

Cryptosecession and the limits of taxation: Towards a theory of non-territorial internal exit

Trent J. MacDonald & Jason Potts[†]

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Abstract

This paper presents a model of partial internal exit that captures the competitive dynamic between incumbent and potential governments in a non-territorial political system. This model particularly applies to the case of ‘cryptosecession’ that appears the most likely avenue for non-territorial decentralisation to ever eventuate. It demonstrates how fiscal exploitation is reduced and eventually eliminated as the capability of citizens to move to non-territorial jurisdictions increases. When interpreted as a model of cryptosecession, it shows how the balance of citizen opacity and government legibility determines the balance of fiscal exploitation versus equivalence.

Keywords: Non-territorial, jurisdiction, secession, internal exit, cryptoanarchy.

A spectre is haunting the modern world, the spectre of crypto anarchy. Computer technology is on the verge of providing the ability for individuals and groups to communicate and interact with each other in a totally anonymous manner. The State will of course try to slow or halt the spread of this technology, citing national security concerns, use of the technology by drug dealers and tax evaders, and fears of societal disintegration. Many of these concerns will be valid.

Timothy C. May, *The Crypto Anarchist Manifesto*

[†] School of Economics, Finance and Marketing, RMIT University, 445 Swanston St, Melbourne VIC 3000, Australia: trent.macdonald@rmit.edu.au.

1. Introduction: Efficiency and exploitation

It is no overstatement that James M. Buchanan was one of the most influential economists of the twentieth century. He is also, somewhat curiously, one of the most subversive—laying the theoretical foundations that explain a political dynamic that is only just beginning to unfold, and with the potential to transform governance as we know it.

A Nobel laureate for his development of the contractual and constitutional bases for the theory of economic and political decision-making, Buchanan made seminal contributions to several fields within economics and was a major figure in the revival of classical liberal political economy in the late twentieth century. He founded no less than *two* distinctive schools and research programs: (1) public choice theory, applying the tools of economic analysis to traditional problems of political science and turning on its head the notion of the benevolent, omniscient government social-planner (‘politics without romance’) (Buchanan & Tullock 1962; Buchanan & Wagner 1977; Buchanan & Tollison 1984); and (2) constitutional economics, the study of the legal-institutional-constitutional rules that constrain the choices and activities of economic and political agents (‘the rules of the game’) (Brennan & Buchanan 1985; Buchanan 1987, 1990).

But it is one of his lesser-known articles—‘Secession and the limits of taxation: Toward a theory of internal exit’—that promises to be the most revelatory. And more surprisingly—for a product of rural Rutherford County, Tennessee, accustomed to hoeing his own cabbages, and a self-described “outdated freak whose functional role in the general scheme of things has passed into history” (Buchanan 1979: 279)—it is bitcoin and emerging second-generation blockchain based cryptographic technologies that provide the platform for his theory of internal exit to play out.

Acclaimed technologist and formative cypherpunk writer Timothy C. May might have declared “A spectre is haunting the modern world, the spectre of crypto anarchy” in his *Crypto Anarchist Manifesto* (1992), but already in *The American Economic Review* in 1987 Buchanan and co-author Roger L. Faith had outlined the necessary conditions for the spectre to ever materialise. May envisioned a future in which cryptography and self-executing, self-enforcing, ‘smart’ contracts would empower individuals to make voluntary economic arrangements that transcend unresponsive or predatory government. In effect, citizens would be able to economically secede from an existing political unit, establish new institutions to provide collective goods or services, and reorder the jurisdictional system to more closely align with their underlying preferences. Indeed, bitcoin enthusiasts and crypto-evangelists believe we are on the cusp of such a transformative horizon. But while they valorise figures in the cypherpunk tradition, including mythical bitcoin inventor Satoshi Nakamoto and WikiLeaks founder Julian Assange, they find no room in their Pantheon for Nobelist Buchanan.

In this paper, we first outline the basic set up and assumptions of the Buchanan and Faith (1987) model of internal exit, which is essentially a model of secession, as we know it. We examine the general results of the model and implications, and discuss how these can be extended to shed light on the dynamics of ‘non-territorial secession’ (pertaining to an institutionalised mechanism) or ‘cryptosecession’ (a non-sanctioned mode of seceding that is exemplified by bitcoin and emerging blockchain based technologies). We then develop a game-theoretic model of cryptosecessionist internal exit that we argue captures the dynamic of non-territorial decentralisation.

One of the main contentions of non-territorial decentralisation is that it corresponds to a political-jurisdictional order in which the alignment of citizens and policies is optimally efficient (MacDonald 2015). That is to say there is allocative efficiency in the provision of political goods; no citizen would be better off by moving between jurisdictions and no groups of citizens would seek to form new jurisdictions with new policies. This in turn means that non-territorial decentralisation reduces, or in the limit entirely eliminates, ‘fiscal exploitation.’ Individuals or groups pay the average cost of political good provision so there is no scope for fiscal redistribution (i.e., no transfers), and the bundles of political goods match the preference-cost valuations of all citizens (i.e., no forced consumption of non-preferred political goods). Conversely, when there *is* fiscal exploitation some subset of the population of citizens is either: (1) paying above average cost for their preferred bundle of political goods with the resulting fiscal surplus being transferred to others; or (2) forced to consumer a non-preferred bundle of political goods (or elements within that bundle) at a non-exploitative tax price; or (3) getting some combination of exploitative tax prices and non-preferred policy bundle elements.

Thus if a political-jurisdictional order is not yet allocatively efficient—and some subset of citizens is being fiscally exploited—the process of non-territorial decentralisation should see taxes converge on average costs of provision, fiscal surpluses disappear, and transfers cease. Moreover, non-territorial decentralisation is a process of jurisdictional proliferation. For instance, a unitary, exploitative state would be decentralised along functional and personal dimensions to form overlapping constellations of citizens in which political preferences were homogenous and political goods were non-discriminately financed and provided. So non-territorial decentralisation is characterised by both resistance to fiscal exploitation and jurisdictional reorganisation—where the purpose of the latter is to underwrite the former.

We could delineate this process by the multitudes of latent and emergent political groups, or we could conceptualise it more simply as the interplay between two encompassing groups: those who are net beneficiaries from the political process and those who on net contribute more than they receive. Within these there are many constituent groups with varying net positions vis-à-vis political provisions and redistributions, depending on the extent to which their political preferences are

satisfied and the fiscal transfers they finance and extract. But even so, if non-territorial decentralisation *does* promote an optimally efficient alignment of citizens and policies, then the underlying dynamics of political group formation and sorting (among various non-territorial units) must ultimately manifest as attrition of political winners and losers.

This is a complex and multifaceted process directed at a non-exploitative and optimally efficient allocation of people and policies to jurisdictions. That is to say, since non-territorial decentralisation is aimed at unwinding complexes of discriminatory fiscal transfers, the patterns of jurisdictional change will also assume a certain requisite complexity. Nevertheless, it can be represented as the interplay between political winners and losers, whereby both groups contract until fiscal exploitation ceases, and hence all members of the encompassing polity become fiscally equivalent. As such, we model jurisdictional change—in this case non-territorial decentralisation—as a two-player game between the encompassing groups of the politically expedient (i.e., net transfer recipients) and the politically ineffective (i.e., net losers from the political process).

Non-territorial decentralisation is a variant of internal exit that is akin to partial secession. Internal exit is defined as secession by a coalition of people into a newly formed political unit, in contradistinction to external exit, which is typically defined as mobility between pre-existing political units. Both of these are complete ‘all-or-nothing’ decisions: internal exit is the typical idea of secession as full disintegration of political units, and external exit is complete relocation between fully disintegrated political units.

Non-territorial decentralisation, on the other hand, can be considered as partial secession. Individual citizens are potentially members of multiple functionally defined political units at once, and multiple political units operate simultaneously in the same location. Within the non-territorial decentralised system, jurisdictional changes attending to fiscal equivalence are not limited to complete realignments of citizens and jurisdictions, but also extend to changes in the distribution of political-economic activity that citizens conduct in their multiple political units.

For instance, consider a group of citizens that are members of two political units both offering a particular political good; if the group decides to switch between providers they have affected a jurisdictional change (which may have reduced fiscal exploitation) but have done so by only *partially* exiting. In this way citizens that are outside the dominant political coalition are able to moderate the circumstances of their fiscal exploitation without having to completely secede from all aspects of polity, economy, and society. As such, we model non-territorial decentralisation as partial secession; both the politically ineffective *and* expedient are able to shift economic activity among political units to maximise post-tax payoffs.

We proceed as follows. In the next section we review the model of internal exit and the limits of fiscal exploitation by Buchanan and Faith (1987) that is the basis for our model of partial internal exit. We then argue that non-territorial decentralisation in general, and cryptosecession in particular, is a form of partial internal exit and outline a model of cryptosecessionist partial internal exit. We conclude by discussing the implications of the model for non-territorial decentralisation and blockchain based cryptosecession.

2. Buchanan and Faith on internal exit and fiscal exploitation

In the first instance Buchanan and Faith (1987) are concerned with the central problem of public economics—ensuring allocative efficiency in the provision of public goods. Economists who focus on the *free rider problem* and the subsequent *underprovision* of some public good have tended to recommend centralised (monopoly) provision of public goods, financed perhaps by a proportional tax on the income of all citizens in a polity. This solution does indeed have the capacity to generate sufficient funds for financing public goods, but often comes at the cost of *overprovision* or, as the case may be, *overtaxation*. Politically connected insiders, special interests, or decisive coalitions can extract the resulting fiscal surplus as a form of political redistribution (fiscal transfer). In short, this engenders what can be called the *exploitation problem*.

In response, economists have studied the role of *external exit* and ‘voting with feet’ as a means to limit *overprovision* and *overtaxation*, and ensure allocative efficiency. This work is based on the seminal Tiebout (1956) sorting model, whereby competitive government units (cf. monopolism) provide public goods *in parallel*, and are incentivised to provide them at the efficient level and tax-price (i.e., in line with citizens’ preferences). Buchanan and Faith (1987) use this as the departure point for their analysis, and introduce the concept of *internal exit*—“secession by a coalition of people from an existing political unit along with the establishment of a new political unit that will then provide public goods to those who defect from the original unit” (1023). They argue that this too is an alternative means to efficient governance.

The main connection between these three approaches is that: (1) the *free rider problem* can be overcome by the monopoly provision of public goods, but in turn generates an *overprovision*, *overtaxation*, and *exploitation problem*; (2) the competitive provision of public goods via *external exit* can then overcome these problems, but assumes a multiplicity of jurisdictions in competitive supply without describing how such jurisdictions came to be formed (i.e., assumes exogenously-determined jurisdictional structure); and subsequently (3) the Buchanan and Faith (1987) theory of *secession* and *internal exit* fills the gap in describing how multiple jurisdictions come to be

(i.e., endogenously), while also describing how the exploitation problem can be overcome without even having to ‘vote with feet’ or any such exit at all (external *or* internal).

Buchanan and Faith (1987) provide an analytic model that demonstrates the logic of internal exit as a political mechanism restricting the size of fiscal surplus and transfer by monopoly government. As they put it, they show “how the prospects for removal from authority might exert limits on the taxing proclivity of government” (1031). They also suggest the model “may be helpful in deriving testable implications relative to the growth of tax evasion-avoidance” (1023). In addition to this, I claim that it can also be modified and applied to the emerging phenomena of ‘cryptosecession.’ Cryptosecession is the process in which citizens secede from an incumbent state and reconstitute in new ‘crypto states’ that are akin to non-territorial public good clubs (Ludlow 2001; MacDonald 2015; Vanberg 2016). It can be described as a form of tax evasion, but it is more accurately classified as a process of partial secession and *de facto* jurisdiction formation.

Buchanan and Faith (1987) note that the previous lack of consideration for internal exit (secession) is likely due to the prevailing perception that secession is legally or constitutionally impermissible, and therefore prohibitively costly to effect. Other factors aside from unconstitutionality that make internal exit prohibitively costly (and thus less likely) include locational interdependences among people in a polity (i.e., agglomeration economies, positive spillovers in spatial distribution of people and property) and difficulties in forming coalitions among potential members of a seceding group (i.e., transaction costs or collective action problems).

The upshot, however, is that these factors become the conditions for when internal exit is a viable response to fiscal exploitation. Buchanan and Faith (1987) assume that citizens possess a legal-constitutional right of secession that is effectively ‘costless’ to exercise in and of itself. They also assume that political conflict between groups or collective action difficulties in forming the new political unit are not limiting factors. The main considerations are then the opportunity cost of reduced private product (i.e., forgone agglomeration economies) and the cost of providing political goods independently (i.e., foregone economies of scale), from leaving the larger polity-economy. The costs of secession lessen and internal exit becomes a more viable option in a world where people can easily form political groups, can then secede without having to sacrifice locational interdependences and agglomeration economies (i.e., with perfect economic integration or via non-territorial secession), and once they have done so find that scale economies of political good provision are attenuating (i.e., average costs are converging or constant).

Arguably this describes the conditions and consequences of cryptographic technology: (1) secession is ‘permissionless’; (2) it is non-territorial, so locational interdependences need not be sacrificed in seceding; and (3) the cost of forming seceding groups is greatly diminished. The legal-

constitutional permissibility assumption is meaningful (and contestable) when applied in the model of *de jure* internal exit; but due to the ‘permissionless’ character of cryptosecession, it is definitional to a model of *de facto* internal exit. Similarly, in the cryptographic world where the costs of collective action are greatly diminished, internal exit is becoming evermore viable. The implication is that permissionless cryptosecession, like internal exit, “imposes constraints on the potentially exploitative behavior of those in the dominating or ruling political coalition” (1024). That is to say, the ability of the politically expedient to extract fiscal transfers is restricted in a way that is analogous, perhaps even superior, to both external-exit territorial mobility and internal-exit territorial secession.

Competitive political sorting is more commonly observed than secession, and therefore appears more a realistic and relevant mechanism of fiscal equivalence; but we do occasionally observe secession in various forms. Moreover, it is possible that the mere *threat* of secession induces a fiscal competition between the incumbent government and the government of the potential new jurisdiction, without internal exit actually eventuating. We can say the same thing of non-territorial decentralisation in general and cryptosecession in particular. Both are uncommon and largely unobserved modes of jurisdictional change—in fact *cryptosecession* by its very nature is unobservable. Nevertheless the *capability* of citizens to reconfigure their political memberships or to use cryptography to remove themselves from incumbent institutions could still play an important role in curtailing fiscal exploitation, short of decentralisation or cryptosecession actually occurring.

This is reflected in the Buchanan and Faith (1987) model too. The threat of secession is a means of avoiding the tyranny of the majority, or dominant minority. Internal exit need not actually occur; the mere possibility acts as a brake on the exploitative actions of the politically expedient coalition, which adjusts the tax rate to an equilibrium ‘secession-proof’ level. At equilibrium, fiscal surplus and transfer still occurs, but not beyond the point that would induce secession. We arrive at an equilibrium level of fiscal exploitation. The contention is that cryptosecession might further lower the secession-proof equilibrium to the point of non-exploitation. Then, neither secession nor cryptosecession would obtain, and the polity would remain in non-exploitative, fiscally equivalent, efficient equilibrium.

Of course, in reality not all governments adhere to the secession-proof rule. The equilibrium condition can be a useful tool for interpreting episodes where government do overstep the mark, people agitate for secession, and indeed when they succeed in removing themselves from circumstances of fiscal exploitation. Buchanan and Faith (1987: 1023) note, “secession in various forms does occur”—whether at the scale of the nation-state (e.g. “threats and declarations of independence from existing national governments”) or at the level whereby subsets of citizens seek exemption from an existing jurisdiction to provide and finance public goods privately (e.g. special

districts, private schooling, lighthouses). Again, we might note that forms of non-territorial cryptosecession also do occur—these include cryptoanarchist enterprises (e.g. bitcoin, *Ethereum*, *Bitnation*), but also the shadow economy and *Système D* (Soto 1989; Schneider & Enste 2013); agorism and counter-economics (Konkin, Conger & Seely 2006); and *parallel poleis* in civil society (Benda et. al 1988; Lagos, Coopman & Tomhave 2014).

By manipulating the basic internal exit model, we can garner insights into how current trends might play out in the future concerning allocations of political goods and jurisdictions. It appears that institutional and technological trends could have the impact of drastically reducing the costs of secession, and in a non-territorial way, so as to overcome the cost of foregone locational interdependences and agglomeration economies. The effect could be an upsurge in ‘group secession’ where people excise their economic activity from an encompassing jurisdiction and coordinate on institutions to provide public goods competitively and in parallel. Or we might observe ‘personal secession’ where people individually secede before recoalescing as groups by coordinating with extant governance providers.

Or, perhaps less radically, the proclivities of governments to overtax and provide fiscal transfers might be appropriately curtailed, to the point even of elimination, without inducing cryptosecession (i.e., the secession-proof condition lowered to the average cost of provision). This will depend on how incumbent governments respond to changing circumstances, as represented by inclusion of the cryptosecession option in the internal exit model. But in the very least, to paraphrase Buchanan and Faith, such a model may be helpful in deriving testable implications relative to the growth of cryptosecession-mediated internal exit, or conversely, to the pressures for fiscal reform.

3. The basic internal exit model

In the simplest version of the internal exit model, the polity is comprised of two groups. (1) The *sharing coalition* has the ability to extract fiscal surplus, due perhaps to being active participants in the political process. It includes “all groups that are successful in obtaining net transfers from the government” (1024). They do so via fiscal redistribution, but this could occur elsewhere, for instance with discriminatory spending on political goods that are consumed only by the sharers. (2) Those *outside* the sharing coalition (*non-sharers*) are net losers from the political process as they have wealth partially redistributed away from them, over and above the average cost of the public good. This is “the politically ineffective, unrepresented, or rationally nonparticipating segment of the population” (1024) but this group also presents a potential for secession.

The basic model assumes that the public good to be provided is inherently monopolistic and must be provided for any private production to take place. The public good is financed with a non-discriminatory, proportional tax on income, levied on all members of the polity. Hence, the minimum (non-exploitative) tax rate would be equal to the average cost of the public good. However, since provision is monopolistic the sharing coalition (who has control of the government) uses its power to tax above the non-exploitative rate. The resulting fiscal surplus is transferred to sharers in equal proportions. This is a highly stylised model where the benefit of being in the sharing coalition is ostensibly a cash transfer, although the logic also applies to ‘benefits in kind’ or preferential spending on other political goods that are consumed only by sharers (i.e., rent-seeking, pork-barrelling). The sharers’ net position after the political process is improved by the amount of one share of the total fiscal surplus (net of the proportional income tax), however it is administered.

The main constraint to fiscal exploitation is the ‘liberty of secession.’ Non-sharers can secede without cost, but must then finance and provide the public good (which *must* be provided for the new polity to produce any private income) themselves. Thus the threat of secession and the extent of fiscal surplus extraction are largely determined by the cost function for public good provision and the production function for citizens in the private sector. The impact of other factors such as economic characteristics of citizens in the polity (differentiated according to income product) and the size of the polity in terms of number of member citizens are investigated by Buchanan and Faith (1987) and Graziosi (2007), but are not relevant to our purposes here. We require only the previous authors’ derivations of the equilibrium secession-proof tax rate, transfers, and sharer and non-sharer post-tax payoffs.

Consider a community of K people, in which each person has an individual private product, or income, of $g(K)$. Some government must provide a public good or no private product is possible in the community. The cost of provision for the public good is $f(K)$ where $f'(K) \geq 0$. Assume that community income (total private product) is sufficient to finance the public good $Kg(K) > f(K)$. Fiscal surplus (transfer) is the difference between total tax revenue and the cost of public good provision $T = tKg(K) - f(K)$. The non-exploitative tax rate $t_0(K) = \frac{f(K)}{Kg(K)}$ covers provision cost without generating fiscal surplus. Non-sharer post-tax income is simply private product minus tax paid $P = g(K)(1 - t)$. There are M citizens in the sharing coalitions, who each receive an equal share of fiscal surplus; and sharer post-tax income is therefore $B = g(K)(1 - t) + \frac{T}{M}$.

Now consider a polity that consists of N identical individuals; the remaining $S = N - M$ citizens therefore form the set of potential seceders. Assume seceders will employ the non-exploitative tax rate $t_0(S) = \frac{f(S)}{Sg(S)}$ in the potential new polity. If secession obtains, seceder post-tax income will be:

$$P(S) = g(S)(1 - t_0(S))$$

$$P(S) = g(S) \left(1 - \frac{f(S)}{Sg(S)} \right)$$

$$P(S) = g(S) - \frac{f(S)}{S} \quad (1)$$

The equilibrium secession-proof tax rate t^* maximises the post-tax net income of sharers without inducing secession of non-sharers. At equilibrium, secessionists are indifferent between leaving the original polity and receiving $P(S)$ or remaining and receiving $P^*(N)$. So the equilibrium secession-proof condition is:

$$P^*(N) = P(S)$$

$$g(N)(1 - t^*) = P(S)$$

$$t^* = 1 - \frac{P(S)}{g(N)} \quad (2)$$

$$t^* = 1 - \left(\frac{g(S)}{g(N)} - \frac{f(S)}{Sg(N)} \right)$$

$$t^* = 1 - \frac{g(S)}{g(N)} + \frac{f(S)}{Sg(N)}$$

$$t^* = \frac{g(N) - g(S)}{g(N)} + \frac{f(S)}{Sg(N)} \quad (3)$$

If there are agglomeration economies or efficiency losses from separation, then secession reduces private income, so that $\frac{g(S)}{g(N)} < 1$ and $t^* > \frac{f(S)}{Sg(N)}$. Therefore the equilibrium secession-proof tax rate in the original polity is higher than the non-exploitative tax rate in the potential new polity $t^* > t_0(S)$ because potential seceders must sacrifice agglomeration economies. If there are no agglomeration economies (or seceders need not sacrifice them) then $t^* = t_0(S)$, which means that the equilibrium rate in the full polity is the non-exploitative rate in the potential new polity. Thus if citizens can non-territorially secede then the polity will be forced to implement a tax rate that is closer to the non-exploitative rate, which means that fiscal surplus and transfers will approach zero.

Equilibrium fiscal surplus (i.e., transfers) is:

$$T^* = t^*Ng(N) - f(N) \quad (4)$$

$$T^* = \left(\frac{g(N) - g(S)}{g(N)} + \frac{f(S)}{Sg(N)} \right) Ng(N) - f(N)$$

$$T^* = \left(g(N) - g(S) + \frac{f(S)}{S} \right) N - f(N)$$

$$T^* = Ng(N) - Ng(S) + \frac{Nf(S)}{S} - f(N)$$

$$T^* = (Ng(N) - f(N)) - \frac{N}{S}(Sg(S) - f(S))$$

$$T^* = W(N) - \frac{N}{S}W(S) \quad (5)$$

Where $W(K) = Kg(K) - f(K)$ is welfare (i.e., total private income net of public good provision cost). Transfers are positive if total welfare in the original polity is at least as large as total welfare in the potential new polity scaled up by a factor of $\frac{N}{S}$. Put another way, transfers per citizen $\frac{T^*}{N}$ are positive if welfare per person $\frac{W(N)}{N}$ in the original polity is at least as large as welfare per seceder $\frac{W(S)}{S}$ in the potential new polity (dividing (5) through by N). If so, potential seceders will remain in the original polity and accede to fiscal transfers rather than secede to the new polity.

As below, equilibrium non-sharer post-tax income is one share of total welfare in the potential new polity (i.e., average welfare), which corresponds to the equilibrium condition that non-sharers are indifferent between seceding or not.

$$P^* = g(N)(1 - t^*) \quad (6)$$

$$P^* = g(N) \left(1 - \left(\frac{g(N) - g(S)}{g(N)} + \frac{f(S)}{Sg(N)} \right) \right)$$

$$P^* = g(S) - \frac{f(S)}{S} \quad (7)$$

$$P^* = \frac{Sg(S) - f(S)}{S}$$

$$P^* = \frac{W(S)}{S} \quad (8)$$

Finally, equilibrium sharer post-tax income is one share of the excess of total welfare in the original polity over total welfare in the potential new polity.

$$B^* = P^* + \frac{T^*}{M} \quad (9)$$

$$B^* = \frac{W(S)}{S} + \frac{W(N)}{M} - \frac{N}{MS} W(S)$$

$$B^* = \left(\frac{1}{S} - \frac{N}{MS} \right) W(S) + \frac{1}{M} W(N)$$

$$B^* = \frac{1}{S} \left(1 - \frac{N}{M} \right) W(S) + \frac{1}{M} W(N)$$

$$B^* = \frac{1}{S} \left(\frac{M - N}{M} \right) W(S) + \frac{1}{M} W(N)$$

$$B^* = \frac{1}{S} \left(\frac{-S}{M} \right) W(S) + \frac{1}{M} W(N)$$

$$B^* = \frac{W(N) - W(S)}{M} \quad (10)$$

4. Cryptosecession as partial internal exit

In the basic model, private product is a function of the size of polity, which may be interpreted as a state of full economic disintegration between the two polities after secession. Therefore we could say that seceders cannot generate private product within the entire community, only their fellow cohort, because they would be excluded access to markets, courts, or such, in the original polity. The order produced in the original polity is worthless to them; they can't use it. Similarly for remaining citizens, they cannot use the order produced in the potential new polity without paying for access to their market infrastructure and institutions.

Citizens face a trade-off between smaller incomes in smaller polities (albeit with smaller tax costs) versus larger incomes in larger polities (although with larger tax costs). The model *assumes* this—when seceders stop paying the tax they lose access to the public good, and thus lose access to the larger market in the larger polity, so their individual private product falls. Conversely, citizens of the original polity pay their own price for their public good and can only trade among themselves, so their individual private product falls too. It is up to the sharing coalition in the original polity to set the ‘secession-proof’ tax rate that maximises their post-tax post-transfer

income. Non-sharers have little recourse; they must accept the state of ‘optimal exploitation’ since secession would only reduce their post-tax income.

Likewise, in the cryptosecession example two polities produce ‘order’ simultaneously. The original polity continues to produce the public good for its citizens, and the potential new polity will produce order for the seceders. And again, the point of the ‘order’ public good is simply to make private product possible in each domain. But we argue that with *de facto* cryptosecession (in contradistinction to *de jure* secession) there is an asymmetry: citizens pay for order in their polity and can only trade among themselves, while cryptoseceders pay for order in the new polity (to a provider of ‘crypto infrastructure’ that we label a ‘crypto state’) but can still trade with everyone remaining in the original polity as well as among themselves. The question to be asked of the basic internal exit model is then: Can seceders retain access to order and markets in the original polity (and thus generate larger private product) but not pay tax for it? Arguably, their model *does* capture this when the assumption of no agglomeration economies (i.e., constant private product with respect to polity size) is made, but we seek an extension that models this dynamic explicitly.

In the cryptosecession case, seceders can still trade within both polities to generate their private product, so they benefit from the order produced by both polities, and retain access to the larger market for generating their private product. The point of secession is to evade (or minimise) the non-discriminatory tax levied on the incomes of all citizens in the original polity. Instead, or in addition, cryptoseceders pay a crypto state for access to its crypto infrastructure and are then able to conduct economic activity not only among themselves but also with citizens remaining in the original polity.

In the perfectly veiled case, cryptoseceders pay tax only to the crypto state (and this is a lower price than that paid by the remaining citizens) because they appear to the original polity to have zero private income (or a negligibly small amount approaching zero). In other more limited cases, the cryptoseceder pays tax to both polities; either: (A) they veil the majority of their activity and income in the crypto economy and thus report and pay only a small amount to the original polity; or (B) their economic activity in formal sectors is documented, so the government knows their income in the original polity and taxes them on it (without knowing about informal crypto activity and income). A third option (C) is that some proportion of economic activity and income within (A) and (B) is documented that is arbitrary and thus not determined by either cryptoseceder or state.

In any case, because the process of cryptosecession is *de facto* and not *de jure*, the seceders still retain their citizenship in the original polity, they just appear to have lower income, and thus pay lower taxes. In (A) income appears to be negligibly small (near zero), and thus so are taxes paid; and in (B) income appears less than it really is (though not zero) and taxes paid are smaller too. The

seceders simply direct (or generate) some portion of their income into the crypto state, so as to evade the non-exploitative tax on income. From the perspective of the sharing coalition in the original polity, a seceder appears to be a low-income citizen; they pay their meagre contribution to the order public good and are allowed to trade in the original polity.

Note also that both non-sharers *and* sharers can be *de facto* cryptoseceders. Thus a model of cryptosecession permits citizens an additional third option over the internal exit model: (1) remain in the original polity as a sharer or non-sharer; (2) secede to a potential new polity as a non-sharer (recall there is no fiscal surplus in the new polity); or (3) partially cryptosecede to another potential new polity as a non-sharer (again, with no fiscal surplus) while remaining in the original polity under the appearance of a lower-income citizen, and as a sharer or non-sharer.

In modelling this we introduce a coefficient β that represents the portion of income that is unreported (or generated) behind the veil of cryptography versus the portion that is reported (generated) in the original polity $\alpha = 1 - \beta$. In the setting with perfect ‘crypto infrastructure,’ individuals can generate all of their income in the crypto economy (notwithstanding a negligible portion that remains in the original polity) so $\beta \rightarrow 1$. They then have access to order and markets in both polities and their individual income is larger (generated in proportion to the entire community size) but they only pay the non-exploitative tax rate on income in the crypto economy. In the mixed setting, individuals generate income in both polities (i.e., the entire community size) and they pay tax in both polities depending on *where* they generate the income, so $0 < \beta < 1$.

The coefficient β could be interpreted as representing the state of cryptosecessionist technology: the lower is β , the lower is the prospect of cryptosecession and the closer to the basic internal exit outcome; the higher is β , the more advanced is the technology and the closer to the non-exploitative outcome. Moreover, this is probably related to crypto technology’s *relative* development. Technologies of *legibility* support efforts “to arrange the population in ways that simplified the classic state functions of taxation, conscription, and prevention of rebellion” while technologies of *opacity* subvert these attempts at exploitation, abet citizen non-compliance, and shrink “state-accessible product” (Scott 1998: 24). A similar interaction exists between technologies that introduce points of *control* and thus lower elasticities to government taxation, regulation, and exploitation, versus technologies of *resistance* that circumvent points of control (Dourado 2011). Thus, as technologies of opacity and resistance exceed technologies of legibility and control, the sharing coalition is constrained in its ability to extract fiscal surplus, and fiscal exploitation converges on fiscal equivalence.

5. The cryptosecession internal exit model

Cryptoseceders generate income in both the original polity *and* the crypto economy. They are taxed on the income they generate in each polity. The question they face is: How much economic activity to conduct in each polity? The original polity is larger, and hence private product is larger, but so is the tax rate. The crypto economy is smaller, and hence private product is smaller, as is the tax rate (i.e., the non-exploitative rate). Now in the partial internal exit model, the decision to secede is not ‘all-or-nothing’ as in the basic internal exit model—individuals can strike a balance between larger polity and private product (and tax losses) and smaller polity and private product (and tax losses). Like Buchanan and Faith (1987), we solve the cryptosecession model to find the equilibrium secession-proof and cryptosecession-proof tax rate; but we also solve it to find the equilibrium split of economic activity between polities (i.e., ‘all-or-nothing’ or some $\alpha: \beta$).

The logic of the model is as follows. Initially, all citizens earn income in the original polity; $g(N)$ is increasing in polity size N such that $g(N) > g(N - 1)$. There is a cost of public good provision; and average cost $\frac{f(N)}{N}$ is decreasing in polity size N such that $\frac{f(N)}{N} < \frac{f(N-1)}{N-1}$. Sharers set the tax rate t in the original polity and use it to generate fiscal surplus, which is transferred to the M sharers such that $\frac{T}{M} = \frac{tNg(N) - f(N)}{M}$.

Individuals earn less in the potential new polity because it is smaller than the original polity. It also costs more to provide the public good of order (i.e., average cost) in the potential new polity and thus the potential seceders face a higher non-exploitative tax rate than otherwise $t_0(S) = \frac{f(S)}{Sg(S)}$. But they do not pay for fiscal surplus and transfer; so the choice is between a relatively ‘higher’ non-exploitative rate and an *even higher* exploitative rate (if this wasn’t the case, they would not secede). So for potential seceders the trade-off is: higher private product (larger market) + higher tax cost (fiscal exploitation, but with scale economies) vs. lower private product (smaller market) + lower tax cost (higher average cost, but with no fiscal exploitation).

At equilibrium, private product, average cost, and taxes are balanced so non-sharers are not induced to secede: if the tax rate is higher, they will secede; if it is lower, sharers can and will raise it. In the first instance potential seceders appear to face an ‘all-or-nothing’ choice: if they secede they must remove *all* economic activity to the new polity. But what if they could secede partially? If the secession-proof tax rate were breached no potential seceder will maintain *any* stake in the original polity; but even in equilibrium (at the secession-proof rate) there are incentives to reduce tax burden by conducting economic activity elsewhere or hiding income. Partial secession also presents the possibility that non-sharers will decide *not* to formally secede if the sharers set an over-exploitative tax rate, and rather cryptosecede from within a unitary state. That is, the capacity to

cryptosecede could undermine the secession-proof condition if payoffs are larger for non-sharers in the unitary polity, cryptosecession scenario.

The point of partial secession (for the S potential cryptoseceders) is to generate income in proportion to the *full* population N , while evading the higher tax rate. The typical example is the individual who removes β of their income (e.g. 99%) to the crypto economy to evade tax, but leaves $1 - \beta = \alpha$ (e.g. 1%) in the original polity to maintain access to larger markets of N people. Thus there are two possibilities: (1) the cryptoseceder is able to do this because private product is generated informally in the full market without being documented, and only a small fraction is reported to authorities; or (2) the portion of income that is generated in the original polity is documented and taxed at the appropriate rate, and the portion generated in the crypto economy is undocumented and taxed at its lower rate.

In (1) the cryptoseceder pays tax on 99% of income in the lower taxing crypto state, and on 1% of income in the higher taxing original polity; while in (2) the cryptoseceder pays tax in the polity where it is generated. Intuitively the cryptoseceder will allocate the majority $\beta \rightarrow 1$ of private product to the crypto economy of size S and report only the negligible amount $\alpha \rightarrow 0$ to the original polity; thus minimising tax burden but ensuring that private product is generated in proportion to N . But the amount of activity that can be undertaken in the crypto economy is dependent on the relative development of crypto technology and thus may have some upper bound less than 1, so that even if citizens attempt to cryptosecede as much as possible $\beta \rightarrow \beta^U < 1$.

To model this, let there be $i = 1, 2$ groups, where group 1 is sharers and group 2 is non-sharers. Let there be $\rho = 1, 2, 3$ polities, where polity 1 is original polity, polity 2 is potential new polity, and polity 3 is crypto polity-economy. There are K_ρ^i individuals from group i in polity ρ , $K_\rho = \sum_i K_\rho^i$ individuals from all groups in polity ρ , and $K_i = \sum_\rho K_\rho^i$ individuals from group i in all polities.

The private product (income) of an individual from group i in polity ρ is g_ρ^i and the private product of an individual from any group in polity ρ is $g_\rho = g(K_\rho) = g(\sum_i K_\rho^i)$, where $g(\cdot)$ is an increasing function on polity size K_ρ . Note that individuals only generate private product from a polity if located in it $K_\rho^i = 0 \Leftrightarrow g_\rho^i = 0$; and all individuals in the same polity ρ generate the same private product $K_\rho^i > 0 \Leftrightarrow g_\rho^i = g_\rho$; which means that private product (income) of an individual from group i in polity ρ is $g_\rho^i = \{0, g_\rho | K_\rho^i = 0, K_\rho^i > 0\}$.

Note also that individuals only generate private product from a polity in proportion to the amount of activity they undertake in it. So let θ_ρ^i be the share of activity an individual i conducts in

polity ρ , where $\theta_1^i, \theta_2^i = \alpha^i$ is the share conducted in the visible economy (polities) and $\theta_3^i = \beta^i = 1 - \alpha^i$ is in the hidden economy (crypto). When an individual decides not to cryptosecede $\alpha^i = 1$ and $\beta^i = 0$ and when an individual cryptosecedes $\alpha^i = 1 - \beta$ and $\beta^i = \beta$, where β is the share of activity that *can* be carried out in the crypto economy. We understand this to be determined by the relative state of technology (i.e., legibility versus opacity, Scott 1998; or control versus resistance Dourado 2011) and assume that both groups have equal access to the technology of cryptosecession.

Therefore the actual income an individual i generates in polity ρ , given the relative shares of economic activity, is $\theta_\rho^i g_\rho^i$. We can see that visible income in the *de jure* polities is $g_V^i = \alpha^i (g_1^i + g_2^i)$ and hidden income in the crypto polity is $g_H^i = \beta^i g_3^i$. The total income of an individual from group i is the sum of visible income in the *de jure* polities and hidden income in the crypto polity $g^i = \sum_\rho \theta_\rho^i g_\rho^i$.

The total cost of public good provision in polity ρ of size $K_\rho = \sum_i K_\rho^i$ is $f_\rho = f(K_\rho)$. The total fiscal transfer (surplus) in polity ρ is the difference between tax revenue and public good provision cost $T_\rho = t_\rho (\sum_i K_\rho^i \theta_\rho^i g_\rho^i) - f(K_\rho)$; and therefore the tax rate applied to the visible and hidden income of individuals in polity ρ will be $t_\rho = \frac{f(K_\rho) + T_\rho}{\sum_i K_\rho^i \theta_\rho^i g_\rho^i}$. Finally, the payoff of an individual from group i is $\Pi^i = \sum_\rho (1 - t_\rho) \theta_\rho^i g_\rho^i + \frac{T_{\rho=i}}{K_{\rho=i}^i}$.

At this point it is worth considering how the threat of cryptosecession impacts the secession-proof condition. Since players can now use cryptosecession as a means of escaping fiscal exploitation, the secession-proof condition will be changed. If cryptosecession does in fact impose greater restrictions on fiscal exploitation than basic internal exit, one might expect the incentive for cryptosecession to persist even at the former secession-proof tax rate t^* . Put another way, the secession-proof rate in the cryptosecession model might be lowered compared to the basic internal exit model.

To see this consider the secession-proof condition that non-sharers are indifferent between remaining in the original polity and seceding to a new polity. We define t_S^* as the *new* secession-proof tax rate when potential seceders also have the option of cryptoseceding. If non-sharers do not secede their payoff is $\Pi^2 = (1 - t_S^*)\alpha g(N) + (1 - t_0(S))\beta g(S)$ (from subgame 5 in FIG 7 below). The payoff for non-sharers if they do secede will be either $\Pi^2 = (1 - t_0(S))g(S)$ when they do not also cryptosecede or $\Pi^2 = (1 - t_0(S))\alpha g(S) + (1 - t_0(N))\beta g(N)$ when they do cryptosecede (both from subgame 6 in FIG 8). The first condition is therefore:

$$(1 - t_S^*)\alpha g(N) + (1 - t_0(S))\beta g(S) = (1 - t_0(S))g(S)$$

$$t_S^* = 1 - \frac{g(S)}{g(N)} - \frac{f(S)}{Sg(N)} = t^* \quad (11)$$

When $\alpha = 1, \beta = 0 \Leftrightarrow t_S^* = t^*$

And the second condition is:

$$(1 - t_S^*)\alpha g(N) + (1 - t_0(S))\beta g(S) = (1 - t_0(S))\alpha g(S) + (1 - t_0(N))\beta g(N)$$

$$t_S^* = \frac{\alpha - \beta}{\alpha} t^* + \frac{\beta}{\alpha} t_0(N) \quad (12)$$

When $\alpha < 1, \beta > 0 \Leftrightarrow t_S^* < t^*$

The expression for t_S^* from the first condition is nested in the expression from the second condition so we conclude that the *new* secession-proof tax rate when potential seceders also have the option of cryptoseceding is $t_S^* = \frac{\alpha - \beta}{\alpha} t^* + \frac{\beta}{\alpha} t_0(N)$. The added threat of cryptosecession has the effect of lowering the secession-proof tax rate compared to the basic internal exit model. Now the sharing coalition must reduce their taxing proclivity from the *old* optimally exploitative t^* towards the non-exploitative $t_0(N)$, in respect of the cryptosecessionist capability of citizens β . The derivative of the secession-proof tax rate with respect to the development of technologies of opacity $\frac{\partial t_S^*}{\partial \beta} = \frac{1}{\alpha^2} (t_0(N) - t^*) < 0$ is negative, so the sharing coalition must lower the optimally exploitative tax rate as crypto technology progresses (vis-à-vis technology of legibility and control).

As the relative state of crypto technology improves $\beta \rightarrow 1$, the secession-proof tax rate converges on the non-exploitative $t_S^* \rightarrow t_0(N)$ and the equilibrium outcome converges on fiscal equivalence. Over the range $0 < \beta < \alpha$ the secession-proof rate $t_S^* > t_0(N)$, which indicates fiscal exploitation; and the point $\beta = \alpha$ corresponds to a state of non-exploitation $t_S^* = t_0(N)$. Note that when $\beta > \alpha \Leftrightarrow t_S^* < t_0(N)$, which means that sharing coalition must set a tax rate *below* the non-exploitative rate to prevent secession. Since any $t_S^* < t_0(N)$ will not be sufficient to finance the public good, sharers will not be able to prevent non-sharers from seceding. Thus when opacity balances legibility $\beta = \alpha$ the model predicts a non-exploitative outcome; when legibility trumps opacity $\beta < \alpha$ there is fiscal exploitation of those outside the sharing coalition; and when $\beta > \alpha$ there is secession of political outsiders.

Alternatively, as crypto technology catches up $\beta \rightarrow \alpha$ to balance opacity and legibility, the incentive to continue its development diminishes; that is given the best outcome for non-sharers is to remain in the full sized polity in non-exploitative, fiscal equivalence. Put simply: the better is crypto technology, the more sensitive are non-sharers to fiscal exploitation, the more credible are their threats of secession, and the more empowered they are to remedy exploitation should it arise.

Because non-sharers now have recourse to cryptosecession in escaping fiscal exploitation, there is an additional ‘cryptosecession-proof’ condition that the sharing coalition must take into consideration. We define the ‘cryptosecession-proof’ tax rate t_C^* as the tax rate at which non-sharers are indifferent between cryptoseceding or not. If t_C^* prevents cryptosecession then non-sharer payoff will be $\Pi^2 = (1 - t_C^*)g(N)$ when they do not also secede (from subgame 1 in FIG 3 below) or $\Pi^2 = (1 - t_0(S))g(S)$ when they do secede (from subgame 2 in FIG 4). We use the first of these in the cryptosecession-proof condition, since it contains the variable t_C^* that we are solving for. The payoff for non-sharers if they do cryptosecede will be either $\Pi^2 = (1 - t_S^*)\alpha g(N) + (1 - t_0(S))\beta g(S)$ when they do not also secede (from subgame 1) or $\Pi^2 = (1 - t_0(S))\alpha g(S) + (1 - t_0(N))\beta g(N)$ when they do secede (from subgame 2). The first condition is therefore:

$$(1 - t_C^*)g(N) = (1 - t_S^*)\alpha g(N) + (1 - t_0(S))\beta g(S)$$

$$(1 - t_C^*)g(N) = \left(1 - \frac{\alpha - \beta}{\alpha}t^* - \frac{\beta}{\alpha}t_0(N)\right)\alpha g(N) + (1 - t_0(S))\beta g(S) \quad \text{From (11)}$$

$$t_C^* = \alpha t^* + \beta t_0(N) \quad (12)$$

And the second condition is:

$$(1 - t_C^*)g(N) = (1 - t_0(S))\alpha g(S) + (1 - t_0(N))\beta g(N)$$

$$t_C^* = \alpha t^* + \beta t_0(N) \quad (12)$$

Thus the cryptosecession-proof tax rate is $t_C^* = \alpha t^* + \beta t_0(N)$. This is the average of the optimally exploitative tax rate from the basic internal exit model and the non-exploitative tax rate, weighted by the balance of opacity and legibility. Given $0 < \beta < 1$, the cryptosecession-proof tax rate will be lower than the optimally exploitative t^* , but never quite reduced to the non-exploitative $t_0(N)$. Accordingly, the rate of change with respect to the development of technologies of opacity

$\frac{\partial t_c^*}{\partial \beta} = t_0(N) - t^* < 0$ is negative, so crypto technological progress (vis-à-vis technology of legibility and control) further restricts the taxing proclivities of the government and brings the polity closer to fiscal equivalence. FIG 1 shows that the secession-proof tax rate is less than the cryptosecession-proof tax rate over all values of relative opacity-legibility technological development.

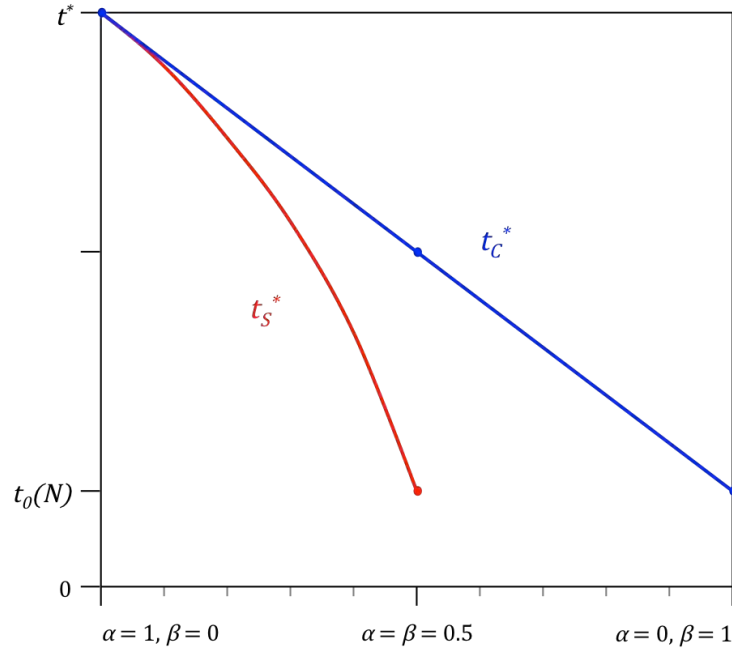


FIG 1 Secession-proof and cryptosecession-proof tax rates

6. The cryptosecession game

We can represent the decisions to secede or cryptosecede in the form of a game. The ‘cryptosecession game’ is played between two players: sharers and non-sharers. The two groups are playing a multi-stage game: in the first stage sharers set the tax rate; in the second stage non-sharers decide to secede or not; and in the third stage both sharers and non-sharers simultaneously decide to cryptosecede or not.

We allow sharers to choose from four different tax rates. (1) The ‘over-exploitative’ tax rate t_x exceeds both equilibrium conditions and will thus induce cryptosecession and secession. The remaining sharers levy a non-discriminatory tax among themselves to finance public good provision, with no surplus or transfers.

(2) The cryptosecession-proof tax rate $t_C^* < t_X$ is the maximum tax rate the original polity can set without inducing *cryptosecession* of non-sharers, and since it is above the secession-proof rate we use it as the second choice point for sharers. Put another way, it is the minimum tax rate sharers will set in response to the threat of cryptosecession. Even though cryptosecession obtains, there will still be a fiscal surplus generated on the remaining state-accessible product, which is then distributed equally among sharers as a fiscal transfer.

(3) The secession-proof tax rate $t_S^* < t_C^*$ also generates a fiscal surplus in excess of the cost of public good provision, which is distributed equally among sharers as a fiscal transfer, and transfers to the sharing coalition. This is the maximum tax rate the original polity can set without inducing secession of non-sharers so we use it as the third choice point for sharers. It is also the most fiscally equivalent outcome short of complete non-exploitation.

(4) The ‘non-exploitative’ tax rate $t_0 < t_S^*$ generates no fiscal surplus and transfers, and thus raises just enough tax revenue to finance the provision of the public good. This is the minimum tax rate a polity could possibly set in our simple model (absent a fiscal debt mechanism) and so we use it as the lower bound of the choice range for sharers.

Next, non-sharers choose to secede or not. If they decide to secede we assume they will employ the non-exploitative tax rate to finance the public good in the new polity. Even if the government in the new polity behaves exploitatively, Buchanan and Faith (1986) show that if the size of the sharing coalition in proportion to the size of the new polity is the same as that in the original polity, then the same outcome obtains. Essentially, the new non-sharers will again secede, and so on until all polities are behaving non-exploitatively; and there is incentive to secede only once so as not to dilute the benefits of polity size (i.e., private product, average cost of public good provision).

Finally, sharers and non-sharers choose to cryptosecede or not. In this stage players choose between $\beta^i = \beta$ and $\beta^i = 0$. At this decision point the players do not know what each other will decide, since they make the decision simultaneously. Again, we assume that the non-exploitative tax rate will be employed in the new crypto polity.

An extensive-form representation is used to formalise the cryptosecession game in FIG 2 below. This is a multi-player generalisation of the decision tree facing sharers and non-sharers and can be solved using backward induction over the first two decision points (i.e., set tax rate and secede or not). The final decision point consists of eight simultaneous-move subgames (i.e., dotted lines represent that players do not know if the other player has cryptoseceded or not). Payoffs are calculated in the appendix and normal-form representations of the subgames are presented below in FIG 3 to FIG 10. The solution concept is a simple comparison of payoffs for each player (i.e., Nash

equilibrium) given the branch of the decision tree they find themselves on (i.e., what tax rate was chosen, and whether or not secession has taken place). If each player has chosen a strategy and no player can benefit by changing strategies while the other player keeps theirs unchanged, then that set of strategy choices and the corresponding payoffs constitutes the equilibrium solution. Then by using backward induction we eliminate non-credible threats and deduce the subgame perfect Nash equilibrium solution of the cryptosecession game.

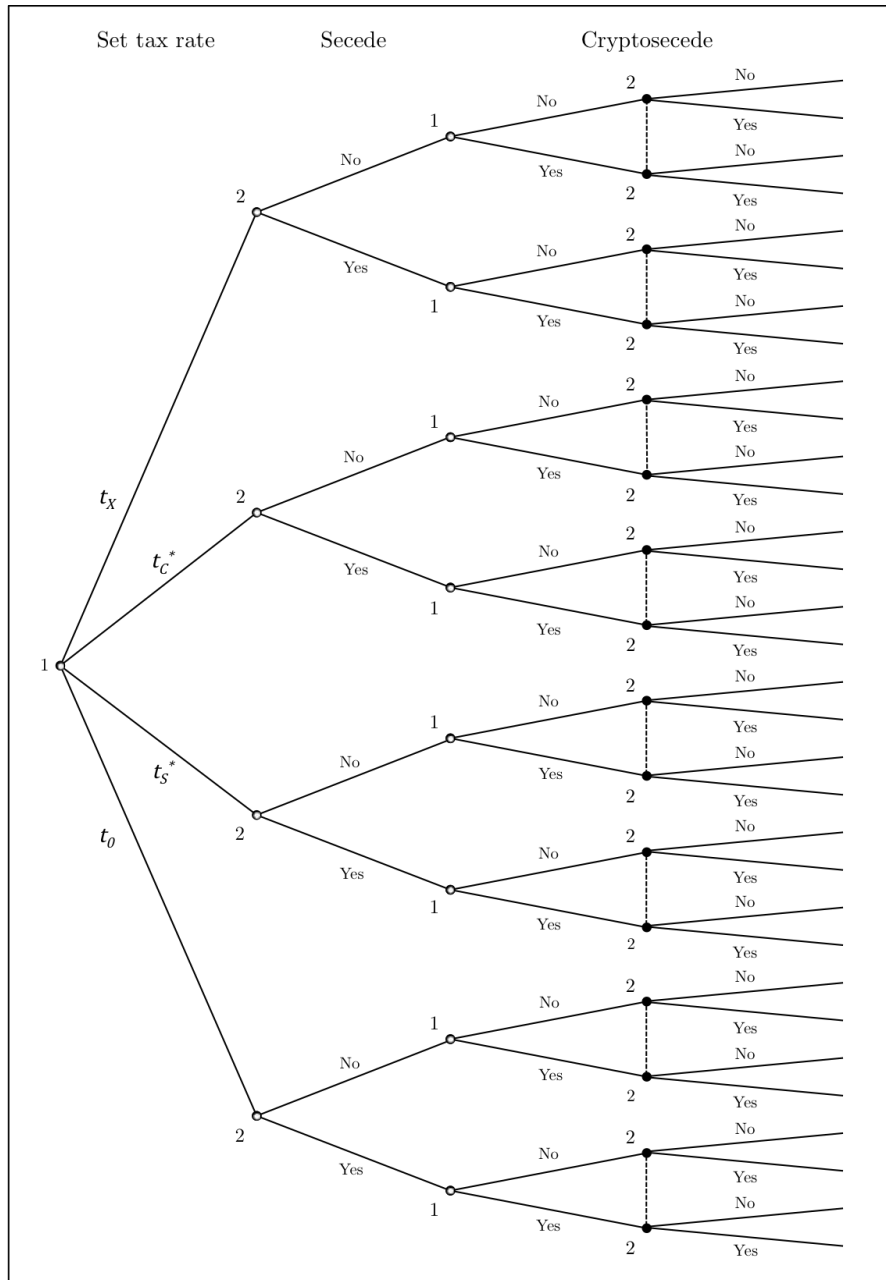


FIG 2 Extensive-form representation of the cryptosecession game

Consider first subgame 1, where the sharers have set an ‘over-exploitative’ tax rate and yet the non-sharers have not seceded. If non-sharers do not cryptosecede, then the payoff for sharers when they do cryptosecede is less than their payoff when they do not. This means that *if non-sharers do not cryptosecede, then sharers will not either*. Similarly, if non-sharers do cryptosecede, again the payoff for sharers when they cryptosecede is less than when they do not. So *if non-sharers do cryptosecede, then sharers still will not*. No matter what non-sharers do, sharers will not cryptosecede—this only reduces fiscal transfers or the private product of the economic activity they shift to the smaller crypto economy. Next we can deduce the non-sharer decision by considering their payoffs when sharers do not cryptosecede. The payoff when non-sharers cryptosecede is more than that when they do not, which indicates that *non-sharers will cryptosecede, given that sharers do not cryptosecede*. The Nash equilibrium is the shaded cell in FIG 3 below.

		Non-sharers	
		No crypto	Yes crypto
Sharers	No crypto	$\Pi^1 = (1 - t_x)g(N) + \frac{t_x Ng(N) - f(N)}{M}$ $\Pi^2 = (1 - t_x)g(N)$	$\Pi^1 = (1 - t_x)g(N) + \frac{t_x(M + \alpha S)g(N) - f(N)}{M}$ $\Pi^2 = (1 - t_x)\alpha g(N) + (1 - t_0(S))\beta g(S)$
	Yes crypto	$\Pi^1 = (1 - t_x)\alpha g(N) + (1 - t_0(M))\beta g(M) + \frac{t_x(\alpha M + S)g(N) - f(N)}{M}$ $\Pi^2 = (1 - t_x)g(N)$	$\Pi^1 = (1 - t_x)\alpha g(N) + (1 - t_0(N))\beta g(N) + \frac{t_x \alpha Ng(N) - f(N)}{M}$ $\Pi^2 = (1 - t_x)\alpha g(N) + (1 - t_0(N))\beta g(N)$

FIG 3 Normal-form subgame 1: Over-exploitative t_x and no secession

Next consider subgame 2, where the sharers have set an ‘over-exploitative’ tax rate and the non-sharers have responded by seceding. Like in subgame 1, if non-sharers do not cryptosecede, then the payoff for sharers when they do cryptosecede is less than their payoff when they do not. This means that *if non-sharers do not cryptosecede, then sharers will not either*. However, if non-sharers do cryptosecede, the payoff for sharers is more if they cryptosecede also. Since the polity is already disintegrated, when both groups cryptosecede they actually generate a *higher* average private product for the portion of activity they conduct in the crypto economy than in their respective polities (i.e., the whole population of citizens can be found there). The same applies to the non-sharers—*if sharers do not cryptosecede, then non-sharers will not either and if sharers do cryptosecede, then non-sharers will also*. There are therefore two Nash equilibriums: (1) both players do not cryptosecede, and (2) both players do cryptosecede.

Note also that the payoffs are higher for both players when they both cryptosecede than when they both don't. This is a coordination game (i.e., the 'stag hunt') and the players are subject to a coordination problem: they can realise mutual gains, but only by making a mutually consistent decision (i.e., if they cooperate by cryptoseceding together). However, cooperation might fail because each player has an alternative that is safer: choosing not to cryptosecede does not require cooperation to succeed and the difference between payoffs is zero. If a player decides not to cryptosecede and the other does they will still receive the same payoff, while if they cryptosecede alone they will be worse off. For each player, not cryptoseceding is risk-dominant while cryptoseceding is payoff-dominant. Arguably either of the equilibriums could be focal; both cryptoseceding has higher payoffs but neither cryptoseceding has lower coordination failure losses.

		Non-sharers	
		No crypto	Yes crypto
Sharers	No crypto	$\Pi^1 = (1 - t_0(M))g(M)$ $\Pi^2 = (1 - t_0(S))g(S)$	$\Pi^1 = (1 - t_0(M))g(M)$ $\Pi^2 = (1 - 2t_0(S))g(S)$
	Yes crypto	$\Pi^1 = (1 - 2t_0(M))g(M)$ $\Pi^2 = (1 - t_0(S))g(S)$	$\Pi^1 = (1 - t_0(M))\alpha g(M) + (1 - t_0(N))\beta g(N)$ $\Pi^2 = (1 - t_0(S))\alpha g(S) + (1 - t_0(N))\beta g(N)$

FIG 4 Subgame 2: Over-exploitative t_x and secession

		Non-sharers	
		No crypto	Yes crypto
Sharers	No crypto	$\Pi^1 = (1 - t_c^*)g(N) + \frac{t_c^*Ng(N) - f(N)}{M}$ $\Pi^2 = (1 - t_c^*)g(N)$	$\Pi^1 = (1 - t_c^*)g(N) + \frac{t_c^*(M + \alpha S)g(N) - f(N)}{M}$ $\Pi^2 = (1 - t_c^*)\alpha g(N) + (1 - t_0(S))\beta g(S)$
	Yes crypto	$\Pi^1 = (1 - t_c^*)\alpha g(N) + (1 - t_0(M))\beta g(M) + \frac{t_c^*(\alpha M + S)g(N) - f(N)}{M}$ $\Pi^2 = (1 - t_c^*)g(N)$	$\Pi^1 = (1 - t_c^*)\alpha g(N) + (1 - t_0(N))\beta g(N) + \frac{t_c^*\alpha Ng(N) - f(N)}{M}$ $\Pi^2 = (1 - t_c^*)\alpha g(N) + (1 - t_0(N))\beta g(N)$

FIG 5 Subgame 3: Cryptosecession-proof t_c^* and no secession

In subgame 3 sharers have set a ‘cryptosecession-proof’ tax rate and non-sharers have not seceded. Like previously, *if non-sharers do not cryptosecede, then sharers will not either* because if they cryptosecede on their own they generate a lower average private product for the portion of activity they conduct in the crypto economy. And again, like subgame 1, *if non-sharers do cryptosecede, then sharers still will not*, for the same reasons. Unlike previously, since this is a cryptosecession-proof subgame, *non-sharers will not cryptosecede, given that sharers do not cryptosecede*. Therefore the Nash equilibrium is both players do not cryptosecede.

Next consider subgame 4, where the sharers have set a ‘cryptosecession-proof’ tax rate and the non-sharers have responded by seceding. The payoffs for both players are the same as those in subgame 2, and thus so are the Nash equilibriums: (1) both players do not cryptosecede, and (2) both players do cryptosecede. Both players cryptoseceding is the higher payoff, but cannot be guaranteed due to the coordination problem.

		Non-sharers	
		No crypto	Yes crypto
Sharers	No crypto	$\Pi^1 = (1 - t_0(M))g(M)$ $\Pi^2 = (1 - t_0(S))g(S)$	$\Pi^1 = (1 - t_0(M))g(M)$ $\Pi^2 = (1 - 2t_0(S))g(S)$
	Yes crypto	$\Pi^1 = (1 - 2t_0(M))g(M)$ $\Pi^2 = (1 - t_0(S))g(S)$	$\Pi^1 = (1 - t_0(M))\alpha g(M) + (1 - t_0(N))\beta g(N)$ $\Pi^2 = (1 - t_0(S))\alpha g(S) + (1 - t_0(N))\beta g(N)$

FIG 6 Subgame 4: Cryptosecession-proof t_C^* and secession

In subgame 5 sharers have set a secession-proof tax rate and non-sharers have not seceded. For the sharers this game is played like subgame 1, but for the non-sharers the decision is reversed and they will *not* cryptosecede. If non-sharers do not cryptosecede, then the payoff for sharers when they do cryptosecede is less than their payoff when they do not. Since the polity is still integrated in the secession-proof tax rate scenario, if the sharers cryptosecede on their own, they generate a lower average private product for the portion of activity they conduct in the crypto economy. This means that *if non-sharers do not cryptosecede, then sharers will not either*. And if non-sharers do cryptosecede, the payoff for sharers is less if they cryptosecede also, so *if non-sharers do cryptosecede, then sharers still will not*. Evidently the gain from cryptoseceding together (higher individual private product and non-exploitative tax rate) is overshadowed by the loss in fiscal transfers. The payoff when non-sharers cryptosecede

is less than that when they do not, which indicates that *non-sharers will not cryptosecede, given that sharers do not cryptosecede*. Therefore the Nash equilibrium is both players do not cryptosecede.

		Non-sharers	
		No crypto	Yes crypto
Sharers	No crypto	$\Pi^1 = (1 - t_s^*)g(N) + \frac{t_s^*Ng(N) - f(N)}{M}$ $\Pi^2 = (1 - t_s^*)g(N)$	$\Pi^1 = (1 - t_s^*)g(N) + \frac{t_s^*(M + \alpha S)g(N) - f(N)}{M}$ $\Pi^2 = (1 - t_s^*)\alpha g(N) + (1 - t_0(S))\beta g(S)$
	Yes crypto	$\Pi^1 = (1 - t_s^*)\alpha g(N) + (1 - t_0(M))\beta g(M) + \frac{t_s^*(\alpha M + S)g(N) - f(N)}{M}$ $\Pi^2 = (1 - t_s^*)g(N)$	$\Pi^1 = (1 - t_s^*)\alpha g(N) + (1 - t_0(N))\beta g(N) + \frac{t_s^*\alpha Ng(N) - f(N)}{M}$ $\Pi^2 = (1 - t_s^*)\alpha g(N) + (1 - t_0(N))\beta g(N)$

FIG 7 Subgame 5: Optimally exploitative t_s^* and no secession

In subgame 6, where the sharers have set a secession-proof tax rate and the non-sharers have responded by seceding, the payoffs for both players are the same as those in subgames 2 and 4, and so are the ‘stag hunt’ equilibrium solutions.

		Non-sharers	
		No crypto	Yes crypto
Sharers	No crypto	$\Pi^1 = (1 - t_0(M))g(M)$ $\Pi^2 = (1 - t_0(S))g(S)$	$\Pi^1 = (1 - t_0(M))g(M)$ $\Pi^2 = (1 - 2t_0(S))g(S)$
	Yes crypto	$\Pi^1 = (1 - 2t_0(M))g(M)$ $\Pi^2 = (1 - t_0(S))g(S)$	$\Pi^1 = (1 - t_0(M))\alpha g(M) + (1 - t_0(N))\beta g(N)$ $\Pi^2 = (1 - t_0(S))\alpha g(S) + (1 - t_0(N))\beta g(N)$

FIG 8 Subgame 6: Optimally exploitative t_s^* and secession

In subgame 7 sharers have set a ‘non-exploitative’ tax rate and non-sharers have not seceded. If non-sharers do not cryptosecede, then the payoff for sharers when they do cryptosecede is less than their payoff when they do not. And if non-sharers do cryptosecede, the payoff for sharers is more if they cryptosecede also. The same applies to the non-sharers. So again there are two

Nash equilibriums: (1) both players do not cryptosecede, and (2) both players do cryptosecede. This is another coordination game (i.e., the typical ‘choosing sides’ variant). Since the payoffs for both players when they both cryptosecede are the same as when they both don’t, they cannot realise mutual gains by coordinating, but can avoid the lower payoffs of making mutually inconsistent decisions. Arguably either of the equilibriums could be focal since they have equal payoffs and the other payoffs are symmetrical, but since the non-exploitative tax rate is less than the cryptosecession-proof tax rate it seems more likely the status quo of not cryptoseceding will prevail.

		Non-sharers	
		No crypto	Yes crypto
Sharers	No crypto	$\Pi^1 = (1 - t_0(N))g(N)$ $\Pi^2 = (1 - t_0(N))g(N)$	$\Pi^1 = (1 - t_0(N))g(N)$ $\Pi^2 = (1 - t_0(N))\alpha g(N) + (1 - t_0(S))\beta g(S)$
	Yes crypto	$\Pi^1 = (1 - t_0(N))\alpha g(N) + (1 - t_0(M))\beta g(M)$ $\Pi^2 = (1 - t_0(N))g(N)$	$\Pi^1 = (1 - t_0(N))g(N)$ $\Pi^2 = (1 - t_0(N))g(N)$

FIG 9 Subgame 7: Non-exploitative t_0 and no secession

Finally, in subgame 8 sharers set a ‘non-exploitative’ tax rate and non-sharers responded by seceding. The payoffs and solutions are the same as previous ‘stag hunt’ subgames: neither player cryptosecedes versus both players cryptosecede. The higher payoff from both cryptoseceding cannot be guaranteed due to coordination problem.

		Non-sharers	
		No crypto	Yes crypto
Sharers	No crypto	$\Pi^1 = (1 - t_0(M))g(M)$ $\Pi^2 = (1 - t_0(S))g(S)$	$\Pi^1 = (1 - t_0(M))g(M)$ $\Pi^2 = (1 - 2t_0(S))g(S)$
	Yes crypto	$\Pi^1 = (1 - 2t_0(M))g(M)$ $\Pi^2 = (1 - t_0(S))g(S)$	$\Pi^1 = (1 - t_0(M))\alpha g(M) + (1 - t_0(N))\beta g(N)$ $\Pi^2 = (1 - t_0(S))\alpha g(S) + (1 - t_0(N))\beta g(N)$

FIG 10 Subgame 8: Non-exploitative t_0 and secession

To play the cryptosecession game we use backward induction, beginning with the decision by player 2 (non-sharers) to secede or not. In the first branch of the decision tree (where player 1 has chosen the over-exploitative tax rate t_X) the payoff from not seceding $\Pi^2 = (1 - t_X)\alpha g(N) + (1 - t_0(S))\beta g(S)$ is the equilibrium in the first normal-form subgame. There are two possible equilibrium payoffs from seceding in the second normal-form subgame: neither player cryptoseceding $\Pi^2 = (1 - t_0(S))g(S)$ and both players cryptoseceding $\Pi^2 = (1 - t_0(S))\alpha g(S) + (1 - t_0(N))\beta g(N)$. Since the smaller of the two possible payoffs from seceding in the second subgame (neither cryptosecede) is more than the payoff from not seceding in the first subgame, player 2 will decide to secede (see appendix for calculations). This is to be expected since the over-exploitative tax rate is by definition above the secession-inducing threshold.

In the second branch of the decision tree (where player 1 has chosen the cryptosecession-proof tax rate t_C^*) the payoff from not seceding is the equilibrium in the third normal-form subgame $\Pi^2 = (1 - t_C^*)g(N)$. There are two possible equilibrium payoffs from seceding in the fourth normal-form subgame: neither player cryptoseceding $\Pi^2 = (1 - t_0(S))g(S)$ and both cryptoseceding $\Pi^2 = (1 - t_0(S))\alpha g(S) + (1 - t_0(N))\beta g(N)$. Since the payoffs from seceding in the fourth subgame are more than or equal to the payoff from not seceding in the third subgame, player 2 will secede. Again this is the intuitive outcome, since the cryptosecession-proof tax rate is in excess of the secession-proof rate.

In the third branch of the decision tree (where player 1 has chosen the secession-proof tax rate t_S^*) the payoff from not seceding is the equilibrium in the fifth normal-form subgame $\Pi^2 = (1 - t_S^*)g(N)$. There are two possible equilibrium payoffs from seceding in the sixth normal-form subgame: neither player cryptoseceding $\Pi^2 = (1 - t_0(S))g(S)$ and both cryptoseceding $\Pi^2 = (1 - t_0(S))\alpha g(S) + (1 - t_0(N))\beta g(N)$. The larger of the two possible payoffs from seceding in the fourth subgame is less than the payoff from not seceding in the third subgame. This is the branch where the sharers set the secession-proof tax rate so this is expected; and we conclude that player 2 will decide not to secede.

In the fourth branch of the decision tree (where player 1 has chosen the non-exploitative tax rate $t_0(N)$) in both equilibriums of the fifth normal-form subgame the payoff from not seceding is $\Pi^2 = (1 - t_0(N))g(N)$. There are two possible equilibrium payoffs from seceding in the sixth normal-form subgame: neither player cryptoseceding $\Pi^2 = (1 - t_0(S))g(S)$ and both players cryptoseceding $\Pi^2 = (1 - t_0(S))\alpha g(S) + (1 - t_0(N))\beta g(N)$. Since the larger of the two possible payoffs from seceding in the eighth subgame (both cryptosecede) is less than the payoff from seceding in the seventh subgame, player 2 will not secede.

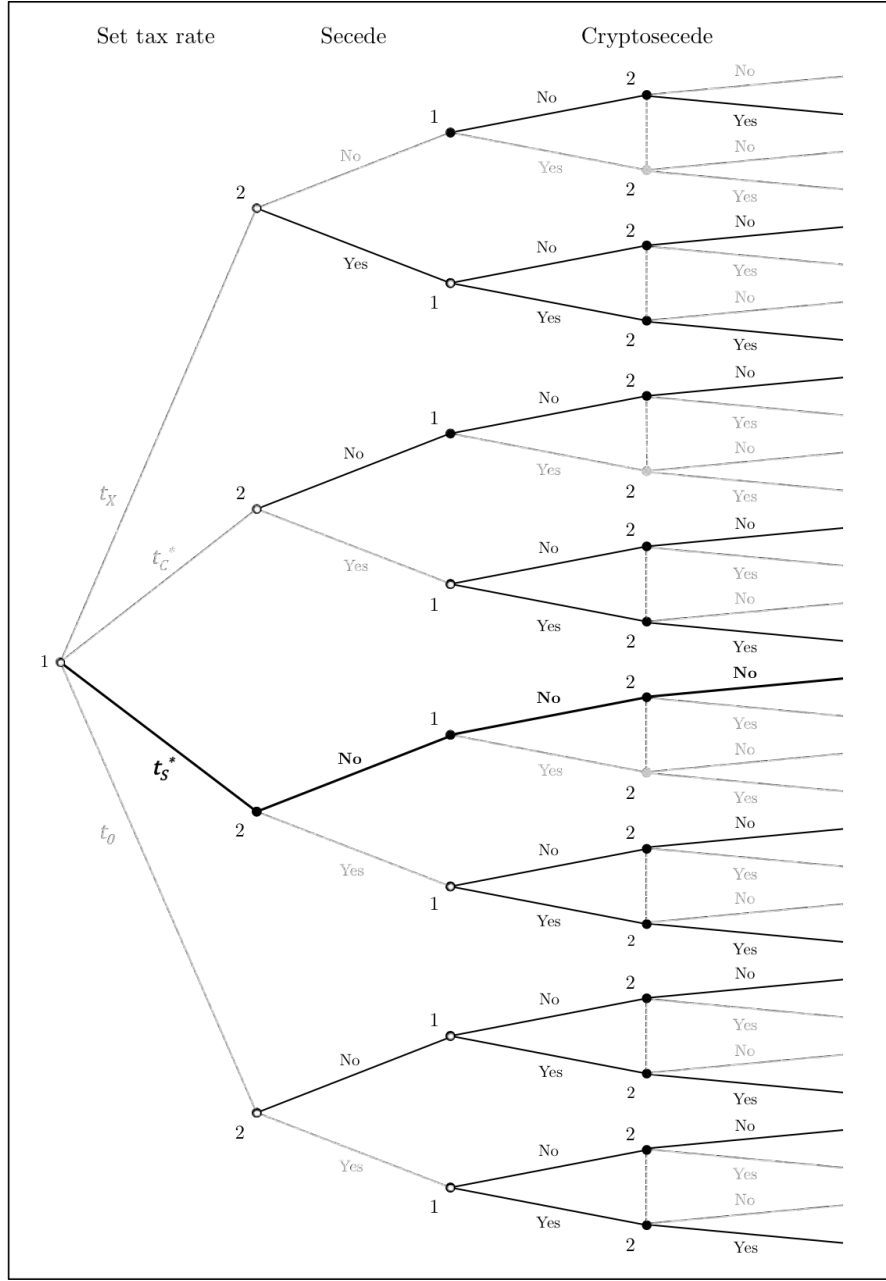


FIG 11 Backward induction solution of the cryptosecession game

Now consider the decision by player 1 (sharers) to set the tax rate in the original polity. There are two possible equilibrium payoffs in the second subgame of the first branch of the decision tree: if player 1 chooses to set an over-exploitative tax rate t_X the payoff will be $\Pi^1 = (1 - t_0(M))g(M)$ if neither player cryptosecedes or $\Pi^1 = (1 - t_0(M))\alpha g(M) + (1 - t_0(N))\beta g(N)$ if both players do. The payoff from setting a cryptosecession-proof tax rate t_C^* is $\Pi^1 = (1 - t_C^*)g(N) +$

$\frac{t_C^* N g(N) - f(N)}{M}$, and $\Pi^1 = (1 - t_S^*)g(N) + \frac{t_S^* N g(N) - f(N)}{M}$ from a secession-proof tax rate t_S^* . Lastly, the payoff from a non-exploitative tax rate $t_0(N)$ is $\Pi^1 = (1 - t_0(N))g(N)$.

Player 1 will prefer the cryptosecession-proof tax rate t_C^* to the over-exploitative tax rate t_X since the payoff is more than the largest of the two over-exploitative payoffs (see appendix). Next, the payoff from setting a secession-proof tax rate t_S^* is more than the payoff from the cryptosecession-proof tax rate t_C^* . And finally, the payoff from the secession-proof tax rate t_S^* is more than the payoff from a non-exploitative tax rate $t_0(N)$, due to the extract fiscal transfers. Player 1 will decide to set a secession-proof tax rate t_S^* .

The backward induction solution to the cryptosecession game is shown in extensive-form representation in FIG 11 above. The outcome: player 1 sets the secession-proof tax rate t_S^* ; player 2 does not secede; and neither player cryptosecedes. The polity remains integrated in both the territorial *de jure* sense and the non-territorial *de facto* sense. While neither secession nor cryptosecession obtain, the capability of non-sharers to use them curtails the taxing proclivities of the government. The threat of secession and the threat of cryptosecession combine to reduce fiscal exploitation as much as possible, though not entirely. Fiscal exploitation versus equivalence is ultimately determined by relative development of crypto technology: legibility α versus opacity β .

7. Cryptosecession and non-territorial decentralisation

Somewhat ironically, the solution to the cryptosecession game is that there is no cryptosecession. But this mirrors the outcome in Buchanan and Faith's (1987) model of internal exit. That is to say, while secession and cryptosecession do not occur, their presence as options for non-sharers serves to limit the exploitative behaviour of the sharing coalition, and ensures an optimally efficient outcome. It is precisely the capability to secede—whether fully or partially, territorially or non-territorially—that induces a fiscal competition between incumbent and potential governments, and which restricts fiscal exploitation. The threatened actions need not ever actually materialise; the mere possibility disciplines the exploitative ambitions of the politically expedient coalition.

Fiscal exploitation is restricted and the post-tax position of non-sharers is enhanced due to the ability to excise activity from the reaches of government. The secession-proof tax rate that is implemented $t_S^* = \frac{\alpha - \beta}{\alpha} t^* + \frac{\beta}{\alpha} t_0(N)$ is less than the basic internal exit model, set somewhere between t^* and $t_0(N)$. All depends on the ability to shift activity to the crypto economy, which in turn depends on the relative state of crypto technologies of opacity versus state technologies of

legibility. Since by definition non-sharers must maintain *some* activity in each of the original polity and the crypto economy $0 < \beta < 1$, the actual tax rate will always be lower when cryptosecession is a possibility than if basic internal exit is the only recourse $t_S^* < t^*$. Moreover, the secession-proof tax rate will be reduced all the way to the non-exploitative $t_0(N)$ if the state of crypto technology is such that citizen opacity and government legibility are perfectly balanced $\beta = \alpha$.

Any $\beta > \alpha$ will undermine the ability to finance the public good in the original polity and precipitate political disintegration. Yet the threat of cryptosecession is fully realised once crypto technology catches up to balance opacity and legibility. At the point of fiscal equivalence there is no longer any incentive for crypto technological progress since exploitation is no more and governance is efficient. And by provoking secession, payoffs for each group fall, as they must duplicate the cost of public good provision in their respective polities. Moreover, it is difficult to imagine the situation where 50% of the economy could be hidden from the reaches of the state—or put another way, where the *de facto* crypto economy eclipses the *de jure* visible economy. Cryptosecessionist capabilities are currently very small, and likely to remain that way for some time. Polity-economies are well and truly still within the $\beta < \alpha$ range of the opacity-legibility technology spectrum, and thus gradual reduction of fiscal exploitation is more probable than impending political disintegration from excessive cryptosecession.

The results from the cryptosecession model mirror the results from the basic internal exit model when there are no agglomeration economies in private production and no scale economies in public provision. That is, *if* crypto technology is developed to the point that citizen opacity balances government legibility. Moreover, this occurs in the cryptosecession model under the more reasonable assumptions of *positive* agglomeration economies *and* scale economies. Cryptosecessionist partial internal exit overcomes the disadvantage of territorially moving from a larger polity-economy, which is characteristic of secession, as we know it. It is thus a more potent force for correcting inefficient allocations of policies, peoples, and polities than basic internal exit.

As discussed earlier, we have conceptualised what is a complex constellation of groups, jurisdictions, and transfers therein, as the interplay between the politically expedient (i.e., net transfer recipients) and the politically ineffective (i.e., net losers from the political process). But underlying this might be a compound federation or polycentric system of jurisdictions, albeit under the ultimate authority of an encompassing sovereign state. Likewise, in equilibrium, potentially many latent political groups are subject to optimal exploitation and thus do not agitate for political-jurisdictional change.

So while the outcome of the cryptosecession game is that neither secession nor cryptosecession obtain, this does not tell us what is the underlying political-jurisdictional order. There is ‘one polity’

in the sense that non-sharers do not create a separate new state in not seceding from sharers, but this does not mean, literally, that there is just one political entity or jurisdiction. Rather, whatever the initial jurisdictional order, non-sharers do not secede from it to create *additional* territorial jurisdictions, and neither do they partially secede from it to create *additional* non-territorial jurisdictions.

In the limit, where $\beta = \alpha$, there might exist many groups in multiple jurisdictions, but no group benefits at the expense of others, so there is no distinction to be made between sharers and non-sharers. There might even exist a structure of inter-group or inter-jurisdictional transfers, but on net they would necessarily negate each other for there to be fiscal equivalence. In fact, it is likely that the non-exploitative order would be polycentric, due to the inherent difficulty in centrally planning an optimally efficient jurisdictional allocation. We cannot say precisely what the underlying order of policies and jurisdictions looks like, merely that it is non-exploitative, and there is therefore no inducement to exploitation reducing, efficiency enhancing change.

Outside of equilibrium, however—following a change in model parameters, e.g. cost function $f(K)$, product function $g(K)$, or crypto technology legibility-opacity coefficients α and β —there is scope for political-jurisdictional change. Consider crypto technological progress $\beta \rightarrow \alpha$. An initial optimally exploitative political-jurisdictional order will transform into some new alignment of citizens and policies. This might take the form of an overall reduction in a non-discriminatory tax rate, or policy changes that remove discriminatory financing and provision arrangements, or jurisdictional changes that reorganise boundaries more efficiently (i.e., internal rebordering or transfer of responsibilities between political sub-units).

We have claimed that the model of partial internal exit presented here captures the dynamic of non-territorial decentralisation. There are two ways political-jurisdictional re-equilibration (e.g. following crypto technological change) can be related to non-territorial decentralisation. First, the capability of citizens to reconfigure their political memberships by switching between jurisdictions non-territorially incentivises incumbent institutions to dispense of inefficient or exploitative policies. In the cryptosecession model non-sharers are more sensitive to fiscal exploitation and incumbent governments must pay more heed to their threats of secession. And secondly, if non-territorial decentralisation does indeed promote an optimally efficient alignment of citizens and policies then the patterns of political-jurisdictional re-equilibration should reflect this. In responding to the threat of secession, the sharing coalition should permit non-territorial political relations to emerge. These are testable implications of the model: that the growth of cryptography-mediated internal exit will exert pressures for fiscal reform, and subsequent patterns of change will resemble to non-territorial forms. Additionally, governments may redouble their efforts at exploitation and seek to prohibit or regulate cryptosecessionist technologies and enterprises.

It is clear that increased burden of taxation, perverse regulations, poorly performing ‘official’ economies, and deficient quality of public goods and services are significant drivers of both crypto and shadow economies. But we must concede that cryptosecessionist technologies are currently underdeveloped and the crypto economy is trivially small compared to formal markets and even the informal shadow economy. World market capitalisation as of 2016 is estimated in the realm of 70 trillion US dollars, whereas crypto market cap is, approximately 7 billion dollars—or four orders of magnitude smaller, i.e., $\beta = 0.0001$ (Coin Market Cap 2016; World Bank 2016). The model presented here suggests that for fiscal exploitation to be eliminated the cryptosecession coefficient should converge on the official economy coefficient $\beta \rightarrow \alpha$ or $\beta \approx 50\%$. So it is equally clear that it could be some time before partial internal exit in turn becomes a significant driver of political-jurisdictional reform and reorganisation—notwithstanding a gradual reduction of fiscal exploitation is certainly possible.

How then do we characterise the current state of affairs? The stylised facts are that cryptosecession is trivially small relative to the official economy, and the informal economy is small as well but not insignificant. Our model indicates that the low prevalence of cryptosecession might correspond to a state of optimal exploitation or, on the other hand, non-exploitation. Given that cryptosecession happens at all, albeit uncommonly, it is unlikely that this could be evidence of non-exploitation. Rather, on first estimation we take this as implying optimally exploitative fiscal conditions (though perhaps close to the non-exploitative end) or as indicative that non-sharer groups are negligible in size compared to the sharing coalition.

If small groups of non-sharers do not contribute much to private product in the original polity (by way of agglomeration economies), then the sharing coalition will have less incentive to prevent secession. This could plausibly explain the persistence of crypto economies in spite of the model prediction that incumbent states should respond by modifying policies or jurisdictions to reduce fiscal exploitation. Likewise, informal economies are persistent and incumbent states have not responded as expected. And likewise, if informal sector non-sharers do not add appreciably to the individual private product of members of the sharing coalition—that is, the product function $g(K)$ is not increasing in polity size for these citizens—then they will be allowed to non-territorially secede to the shadow economy. If and when the product function changes to meet to the agglomeration economies assumption of our model (i.e., through development or as the crypto or informal economies increase in size) then perhaps the sharing coalition will again be incentivised to entice non-sharers back into the original polity, by lowering the tax rate or making policy changes that moderate fiscal exploitation.

Another possible explanation for small but persistent crypto and informal economies is that non-sharer perturbation and sharer re-equilibration does not happen instantaneously. We can thus

account some time to the adjustment process—partial internal exit might occur while the model is out-of-equilibrium, and precipitate an exploitation reducing re-equilibration and reintegration (i.e., lowering the tax rate or policy change or jurisdictional change). Moreover, we might expect patterns of change in re-equilibration to mirror the change of the initial perturbation. For instance, if cryptoseceders find that crypto technology has progressed in advance of the current cryptosecession-proof equilibrium, rather than simply waiting for the sharing coalition to respond they will partially exit to whatever crypto institutions have become available to them. If and when the government does respond, adjustments would likely emulate the temporary crypto institutions. That is to say, patterns of change resemble a co-evolutionary ebb-and-flow between permissionless cryptosecessionist innovations and government accommodations.

Finally, the persistence of crypto and informal economies could be due to asymmetries in information and diffusion of crypto technologies. The model assumes that all individuals in each group have identical cryptosecessionist capabilities; if this is not the case then the model results and implications might not hold. First, if non-sharers have differential access to crypto technologies (among themselves) then this could generate ongoing bouts of cryptosecession and accommodation. As each non-sharer subgroup gains access to the technology their threat of cryptosecession becomes credible, and only then will government respond—resulting in a lumpy and piecemeal pattern of political-jurisdictional change. Thus the model might be extended so that sharers and no-sharers have differential access to the crypto technology $\beta^1 \neq \beta^2$ and incomplete knowledge of each other's capabilities. The most obvious scenario to investigate is where non-sharers have superior crypto technologies $\beta^2 > \beta^1$ and sharers have limited knowledge of this, perhaps wrongfully assuming equal capabilities $\beta^2 = \beta^1$. An interesting variant of this would be to model sharers as having no cryptosecession capability $\beta^1 = 0$ and $\beta^2 > 0$, while assuming the same of sharers $\beta^2 = \beta^1 = 0$ (i.e., no knowledge of cryptosecession).

Like the Buchanan and Faith (1987) paper, we have titled this paper '*Toward* a theory of non-territorial internal exit,' because the assumptions underlying our basic model are rather restrictive. Despite this, the implications derived are both interesting and potentially relevant, especially if the promises of cryptoanarchy are realised. The inclusion of the capability to partially and non-territorially shift political-economic activity among jurisdictions reduces fiscal exploitation over the basic internal exit mechanism. And the balance of citizen opacity and government legibility ultimately determines the balance of fiscal exploitation versus equivalence. To paraphrase Buchanan and Faith (1987) a final time—the non-territorial secession models presented in this paper provide a useful basis for more complex analyses of how the prospect of non-territorial decentralisation might exert limits on the taxing proclivity of government.

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