mb}$, $V^m = u(g(w - f; \psi); \phi)$, x^{nmc} is independent of (ϕ, ψ, f, w) and z^{nmc} rises with (ϕ, ψ, w) and falls with f.

Thus, $z_s^{nmc} > 0$ for all $s \in \{\phi, \psi, w\}$ and falls with f and $x_s^{nm} > 0$ for all $s \in \{\psi, w\}$ and falls with (f, ϕ) due the concavity of f and u. x^{nmc} is independent of (ϕ, ψ, f, w) and z^{nmc} rises with (ϕ, ψ, w) and falls with f.

$\square$

Proof of Proposition 8. In this case $(x^{nmc}, (w - x^{nmc}), y^{mu})$.

If $\delta \geq \delta(w)$, x^{nmc} satisfies the following

$$u_1(x) - 1 - u_1((w - x^{nm}); \phi) + p = 0.$$

Thus, $z_s^{nmc} > 0$ for all $s \in \{\phi, w\}$, falls with f, and is independent of ψ and x_s^{nm} rises with (w, ϕ), falls with f and is independent of ψ due the concavity of f and u.

If $\delta > \delta(w)$, then x^{nmc} satisfies the following

$$x = \delta\big(u(x) + u(w - x; \phi) - V^m\big)$$

Thus, for any $s \in \{\phi, \psi, f, w, \delta\}$,

$$\frac{\partial x^{nmc}}{\partial s} = \frac{1}{1 - \delta(u_1(x) - u_1(z; \phi))} \frac{\partial \delta\big(u(x) + u(w - x; \phi) - V^m\big)}{\partial s}.$$

Thus, x^{nmc} rises with δ and y^{nmc} falls with it. Because $w < w^{nmc}$ and $w^{nmc} = w^{mc}$, $V^m = u(w; \phi)$, $z^{nmc} < z^m$. This together with the concavity of u plus the complementarity between z and ϕ implies that x^{nmc} rises $\{\phi, w\}$ and falls with (f, ϕ) and z^{nmc} rises with $\{\phi, \psi, w\}$ and falls with f.

□

Proof of Proposition 9. Recall that

$$V^{nm} = \begin{cases} u(x^{nmu}) + u(z^{mu}; \phi) - z^{mu} + g(y^{mu}; \psi) + w - y^{mu} - f & \text{if } w \geq w^{nmu}, \\ u(x^{nmc}) + u((w + g(y^{mu}; \psi) - y^{mu} - f - x^{nmc}); \phi) & \text{if } w \in [w^{nmb}, w^{nmu}), \\ u(x^{nmc}) + u((g(w - f; \psi) - x^{nmc}); \phi) & \text{if } w \in [w^{nmc}, w^{nmb}), \\ u(x^{nmc}) + u((w - x^{nmc}); \phi) & \text{if } w \in [0, w^{nmc}). \end{cases}$$

When $w \geq w^{nmu}$ and $\delta \geq \delta^{mnu}$, the result follows from the envelope theorem and the fact that $u_\phi(z^{mu}; \phi) > 0$, $g_\psi(y^{mu}; \psi) > 0$ and welfare, ceteris-paribus, rises with $w - f$. In contrast when $\delta < \delta^{mnu}$

When $w < w^{nmu}$ and $\delta \geq \delta^{mnc}$, the result follows again from the envelope theorem and the fact that $u_\phi(z^{mu}; \phi) > 0$, $g_\psi(y^{mu}; \psi) > 0$ and welfare, ceteris-paribus, rises with $w - f$.

Observe that for all $w < w^{nmu}$, $V^{nm} - V^n$ rises with w if and only if

$$u_1(x^{nmc})\frac{\partial x^{nmc}}{\partial w} + u((w + m(g(y^{nmc}; \psi) - y^{nmc} - f) - x^{nmc}); \phi) \times \\ \Big(1 + \frac{\partial m(g(y^{nmc}; \psi) - y^{nmc})}{\partial w} - \frac{\partial x^{nmc}}{\partial w}\Big) u_1(x^n)\frac{\partial x^n}{\partial w}.$$

In Propositions 7 and 8, we show that $\frac{\partial x^{nmc}}{\partial w} \in (0, 1)$, $1 + \frac{\partial m(g(y^{nmc}; \psi) - y^{nmc})}{\partial w} = 1$ if $w < w^{nmc}$, and

$1 + \frac{\partial m(g(y^{nmc};\psi)-y^{nmc})}{\partial w} = g_1(w-f;\psi) > 1$ if $w \in [w^{nmc}, w^{nmb})$, and $1 + \frac{\partial m(g(y^{nmc};\psi)-y^{nmc})}{\partial w} = 1$ if $w \in [w^{nmb}, w^{nmu})$.

Taking the limit as w goes to zero to both sides of the equation, noticing that $\lim_{w \to 0} \frac{\partial x^{nmc}}{\partial w} \to 0$ and $u((0;\phi) < u_1(0)$.

Observe also that $\lim_{w \to 0}(V^{nm} - V^n) \to 0$ and $\lim_{w \to w^{nmu}}(V^{nm} - V^n) > 0$. By the Intermediate-value theorem, this, together with the result above and the fact that $V^{nm} - V^n$ is continuous in w, implies there exists a threshold $w^* \in (0, w^{nmu})$, such that $V^{nm} > V^n$ for all $w > w^*$,

Lastly, let's consider the case in which $w < w^{nmc}$. In this case, $x(\delta, 0, 0)$ is non-increasing with (w, ψ) and non-decreasing with (f, ϕ) since the payoff from the one static game V rises with (ψ, w) and falls with (ϕ, f). Hence whenever $w^{nmc} > w \geq w^{mc}$, the payoff during the punishment phase is V^m. When $w < w^{mc}$, the equilibrium in the static game entails autarky and thereby the payoff during the punishment phase is w. $\square$