Persistently Inefficient?
The Common-Agency Problem and Organizational Fragmentation in the US Healthcare System

by

Brigham Frandsen,
Brigham Young University

Michael Powell,
Northwestern University

James B. Rebitzer,
Boston University
National Bureau of Economic Research, and IZA

December 2014

PRELIMINARY AND INCOMPLETE: PLEASE DO NOT CIRCULATE

Abstract

Inefficient organizational fragmentation is an old theme in health care policy and motivates recent policies designed to promote more integrated care delivery. But if fragmented delivery is inefficient, what market failure can explain its persistence? What implication does this market failure have for public policy? We offer a model of contracting between payers and providers that addresses these questions. The market failure we highlight is a "common-agency" problem in which multiple payers write contracts with a common agent, the provider.

In a fragmented healthcare system, moving to integrated care delivery requires significant up-front investments by providers. In our model, common agency can cause payers to offer inefficient contracts, i.e. contracts that fail to provide incentives sufficient to induce these investments. Our model also identifies channels through which policy can promote efficient contracts. We find that some of the features of the Affordable Care Act such as Accountable Care Organizations are sensible responses to the common-agency market failure. We also find that short-run policies can jumpstart long-run changes that persist even after the initial policy is reduced or rescinded. Promoting efficient integrated care may thus be less costly than previously supposed.

Introduction:

The U.S. health care system suffers from numerous and significant inefficiencies (Katherine Baicker and Amitabh Chandra 2011). Although the precise causes of these inefficiencies are poorly understood, much attention in academic and policy discussions has focused on the problem of organizational fragmentation (Francis J. Crosson 2009; Randall D. Cebul, James B. Rebitzer, Lowell J. Taylor and Mark E. Votruba 2008; Moses H, III, Matheson DM, Dorsey E, George BP, Sadoff D,Yoshimura S. 2013; David Blumenthal 2011). Organizational fragmentation refers to the difficulties that result when care delivery is spread across too many independent providers leading to poor coordination, high costs and low quality. The inefficiencies are worse when the providers are working as independent owners of small practices, and they are especially severe for patients with the chronic conditions that account for the bulk of U.S. health care expenditures.

The problem of organizational fragmentation poses an important challenge for economics. If fragmentation is truly associated with meaningful inefficiencies, one would expect the normal process of competition to force fragmented organizational forms out of the market (George J. Stigler 1958). Why didn't this happen? One possible answer is that the claimed inefficiencies of fragmentation are overstated. Another possibility, however, is that there are factors inhibiting the operation of normal market forces. [1]

We analyze this second possibility via a theoretical model of market failures in contracting between payers and providers. Our model rests on two assumptions: (i) that the transition from fragmented to integrated care delivery requires costly, discrete investments on the part of providers; and (ii) that provider incentives for making these investments depends on the contracts they have with *all* their payers. This latter feature is often referred to as a "common agency" problem because multiple principals

[1] In earlier eras one could have pointed to legal strictures that sustained fragmentation – especially the corporate practice of medicine laws that made it illegal for physicians to be employed by other organizations, especially hospitals (James C. Robinson 1999). The legal impact of these laws, however, has nearly disappeared over time – so other explanations are required (Randall D. Cebul, James B. Rebitzer, Lowell J. Taylor and Mark E. Votruba 2008; James B. Rebitzer and Mark E. Votruba 2011) .

are simultaneously trying to influence the behavior of a common agent. The fact that provider incentives depend on the contracts written by numerous payers makes the common-agency problem potentially more severe than conventional moral hazard and it produces a distinct market failure. Specifically, common agency creates the possibility of a coordination failure between payers that yields an equilibrium in which payer contracts do not provide incentives for efficient investments. In the absence of adequate incentives, providers do not undertake requisite investments and so the delivery system can remain stuck in an equilibrium where providers operate within inefficiently fragmented organizations. In addition to explaining the persistence of inefficient organizational forms, our approach also identifies new channels through which policy can promote efficient contracts.

To place the analysis in proper context, we note that many of the ostensible disadvantages of fragmented care delivery can be mitigated by integrated care organizations, yet integrated care organizations in the United States have been for many decades, islands in a sea of fragmentation. In 1933 the Committee on the Cost of Medical Care, a blue ribbon commission investigating the cause of the then-high cost of health care, recommended that comprehensive medical services be provided by structured groups of providers, preferably organized around hospitals. This vision of a "corporate practice of medicine" was in sharp contrast to the then-prevalent model of general practitioners delivering care as autonomous professionals working in their own offices (Joseph S. Ross 2002).[2]

An analysis of the modern healthcare system by Baker, Bundorf and Royalty (2014) points to a continued paucity of integrated care delivery. They estimate that as late as 1998, 29% of physicians worked in solo practices and 55% in practices of 9 or fewer physicians. This contrasts with only 19% of physicians being employed in practices having 50 or more physicians. Since the beginning of this

[2] The Committee on the Costs of Medical Care was concerned with making care affordable in an era where health insurance was generally not available. The majority recommendation discussed above was rejected by the American Medical Association as "incitement to revolution." Minority proposals from the committee were much better received. These emphasized restoring the general practitioner to a central place in medical practice and rejecting the "corporate practice of medicine as wasteful and inimical to high quality and unfair exploitation of the medical profession" (Joseph S. Ross 2002 page 131). For an extended discussion of the law and controversies surrounding the corporate practice of medicine see (James C. Robinson 1999).

century, physicians have slowly migrated towards larger practices so that by 2010, 18% were solo practitioners and only 40% worked in practices of 9 or fewer physicians. (Laurence Baker, Kate Bundorf and Anne Royalty 2014 Table 1). In spite of this migration a great deal of care is still delivered via small practices. According to the 2010 National Ambulatory Care Survey, 31.5% of office visits were to solo practices, and 67.5% were to offices with five or fewer physicians. Only 22.6% of office visits were to multi-specialty groups (Centers for Disease Control 2010, Table 2). There is some evidence of a sharp increase in the fraction of physicians who are office-based but affiliated with hospitals since the year 2000 (Moses H, III, Matheson DM, Dorsey E, George BP, Sadoff D,Yoshimura S. 2013)), but it is not yet clear whether growing hospital affiliations reflect true integration in the delivery of care. (Lawton R. Burns and Mark V. Pauly 2012; 2002).[3]

Another relevant bit of institutional context concerns information technologies. The U.S. medical system badly lagged other economic sectors in the use of information technology and also lagged the health care systems of other industrialized nations including the UK, the Netherlands, Scandinavia, Australia and New Zealand. "As of 2008, only 17% of physicians and 12% of hospitals had basic or fully functional electronic health records." (David Blumenthal 2011 p. 2323). There is, at present, no generally accepted explanation for these lags, but organizational fragmentation likely plays a contributing role as small physician practices operating independently from hospitals had difficulty covering the large fixed costs entailed by these technologies. In addition to the economies of scale issue, information technologies are important complements to integrated care delivery. Market failures that inhibit the formation of information of integrated care delivery organizations may also slow the demand for health information technology.

In response to the slow pace of change, the Affordable Care Act introduced a number of initiatives intended to facilitate a move from fragmented to integrated care delivery. Of these, the most

[3] Burns and Pauly (2012) observe that in the Integrated Delivery Networks of the 1990s, many hospitals purchased physician practices, but true integration and care coordination was not achieved and, as a result, these initiatives largely failed.

important is the creation of Accountable Care Organizations (ACOs). ACOs are entities comprised of hospitals and/or other providers that contract with the Center for Medicate Services (CMS) to provide care to a large bloc of Medicare Patients (5,000 or more). Although the details vary and are complex, ACOs that come in under their specified cost benchmarks keep a fraction of the savings conditional on meeting stringent quality standards.

Integrated delivery systems such as Kaiser Permanente and Geisinger Health Systems can form ACOs, but loosely affiliated networks of providers can also become ACOs. These latter ACOs typically lack a large, salaried multispecialty group of physicians; they may or may not have a hospital as part of the entity, and they may or may not have experience in managing contracts that deviate from the fee-for-service norm. Allowing loosely affiliated networks to form ACOs greatly expands the potential reach of the policy. Moses et al. report that there are more than 300 ACOs established in most regions of the United States with 8% of Medicare patients eligible to be served, with a goal to have one-third of the Medicare recipients enrolled by 2018. The effects of the program are not limited to Medicare. ACOs are also expected to develop similar contracts with private insurers – thereby spreading cost-effective, integrated care throughout the health care system.

As a public policy intervention, ACOs are essentially a commitment by Medicare to engage in a new form of contracting with providers. But we currently do not have a clear understanding of how Medicare's new commitment would help spur change throughout the healthcare system. After all, commercial insurers could have written ACO-like contracts with providers independent of the change Medicare's contracting practices. Why didn't this happen before and why would an ACO program make such contracting more likely? Our model offers an answer to this question that builds on two important assumptions.

The first key assumption that there are efficiency gains from organizing fragmented providers into an ACO-like, integrated entity, but that this sort of reorganization requires, substantial up-front investments by providers. A partial list of these includes investments in health information technology

infrastructure and electronic health record systems and clinical decision making support; investments in managerial and financial systems such as payment methods, prospective budgets and resource planning, measures of provider performance, methods of disbursing shared savings to providers and back office assistance; investments in new organizational processes such as care coordination across service settings, providers and specialties; and investments to create new standards of care and protocols that focus more on primary care physicians and non-physician providers as well as patient wellness and prevention (Lawton R. Burns and Mark V. Pauly 2012). As this list makes clear, some of the investments required to create integrated delivery involve tangible assets, but others require much less-tangible efforts at restructuring relationships between providers.

The second key assumption of our model is that each provider is an agent acting on behalf of a number of payers and that coordination of pay practices among payers is difficult. The significance of being a common agent is that provider incentives to invest are determined by the collective effect of *all* the incentive contracts they have with *all* their payers. If each payer believes it will be the only one to offer contracts with powerful incentives for cost savings, then it can be sure it will not be able to induce providers to invest, so it will be better off sticking with the traditional fee-for-service contract. Put differently, resolving the common-agency problem requires coordination among payers about contract terms. Such coordination is hard to achieve, in part because of anti-trust laws that aim to discourage collusion and in part because of other factors we analyze below.

From this perspective, public policy can operate by enabling coordination among payers. For example, if Medicare, the largest single payer, is committed by law to fee-for-service contracts, the private insurance market can more easily coordinate around fee-for-service. Alternatively if a new policy regime publicly commits Medicare to share cost savings with ACO-like integrated entities, this can make it easier for private insurers to coordinate around contracts that promote the formation of more efficient, integrated delivery organizations.

The core of our argument – that integration in a fragmented *healthcare delivery system* requires substantial up-front investments and that these may not be forthcoming when the *health insurance* system has weak incentives to control costs - will be familiar to many physicians, health services researchers, health economists and other observers of the health care scene. Up until now, however, explanations for the persistence of such inefficient pay practices have been made casually without a clear model of relevant market failures.[4]

There are a number of advantages to explicitly modeling this market failure. First, the model highlights specific mechanisms by which ACOs, subsidies for health information technology and other public policy initiatives might succeed in promoting more efficient health care delivery. Secondly, the model suggests that the common-agency market failure has subtly different effects depending on the nature of the action the incentive contracts are trying to elicit and that these differences matter for policy interventions. Third, our analysis offers new insights into the prospects for using public policy to slow the rate of growth of *future* health care costs by creating sustained demand for cost-reducing innovations.

A final contribution of this analysis is to expand the theoretical toolkit of applied researchers studying the health care system and health care policy. The "common agency" models we present have been studied since the mid-1980s, are well suited to analyzing provider-insurer relationships, but have not been applied in the health care setting to our knowledge.[5] The prior literature on common agency has also abstracted from the coordination failure problems that are so central to explaining persistent inefficiencies in the health care setting. Similarly, our analysis of public policy interventions relies on

---

[4] Crosson (2009), for example, makes a similar argument informally in the *New England Journal of Medicine*. Another noteworthy example is Burns and Pauly (2012) who argue that the decline of the ACO-like Integrated Delivery Networks of the 1990s was the due in part to the absence of sufficient up-front investments combined with the fact that the networks entered capitated contracts on a piecemeal basis with only a few payers. Blumenthal (2011) argues that the fee-for-service payment system fails to reward improved efficiency that investments in health information technology enable.

[5] The seminal paper is Bernheim and Whinston (1986). Much of the subsequent literature on common-agency models focuses on problems of lobbying and influence in political settings. See for example Dixit, Grossman, and Helpman (1997), Besley and Coate, (2001); and Kirchsteiger and Prat (2001). Other prominent applications include Prat and Rustichini (2003).

recent developments in the theory of dynamic coordination games that have not been widely applied in the healthcare setting.

The paper proceeds as follows. In section one we introduce a simple framework for analyzing common-agency problems. In section two, we specialize the model to analyze the coordination failures that arise when payers use incentive contracts to induce providers to make discrete investments in integrated care. We find that Accountable Care Organizations are a reasonable response to the distortions induced by the common-agency problem. In section three we analyze how common-agency problems influence incentives to supply effort to incremental process improvements and cost-containment efforts. This version of the problem is most relevant to the operation of ACO like organizations once they have been established (Brigham Frandsen and James B. Rebitzer 2014). In these settings common agency also produces contracts with less than optimal incentives for reducing costs, but the market failure is subtly different and this has somewhat distinct, implications for policy. In section four, we examine dynamic aspects of common-agency induced coordination failures. We find in this setting that short-run policy interventions promoting integrated care can have long-run consequences. An important implication of this result is that fixing inefficiencies associated with coordination failures may be cheaper and easier than fixing inefficiencies associated with conventionally misaligned incentives (Katherine Baicker and Helen Levy 2013; DM Cutler and F. Scott Morton 2013). We conclude by assessing the limitations of our analysis as well as its implications for future work.

I. Common-Agency Problems: A Simple Framework

In this section we sketch out a simple framework and notation for analyzing common-agency problems. The key features of this set-up are that multiple payers attempt to influence the actions taken by a common agent, the provider. Payers set their contracts non-cooperatively and simultaneously and this leads to problems above and beyond those that arise in conventional-agency settings involving a single principal and single agent.

There is one risk-neutral provider, agent A, and N risk-neutral principals, payers P_1 through P_N. The provider chooses an effort level $e \in E \subset [0,1]$ at cost $c(e) = ce^2$, that affects the probability that a cost-saving investment is successful. Denote the outcome of this investment by the random variable $\tilde{y} \in \{0, y\}$ where $\tilde{y} = 1$ denotes a success, and assume $Pr[\tilde{y} = 1|e] = e$. Each payer receives a benefit of $\frac{B}{N}\tilde{y}$, where B represents the total cost savings resulting from a successful investment. The payers simultaneously offer contracts to the provider that are, without loss of generality a linear function of $\tilde{y}$. We write P_i's contract as $w_i = s_i + b_i\tilde{y}$, which we also summarize by (s_i, b_i). We also impose the restriction that $b_i \geq 0$, meaning that payers write contracts that reward investment but they do not write contracts that penalize investment.

The provider can either accept all contracts or reject them all, in which case all payers and the provider receive a payoff of 0.[6] If the contracts are accepted, payer P_i incurs a cost that increases with the incentive intensity of the contract, $k(b_i) = kb_i$. One can think of this cost as the costs to insurers of negotiating new agreements and understandings with providers as well as the costs of negotiating and implementing quality metrics and standards. Higher powered contracts require parties to anticipate more contingencies and agree on obligations under these contingencies. To the extent that agreeing on each contingency and obligation requires time and effort, then it is reasonable to think that negotiation and implementation costs rise with incentive intensity (Pierpaolo Battigalli and Giovanni Maggi 2002) .[7]

If the provider accepts the contracts, payer $P_i's$ expected payoff is $\frac{B}{N}e - s_i - b_ie - k(b_i)$. The payoff to the provider from choosing effort e is: $\sum_{i=1}^{N}(s_i + b_ie) - c(e)$. In a common-agency game such as this one, the payers *simultaneously* offer contracts to the provider, and the offers are commonly observed. If the contracts are accepted the payers incurs set-up costs as described above while the

[6] Many other papers in the common-agency literature examined this setting which, in the vocabulary of the common-agency literature, is known as an *intrinsic* common-agency problem. In future work we hope to explore the less theoretically explored setting in which the provider can reject some contracts and accept just a subset.

[7] These costs are not necessary for the existence of coordination failures that are our central focus. They are, however, an important ingredient in the "free-rider" version of the model with continuous actions that we present in Section III.

provider chooses an action and incurs the costs of the action. The savings are commonly observed as are the payments to the provider under the incentive contracts.

Given contracts (s_1, b_1), …, (s_N, b_N), the provider chooses an effort level $e^*(b_1, \ldots, b_N)$ to solve

(1) $\max_{e \in E}\{(\sum_{i=1}^{N} b_i)e - ce^2\}$

We assume that, when indifferent, the provider chooses the highest effort level he is indifferent among. Payer $i's$ problem is to choose contract terms that elicit a desired effort level *given the other payers' contracts*, w_{-i}. Formally P_i chooses $\tilde{e}, \tilde{s}_i, \tilde{b}_i$ to maximize $\frac{B}{N}\tilde{e} - \tilde{s}_i - \tilde{b}_i\tilde{e} - k\,\tilde{b}_i$ subject to the incentive compatibility constraint, $\tilde{e} = e^*(\tilde{b}_i, b_{-i})$, and the individual-rationality constraint, $\tilde{s}_i + \tilde{b}_i\tilde{e} + \sum_{j \neq i}(s_j + b_j\tilde{e}) - c(\tilde{e}) \geq 0$.

In this common-agency game, a pure-strategy subgame-perfect equilibrium with participation is a vector of contracts $(w_1^*, \ldots, w_N^*)$ and an effort level e^*such that e^* is consistent with the provider's incentive-compatibility constraint, and given w_{-i}^*, P_i optimally offers w_i^*, and the provider optimally accepts the contracts. We say that $e^*$is an equilibrium effort level if it is part of an equilibrium .

II. Common-Agency Problems and Coordination Failures

2.1 Discrete Investments:

In a fragmented healthcare delivery system, integrated care delivery requires providers to make significant investments in management and information systems required to run a large scale organization. There is little value in having a fraction of a complete IT infrastructure or a fraction of a complete quality improvement system, and so we focus our initial analysis on agents making discrete, up-front investments. Payers may coordinate around inefficient contracts that fail to provide adequate incentives to invest or they may coordinate around efficient contracts that provide adequate incentives.

Formally we represent the provider's effort space as $E = \{0,1\}$ and we assume that $B(1 + k) > c$, so that making this discrete investment is efficient. We further assume that $B < N(1 + k)c$. This

assumption assures that this is a common-agency problem, i.e. that no payer has the unilateral incentive to induce investment. Since $= \{0,1\}$, we can write the cost function as $c(e) = ce^2 = ce$.

Given contracts (s_1, b_1), …, (s_N, b_N), the provider chooses

(2) $e^*(b_1, \dots, b_N) = \begin{cases} 1 \ if \ \sum_{i=1}^{N} b_i \geq c \\ 0 \ if \ \sum_{i=1}^{N} b_i < c \end{cases}$

Given the other payers' contracts w_{-i}, P_i will want to offer a contract that induces the provider to choose the target level of effort, while minimizing the contracting costs she incurs. That is given a target e, P_i will set the incentive pay parameter as follows:

(3) $\tilde{b}_i = \begin{cases} 0 & if \ e = 0 \\ c - \sum_{j \neq i} b_j & if \ e = 1 \end{cases}$

It follows that $P_i's$ incentive-design problem is equivalent to P_i directly selecting e to maximize surplus, $\left(\frac{B}{N} + \sum_{j \neq i} b_j - c + k\left(\sum_{j \neq i} b_j - c\right)\right) e$.

The obvious solution to this problem is:

(4) $e^* = 1 \ if \ \sum_{j \neq i} b_j \geq c - \frac{B}{N} \frac{1}{1+k}$ with $b_i^* = c - \sum_{j \neq i} b_j$ or

$e^* = 0 \ if \ \sum_{j \neq i} b_j \leq c - \frac{B}{N} \frac{1}{1+k}$ with $b_i^* = 0$.

Note that expression (4) identifies two equilibrium effort levels and the low effort level, $e^* = 0$, corresponds to an outcome where no providers invest in integrated care because the cumulative power of the payers' incentives are too low.

2.2 An Example with Two Payers:

To build intuition, we present Figure 1 that depicts the equilibrium outcomes with only two payers. Specifically Figure 1 plots $P_1's$ optimal choice of b_1 (in blue) given a contract by P_2, and it plots $P_2's$ optimal choice of b_2 (in red) given a contract by P_1. Any point at which there is overlap between the blue and the red lines constitutes an equilibrium. In particular, $b_1^* = b_2^* = 0$ is an equilibrium, and so is any (b_1^*, b_2^*) with $b_1^*, b_2^* \geq \ c - \frac{B}{2} \frac{1}{1+k}$ and $b_1^* + b_2^* = c$.

The equilibrium $b_1^* = b_2^* = 0$ occurs when the two payers coordinate around contracts that offer providers minimum incentives to make the up-front investments required to move from fragmented to integrated care delivery. One can think of this equilibrium as representing the longtime status quo in the US healthcare system where Medicare as well as commercial insurers operated with fee-for-service contracts that offered minimal incentives to deliver care in a cost-effective manner. The remaining equilibria, represented by (b_1^*, b_2^*) with $b_1^*, b_2^* \geq\ c - \frac{B}{2}\frac{1}{1+k}$ and $b_1^* + b_2^* = c$, all involve incentives powerful enough to induce upfront investments in efficient integrated care delivery.

More generally, the equilibrium involving $b_i^* = 0$ for each payer is Pareto dominated by the other equilibria in the common-agency game. The market failure sustaining this equilibrium arises from legal and other barriers to payers forming binding commitments on how to pay the common provider. Should payers coordinate around $b_i^* = 0$, the healthcare system will not undertake efficient investments in integrated care delivery. From the perspective of this model, the job of public policy is to get payers to coordinate around more efficient equilibria. This requires an analysis of the conditions under which the inefficient equilibria will be selected.

2.3 Severity of the Coordination Problem and Minimum Cost Subsidies:

If common agency problems can give rise to coordination failures, it is helpful to assess when these failures are more or less severe. In this analysis, we use the term severity in two related senses. In the first sense, we imagine a social planner willing to pay subsidies to ensure that all payers coordinate around efficient contracts in all equilibria. We say that the coordination problem is more severe the greater the minimal subsidy required by the planner. [8] In the second sense of the term, we say that the coordination failure is more severe the greater the likelihood that the payers will coordinate around the

[8] For discussions and applications of this minimal subsidy idea see Sakovics and Steiner (2012) and Bernstein and Winter (2012).

inefficient equilibria with $b_i^* = 0$. As we demonstrate in an appendix, common equilibrium selection rules increasingly favor inefficient equilibria as the size of the minimum cost subsidy increases. [9]

The value of the minimum subsidy is quite simple to derive in a static, one-shot game. It is the subsidy required to ensure that at least one payer, P_i , will choose $e^* = 1$ even if all the other payers choose to set b equal to zero. This will be true so long as the subsidy to payer i, τ_i, exceeds $(1+k)c - \frac{B}{N}$. That is, any subsidy vector from the following set implements $e^* = 1$ as the unique equilibrium action by providers:

(5) $T = \left\{(\tau_1, \ldots, \tau_N): \tau_i \geq (1+k)c - \frac{B}{N} \text{ for some } i\right\}$.

The policy maker's problem is therefore to minimize the sum of subsidies paid out $\min_{\tau \in T} \sum_{t=1}^{N} \tau_t$, and the optimal solution is

(6) $T^* \equiv (1+k)c - \frac{B}{N}$,

which can be paid to any single payer.

2.4 Discussion

We can use equation (6) to identify conditions under which coordination failures due to common agency are more or less severe. Specifically, the larger is T^*, the minimum subsidy required to coordinate around efficient contracts, the more severe is the coordination failure.

The most striking implication of (6) is that, all else equal, the more payers that have to coordinate, the larger is T^*. Intuitively this means that coordination failures in common agency settings become

[9] There is no generally accepted equilibrium selection rule for coordination games, although there are a few commonly used approaches. The risk dominance selection rule, for example, considers each players best response when the other is equally likely to play her strategies. The risk dominant equilibrium is one where both players play their risk dominant strategy (John C. Harsanyi and Reinhard Selten 1988; Russell Cooper, Douglas V. DeJong, Robert Forsythe and Thomas Ross 1992; Russell Cooper, Douglas V. DeJong, Robert Forsythe and Thomas Ross 1990). In the appendix, we demonstrate that a risk dominant equilibrium selection criteria increasingly favors inefficient outcomes as the minimum cost subsidy increases. An alternative but related approach to equilibrium selection in coordination games is to consider basins of attraction. Intuitively, the larger the basin of attraction around an equilibrium the more likely it is that the equilibrium will emerge spontaneously. In the appendix we also consider basins of attraction as an equilibrium selection rule. We find in this case as well that as the minimal subsidy increases, the equilibrium selection rule increasingly favors the inefficient equilibrium.

more problematic as the number of payers increases. This result creates a link between the structure of the payment side of the market and the difficulty of moving from a fragmented to an integrated care delivery. This result also suggests a plausible channel through which Medicare's Accountable Care Organization program might lead to more efficient care delivery. When Medicare commits to introducing incentive contracts via Accountable Care Organizations, this reduces the number of remaining payers that have to coordinate thus making the common-agency problem among commercial insurers less severe.

Another channel through which Medicare's actions can effect efficiency throughout the system is captured by parameter, k, the set-up costs to payers of moving away from minimal cost containment incentives towards contracts that reward cost efficiency. As we have mentioned, these costs involve the negotiation of new terms with providers about the form of the contract, the collection of data on care quality and the formulation of quality standards. These costs might be significantly reduced if Medicare's ACO program comes up with a form of compensation and with quality metrics that private sector payers can adopt with minimal modification. Since there is little scientific or social consensus around quality measures and standards, the legitimacy of Medicare's endorsement of particular measures and standards may also speed negotiations. In these ways Medicare's leadership in formulating the rules and regulations around ACOs can facilitate private payers' ability to coordinate around efficient incentive contracts.

Equation (6) also has implications for one of the major initiatives early in the Obama presidency- the large-scale subsidy of investments in health information technology via the Health Information Technology for Economic and Clinical Health Act. This Act set aside up to $29 billion over ten years to support the adoption and meaningful use of electronic health records (David Blumenthal 2011).[10] By

[10] At the time these subsidies were justified by the observation that the state of health care information technology badly lagged the rest of the economy and that small physician offices could not, on their own, afford the substantial fixed costs such investments entail. Public subsidies of health IT were also seen as part of the larger fiscal stimulus required to combat the very early stages of the severe 2008 recession (David Blumenthal 2011).Some of this money was made available via extra Medicare and Medicaid payments to providers who

reducing the cost of providers' investments in integration, c, these subsidies cause T^* to fall and thus increase the likelihood payers will coordinate around efficient contacts that can induce a transition from fragmented to integrated care delivery.

Equation (6) also suggests that the historical tax treatment of insurance policies in the United States facilitates coordination around inefficient contracts. In the current employer-based health insurance system, insurance premiums are not treated as taxable income for employees. Without these tax breaks, savings from delivering healthcare more efficiently accrue to employees in the form of lower premiums. The value of these savings is partially offset, however, by the fact that the fall in insurance premiums also reduces the size of the tax breaks employees receive. The easiest way to represent this tax-based distortion in our model is as a reduction in parameter, B, i.e. as a reduction in the value of savings from more efficient care delivery. Reducing B has the effect of increasing T^* and hence, ceteris paribus, of increasing the likelihood that insurers will coordinate around inefficient, minimally powered, incentive contracts.

We note in passing that equation (6) can, at least in principle, be tested with the roll-out of Accountable Care Organizations. Already-integrated providers may find it easy to form ACOs, because they have made their investments in integration, but fragmented providers will face the sort of decision problem our model describes. It follows from this that fragmented producers will be more likely to succeed in forming ACOs in markets where: (1) Medicare has a larger share of the insurance market and where the remaining insurance market has fewer payers; (2) subsidies to heath IT and related investments are greatest; and (3) where the tax breaks for insurance coverage are the lowest.

---

became meaningful users of electronic health records, but other funds went to set up a set of regional extension centers to help providers adopt technology and also to train health information technology professionals.

III. Common-Agency Problems and Free Riding

The previous section analyzed how common-agency problems shaped incentives for making the discrete investments required to move from fragmented to integrated care delivery. In this section we examine how common agency influences incentives to supply effort to incremental process improvements and cost-containment efforts. This problem is most relevant to the operation of ACO like organizations once they have been established (Brigham Frandsen and James B. Rebitzer 2014). As in the case of discrete investments, we find that common agency leads to sub-optimal cost-containment incentives, but these results are not due to a coordination failure between payers. Rather there is a unique equilibrium solution to the problem that involves an externality or "free riding". The externality can be resolved by public policy subsidies, and the requisite subsidies will sometimes be larger than those required to resolve the coordination failure analyzed in section 1.

3.1 Setup and Results

Consistent with conventional effort supply analyses, we suppose that the provider's efforts are continuous: $E = [0,1]$ and $B < c$ (to ensure interior solutions), so that the first-best effort solves $\max_e Be - c^2$, and is given by $e^{FB} = B/(2c)$. Given contracts $(s_1, b_1), \dots, (s_N, b_N)$, the provider chooses

(7) $e^*(b_1, \dots, b_N) = \frac{1}{2c}\sum_{i=1}^{N} b_i$.

Next, given w_{-j}, P_i solves

(8) $\max_{\tilde{b}_i} \frac{B}{N} e^*(\tilde{b}_i, b_{-i}) + \sum_{j \neq i} b_j e^*(\tilde{b}_i b_{-i}) - c e^*(\tilde{b}_i b_{-i})^2 - k\,\tilde{b}_i$.

We allow P_i to directly choose e (at minimum cost). That is, given a target e and given (s_j, b_j), P_i will set $\tilde{b}_i = 2ce - \sum_{j \neq i} b_j$. P_i's unconstrained problem then becomes:

(9) $\max_{e \in [0,1]} \frac{B}{N} e + \sum_{j \neq i} b_j e - ce^2 - k\left(2ce - \sum_{j \neq i} b_j\right)$

which is an equivalent problem to

(10) $\max_{e\epsilon[0,1]} \left(\frac{B}{N} + \sum_{j\neq i} b_j - 2kc\right) e - ce^2.$

The problem in (10) is concave, so we can characterize P_i's optimal choice of e by her first-order conditions:

(11) $e^* = \frac{B/_N + \sum_{j\neq i} b_j}{2c} - k.$

In equilibrium, all P_i have to choose the same e^*. Therefore for all i, $b_i^* = b$, so that (since $b^* = 2ce - \sum_{j\neq i} b_j^*$), $b_i^* = \frac{2}{N} ce$, and therefore the unique equilibrium effort level will be:

(12) $e^* = \frac{B}{2c} - Nk.$

The first term on the right hand side of (12) is first-best effort. The second term reflects the costs to the payers of implementing higher powered cost containment incentives that elicit more effort. This cost increases with the number of payers trying to motivate the provider.

3.2 Discussion

Clearly the effort that emerges out of the common-agency problem is less than first-best effort that would arise if there were no contracting costs or $k = 0$. This is another way of saying that the incentives in the common-agency model are weaker than first-best incentives. Equation (12) also suggests that these incentives become progressively weaker as: (1) the number of payers interacting with the provider increases; (2) the cost of effort increases; and (3) the saving accruing to payers from cost-containment efforts increase.[11] These results are analogous to the results we found in section 1, where we found the likelihood of coordinating around inefficient contracts increased with the same three factors. An important difference in this case is that there is no coordination failure in this common-agency problem but rather a unique equilibrium effort level.

The analysis of the common-agency problem in this section differs from Section 1 only in that it allows for continuous rather discrete actions by providers. The differences between the analyses occur

[11] Points (2) and (3) are also true about first-best effort levels.

because discrete actions introduce a strategic complementarity in payer incentives: if one payer knows others will offer high-powered incentives, this increases their own payoff for acting similarly. Continuous actions, in contrast, make payer incentives strategic substitutes and this allows for a free-riding problem to emerge: if other payers offer higher powered incentives to providers, this tempts any individual provider to offer contracts with lower powered incentives. In the equilibrium that results, all payers' incentives will be "too low".

The emergence of free-riding problems subtly alters the workings of public policy interventions aimed at ameliorating common agency. To see this, it is helpful to consider once again the magnitude of the minimum cost subsidy required to resolve the inefficiencies from the common-agency problem. The government offers a subsidy, τ_i to P_i if $\tilde{y} = 1$. The firm's program then becomes

$$(13) \qquad \max_{e\epsilon[0,1]} \left(\frac{B}{N} + \tau_i + \sum_{j\neq i} b_j - k2c\right) e - ce^2 \text{ so } e^* = \frac{{}^{B}/_{N} + \tau_i + \sum_{j\neq i} b_j}{2c} - k$$

Remembering that all P_i have to choose the same e^* it is straight-forward to show that each payer will receive the same subsidy. Define T^* to be the minimum cost of all subsidies required to resolve the common-agency problem, i.e. to achieve the effort levels that could be achieved with a single payer (N = 1). It is similarly straight-forward to prove that:

$$(14) \qquad T^* = 2c(N-1)k.$$

Comparing (14) to (6) it is clear that the type of market failure (coordination failures or externality) matters for public policy interventions. The subsidies required to resolve the coordination failure in Section 1 can be paid to a single payer. In the free-riding problem in this section, however, subsidies must be paid to all payers. As a result, as the number of payers increases, the cost of the minimum-cost subsidies required to resolve common-agency problems grow faster for the free-riding problem. Specifically, so long as $N > \left(\frac{B}{2ck}\right)^{1/2}$, the subsidies needed to resolve the free-riding problem exceed those required to resolve the coordination problem.

In the next section we introduce dynamic considerations and these point to other reasons why resolving coordination problems might be less expensive than resolving free-riding problems.

IV. Common-Agency Problems in a Dynamic Setting.

In this section of the paper we examine dynamic aspects of common-agency induced coordination failures. Modeling dynamics is important for two reasons. First, it offers insights into whether ACOs and other policies aimed at promoting integrated care can achieve the goal of slowing the rate of growth of healthcare costs (David Cutler 2010). Secondly, a dynamic approach to coordination failures reveals features of the model that matter for understanding public policy. Specifically, our dynamic model suggests that short-run policy interventions can have long-run consequences. As a result, costly policy interventions aimed at ameliorating common-agency induced coordination failures may be quicker and cheaper than fixing inefficiencies associated with conventionally misaligned incentives (Katherine Baicker and Helen Levy 2013; DM Cutler and F. Scott Morton 2013).

Slowing the Rate of Growth of Healthcare Costs: Our analysis so far has focused on a single investment in integrated care whose benefits accrue to a stable set of payers. This approach, while tractable, overlooks the fact that today's investments in building Accountable Care Organizations are only a prelude to continued and on-going investments in health information technology, management systems and other process improvements required to "bend the cost curve. Sustaining such a sequence of investments is greatly complicated by the fact that the set of payers who must coordinate to motivate any individual provider changes regularly.[12] The fact that a current set of payers coordinate around efficient

[12] Some of this turnover is the result of the normal process of exit and entry of insurers into local markets, but some results from the fact that patients with ongoing relationships with providers also change insurance companies – sometimes with great frequency. If, for example, a patient changes jobs and moves from one self-insured employer to another, this may introduce an entirely new insurer into the set of insurers trying to influence provider behavior. A similar change of insurers can take place if the patient stays at his or her current job, and the employer switches from one insurance company to another. Cebul et al. (2011) report one-year cancellation rates for private, commercial insurance plans of 21%. Of these 21%, 87% had acquired a new private policy, while 10%

cost-containment contracts is no guarantee that a different future set of payers will achieve such coordination.

The static analyses we have so far conducted are not adequate for analyzing a sequence of investments that require *present and future* coordination between payers around efficient cost-containment contracts. Rather, a dynamic model is required. We present such a dynamic model in the next section.

4.1 Overlapping Generations

In this section, we build upon the overlapping generations (OLG) model in Acemoglu and Jackson (2011) to analyze the dynamic coordination game that emerges from a common-agency problem in an OLG setting. Our goal in this analysis is to identify conditions that ensure present and future insurance contracts that motivate providers to adopt cost reducing innovations even though the set of insurers who must coordinate is shifting from one period to the next. Having established these conditions, we can then apply the model to assess the impact of public policy interventions.

To keep things tractable, we have to specialize our previous model a bit. We assume that in each period, the provider has three insurers: Medicare and two private insurers. Medicare is assumed to have irrevocably committed to introducing ACO-style contracts, so the game we model concerns the coordination problem of the remaining two commercial payers. To introduce insurance turnover into our framework, we posit that private insurance companies live for two periods. The provider contracts with two private insurers in each period: an old insurer and a young insurer. In each period of the game, the two insurers play a common-agency game of the sort we have already analyzed.

More formally, we posit a sequence of payers $P_1, P_2, \ldots, P_T,$ where the subscript denotes the period in which they first establish relationships with the provider. All payers except for P_T live for two periods. P_T lives only for a single period. Payer P_t interacts with payers P_{t-1} and P_{t+1} and chooses a

---

were uninsured. Part of this turnover is a result of job loss and labor market mobility, but a good deal is also the result of employer groups switching from one insurance company to another in search of cheaper plans.

contract w_t that it will offer in both periods t and $t+1$. The contract is a linear function of output in each of the periods in which P_T lives and we assume that $B = 1$. That is, in period t, $w_t = b_t\tilde{y}_t$ and in period $t+1$, $w_{t+1} = b_t\tilde{y}_{t+1}$. In any period, if the provider chooses chooses $e = 0$, then $\tilde{y} = 0$ in that period and similarly $\tilde{y} = 1$ when the provider chooses $e = 1$. To simplify, we restrict the contracts available to payers by restricting the the contract space to allow for $b_t \in \{0, c/2\}$. If payer P_t offers a contract with $b_t = c/2$, she incurs a contracting cost of $k(c/2)$ in each of the two periods of her participation in the model.

In period t, the provider will choose to invest if $b_t + b_{t-1} \geq c$. Therefore, in order for the provider to invest in period t, it has to be the case that $b_t = b_{t-1} = c/2$. We assume that if the provider is indifferent, he chooses to invest and if a payer is indifferent, he chooses to offer high-powered incentives. Denote the action $b = c/2$ by H(for "high-powered incentives") and denote $b = 0$ by L (for "low-powered incentives"). The stage-game payoffs for each of the payers who interact in a given time period depend on actions, A, taken by payers who first interact with the provider in period t and those who first interact in period $t-1$:

	H	L
H	$(1-(1+k)c)/2, (1-(1+k)c)/2$	$-kc/2, 0$
L	$0, -kc/2$	0,0

It will be useful to denote these payoffs in a compact manner. Let $\beta = (1-(1+k)c)/2$ and $\alpha = kc/2$.

As in the analysis of static coordination games in Section II, we introduce subsidies to analyze the coordination failure resulting from the common-agency problem. Subsidies in a dynamic setting, however, are a bit more complex. Suppose that Medicare or some other public entity commits to a sequence $\tau = \{\tau_t\}_{t=1}^{T}$ where τ_t is a subsidy provided to payer P_t for choosing contracts that share savings with providers. The total payoff for each generation $t < T$ is

(15) $\quad (1-\lambda)u(A_t, A_{t-1}; \tau_t) + \lambda u(A_t, A_{t+1}; \tau_t),$

where $u(\,)$ represents the payoff in the stage game as a result of the action, A_t, taken by payer P_t and the other payers with whom P_t interacts. Parameter λ represents the importance that payer P_t attributes to its future interactions with payer P_{t+1} relative to its past interactions with payer P_{t-1}. Throughout, we will assume that $\lambda < 1/2$, so that interactions with past payers are more important than interactions with future payers.[13] Generation T is only in the model for one period so its payoff is $u(A_T, A_{T-1}; \tau_t)$

Given the subsidies, the payoffs for the stage game are shown in the following payoff matrix:

	A_s =H	A_s =L
A_t =H	$\beta + \tau_t, \beta + \tau_s$	$-\alpha + \tau_t$, 0
A_t =L	0, $-\alpha + \tau_s$	0,0

.We assume $\alpha > \beta$. If this were a one-shot coordination game, this assumption would make (L, L) the risk dominant equilibrium.

At the beginning of period *t*, payer P_t enters the market, observes the action of payer P_{t-1}, and chooses the action A_t of either *L* or *H* . Formally, a pure strategy for payer P_t is a mapping $\sigma_t: \{L, H\} \rightarrow \{L, H\}$ describing the action that payer P_t will choose depending on what action P_{t-1} chose in the previous period. Abusing notation slightly, denote by $\sigma_t = 0$ the pure strategy in which P_t chooses *L* without regard to A_{t-1}, $\sigma_t = 1$ the pure strategy in which P_t chooses *H* without regard to A_{t-1}, and $\sigma_t = \frac{1}{2}$ the pure strategy in which P_t matches P_{t-1}'s action: $A_t = A_{t-1}$.

To initialize the game, we take the action of P_0 as the exogenously given status quo in which current players choose fee-for-service contracts: $A_0 = L$. This is a finite supermodular game and therefore, we can make use of a number of results from the theory of supermodular games.[14] For a game with *T* generations of players, given a status quo action A_0 and a subsidy sequence, τ, denote the set of

[13] This assumption can be justified if we think of it as a discount factor that payers face. This assumption is also necessary to capture the possibility that policy can be used to "jump-start" institutional change that is otherwise blocked by coordination failures.

[14] A supermodular game roughly is one in which when one player takes a higher action, the others want to do the same.

equilibria of the game by $\sum_T(\tau, A_0)$ with generic element $\sigma^* \in \sum_T(\tau, A_0)$, and denote by $\bar{\sigma} = (1, \ldots, 1)$ the strategy profile in which all payers choose $A_t = H$ regardless of what the previous payer chooses.

In this framework, the following lemma is a straightforward result from the theory of supermodular games (X. Vives 1990).

Lemma 1: there exists a pure-strategy equilibrium of this game. For any T, τ and A_0, the set $\sum_T(\tau, A_0)$ forms a lattice, with $\underline{\sigma}_T^*(\tau, A_0)$ and $\overline{\sigma}_T^*(\tau, A_0)$ denoting the least and the greatest equilibria of the game. (proof available in Appendix II).

4.2 Policies

We are interested in analyzing how policy might influence the equilibrium contracts that emerge in our dynamic coordination game. We once again consider the effect of subsidies on the set of equilibria of a coordination game. In particular, we will consider the minimum cost sequence of subsidies a social planner can put in place that will ensure that in every period both payers will coordinate around efficient contracts. The social planner solves for the minimum cost sequence of subsidies, sufficient to induce investment. Formally the planner will solve the following program:[15]

$$\min_{\tau} \sum_{t=1}^{T} \tau_t$$

subject to the constraint that $\underline{\sigma}_T^*(\tau, A_0) = \bar{\sigma}$. Put differently, our approach considers all the subsidies that would be sufficient to ensure that all payers always play *H* (after starting the game playing *L)* and selects the sequence of subsidies that achieve this goal at lowest cost. Because this is a supermodular game, for any subsidy sequence, τ, a necessary and sufficient condition for all payers to coordinate around efficient contracts in every equilibrium of the game is that they do so in the least equilibrium $\underline{\sigma}_T^*(\tau, A_0)$.

[15] In this program, the social planner does not discount future subsidies. The reason for this is to rule out very unlikely equilibria such as one where the social planner introduces subsidies only into the far future and in this way reduces the cost of policy interventions.

The social planner, it turns out, can solve the problem by paying a subsidy in each period that takes on one of only four values: 0, α, $\underline{\tau}$, and $\overline{\tau}$. Value 0, of course represents the case of no subsidies while α represents a subsidy sufficient to ensure H regardless of beliefs about the actions the other party will take. In contrast, $\underline{\tau}$ represents the minimum subsidy necessary to ensure that a payer P_t will find it optimal to choose $A_t = H$ if it observes that $A_{t-1} = H$ and she believes that $A_{t+1} = L$. Likewise, $\overline{\tau}$ represents the minimum subsidy necessary to ensure that a payer P_t will find it optimal to choose $A_t = H$ if she observes that $A_{t-1} = L$ and she believes that $A_{t+1} = H$. It follows trivially from the payoff matrix in the stage game that $\underline{\tau} = \alpha - (1-\lambda)(\alpha+\beta)$ and $\overline{\tau} = \alpha - \lambda(\alpha+\beta)$. An important implication of our assumption that $\lambda < \frac{1}{2}$ is that $\underline{\tau} < \overline{\tau}$.

In Appendix II we provide necessary and sufficient conditions describing the sequence of subsidies for the least equilibrium to involve efficient contracting in every period. This sequence requires a subsidy of α in at least one period to ensure that a payer will choose *H* regardless of his beliefs about the other player's actions. In the periods prior to this payment, subsidies must be at least $\overline{\tau}$ and in subsequent periods subsidies must be at least $\underline{\tau}$. In addition, no subsidy is required in the final period, T, and there cannot be more than one period in a row with zero subsidy.

With these results it is straightforward to derive Proposition 1 that characterizes, τ^*, the lowest cost sequence of subsidies that meets these criteria.

Proposition 1: (Short-term actions have long-term consequences): $\tau_1^* = \alpha, \tau_t^* = \underline{\tau}$ for $t = 2, \dots, T-1$, and $\tau_T^* = 0$.

4.3 Discussion

Proposition 1 shows that the minimum-cost subsidy required to ensure that all payers play H in every period in every equilibrium involves a large subsidy in the first period followed by smaller subsidies (possibly 0 if $\underline{\tau} \leq 0$) in subsequent periods. A numerical example can help build intuition for this result. (proof is in Appendix II).

For concreteness, we assign values to the parameters of the stage game. We assume that $\alpha = 6, \beta = 4$, and $\lambda = .4$. In this case $\underline{\tau} = 0$ and $\overline{\tau} = 2$. Using these numbers consider an overlapping generations model lasting five periods as depicted in the chart below. The actions in the chart correspond to actions in the least equilibrium of the overlapping generations model

Period	1	2	3	4	5	Total τ
For periods 1-4 $\tau = \underline{\tau} = 0; \tau_5 = 0$	$A_t = L$	$A_t = L$	$A_t = L$	$A_t = L$	$A_t = L$	0
For periods 1-4 $\tau = \alpha = 6; \tau_5 = 0$	$A_t = H$	$A_t = H$	$A_t = H$	$A_t = H$	$A_t = H$	24
Mixed Subsidies 1	$\tau = \overline{\tau} = 2$	$\tau = \overline{\tau} = 2$	$\tau = \alpha = 6$	$\tau = \underline{\tau} = 0$	$\tau_5 = 0$	10
	$A_t = H$	$A_t = H$	$A_t = H$	$A_t = H$	$A_t = H$	
Mixed Subsidies 2	$\tau = \alpha = 6$	$\tau = \underline{\tau} = 0$	$\tau = \underline{\tau} = 0$	$\tau = \underline{\tau} = 0$	$\tau_5 = 0$	6
	$A_t = H$	$A_t = H$	$A_t = H$	$A_t = H$	$A_t = H$	

In row one the social planner offers a subsidy equal to $\underline{\tau} = 0$, and the subsidy is insufficient to rule out equilibria in which the payer does not offer a high-efficiency contract. In row two the social planner offers a subsidy equal $\tau = \alpha = 6$ in every period except the last where none is required. Not surprisingly, this subsidy is sufficient to ensure that the payer offers a high-efficiency contract in every period, but this is a very expensive subsidy strategy relative to the subsidy strategy in row three. This strategy is less expensive than the strategy in row two because it offers the maximum subsidy, α, only in period three. This ensures that in period three the payer will indeed choose *H*. Given this choice the social planner can rely on the strategic complementarities in the coordination game to sustain efficient contracts in the other periods with lower subsidies. Observe that the subsidies prior to period three are more expensive than the subsidies after. This suggests that while the mixed subsidy strategy 1 described in 3 is a cheap way to induce coordination, there exists a still cheaper way. As illustrated in the final row of the table mixed strategy two requires the planner to offer the maximum subsidy, α, only in period one.

Having coordinated beliefs in period one, no further subsidy is required to achieve the efficient equilibrium.

This example illustrates a general point: in the sort of dynamic coordination games resulting from common-agency problems, initial policy interventions can jumpstart long-lasting effects even if the policy is reduced or rescinded in subsequent periods. This is the result of the strategic complementarities of the coordination game. Indeed it is easy to show that if we alter the stage game to eliminate strategic complementarities, the optimal subsidy scheme takes a more conventional form involving the same large subsidy in every period. [16]

Conclusion

Inefficient organizational fragmentation is an old concern and motivates recent policies designed to promote more integrated care delivery. But if fragmented delivery is inefficient, what market failure can explain its persistence? What implication does this market failure have for public policy? We offer a model of contracting between payers and providers that addresses these questions. The market failure we highlight is a common-agency problem in which multiple payers write contracts with a common agent, the provider.

In a fragmented healthcare system, moving to integrated care delivery requires significant up-front investments by providers. In our model, common agency can cause payers to offer inefficient contracts, i.e. contracts that fail to provide incentives sufficient to induce these investments. The cause of this market failure is that coordination among payers is hard to achieve, in part because of anti-trust laws that aim to discourage collusion and in part because of other economic factors that we highlight in our analysis. We find that analogous market failures emerge in settings where incentive contracts seek to

[16] This result is also closely related to Sakovics and Steiner's conclusion that optimal subsidies for coordination games should target those players whose actions are least affected by the actions of others but whose actions affect others strongly. In our setting, payer P_1 is least affected by other endogenous payers' actions in this game, because she interacts with P_0, whose action is fixed exogenously. Further, payer P_T's actions have the least effect on other payers actions, and any subsidy that ensures that P_{T-1} will choose H also ensures that P_T will choose H.

elicit incremental efforts at cost-containment and process improvement, but here the market failures take the form of free riding problem rather than a coordination failure.

The common-agency problem we analyze produces more severe moral hazard than is typically found in conventional principal-agent settings, but our model also identifies new channels through which public policy can act. In common agency, the inefficiency of contracts grows with the number of payers. It follows that Medicare's public commitment to Accountable Care Organizations is likely to facilitate the spread of efficient contracts in the commercial insurance market. Subsidies to health information technologies, we find, will have a similar effect.

Part of the public policy motivation for promoting ACOs is the hope that wide-spread adoption of contracts that share cost-savings with providers will elicit new, cost-reducing innovations in health care treatment and processes. We assess the prospects for "bending the cost curve" in this way by analyzing a dynamic version of our common-agency model and identifying conditions sufficient for efficient contracts to prevail in the present and persist into the future. Here we find that short-run policies can jumpstart long-run changes that persist even after the initial policy is reduced or rescinded. This result suggests that eliciting coordination around efficient contracts may be cheaper than previously supposed.

Our analysis has a number of limitations. One limitation stems from our central message that resolving coordination failures between payers is an important channel through which public policy can act. To make our analysis tractable, we have assumed identical payers, but coordination failures are likely easiest to resolve by influencing the actions of dominant payers. Thus our analysis suggests, but doesn't establish, that influencing Medicare, state governments, and private insurers with large market share will be especially effective public policy levers.

A closely related limitation of our analysis is that we focused on cost-minimizing subsidies as the tool for achieving coordination. This approach is useful, but it is important to remember that governments have other tools at their disposal to resolve coordination problems. In Massachusetts, for example, the state has established a target for the growth of medical spending that is equal to the long-run

growth of the state economy, estimated to be 3.6% annually. The sanctions for breaching this target are weak and poorly specified, but it might nevertheless be an effective response to coordination failures of the sort we model.[17] The potential power of this intervention lies in the fact it offers the opportunity for major politicians, payers and providers in Massachusetts to publicly commit to it (David Cutler and Steve Walsh 2014). Alternatively, the government might choose to shape beliefs via policies that enable or require actions by each payer. Examples of this sort of intervention might include relaxing antitrust and anti–kickback law enforcement or mandating investments in health information technologies.

A final limitation of our analysis concerns the role of market power. A common theme running throughout our analysis is that reducing the number of payers reduces the distortions resulting from common-agency. Of course, reducing the number of payers also gives payers enhanced market power which leads to other sorts of inefficiencies that we do not include in our model. It is beyond the scope of this paper to assess the trade-offs between inefficiencies resulting from common-agency and those resulting from payer market power. Exploring this issue is, however, an important area for future research.

[17] Cutler and Walsh (2014) indicate that the clinicians and hospitals found to be most responsible for high rate increases may be required to develop and implement performance improvement plans.

Appendix I: Equilibrium Selection and Minimum Cost Subsidies

In this Appendix we examine the relationship between minimum cost subsidies and equilibrium selection. We begin by defining a notion of monotonicity of equilibrium-selection rules and show that in the class of games we consider, common equilibrium-selection rules are monotonic in the cost-minimizing subsidy τ^*.

Notations and Definitions

Define a parameterized class of games $\Gamma(\theta)$, where θ is a vector of parameters and $\theta \in \Theta = \mathbb{R}^J$, the J dimensional set of parameters. Define the set of equilibria of game $\Gamma(\theta)$, by $\mathcal{E}_\theta$. Next, define a **deterministic equilibrium-selection rule** as a mapping $e: \Theta \to \mathcal{E}_\theta$, which chooses, for each vector of parameters θ, and equilibrium $e(\theta) \in \mathcal{E}_\theta$. The set of action profiles consistent with equilibrium for some θ are $\mathcal{E} \equiv \bigcup_{\theta\in\Theta}\mathcal{E}_\theta$ with generic element ε. Define the **set of parameters associated with equilibrium ε under e** as $\theta_e(\varepsilon) = \{\theta \in \Theta: e(\theta) = \varepsilon\}$.

Suppose there is a function $T: \mathbb{R} \to 2^\Theta$ such that $\bigcup_{x\in\mathbb{R}} T(x) = \Theta$ and $T(x) \cap T(x') = 0$ for all $x \neq x'$. The function T therefore defines a partition of the parameter space and associates each value τ with a subset of Θ. Define the **set of parameters associated with value τ under T** as $\theta_T(\tau) = \{\theta \in \Theta: T(\theta) = \tau\}$.

Next, define the set of parameters that are consistent with value τ and the equilibrium-selection rule selects ε as $\theta(\varepsilon, \tau) = \theta_T(\tau) \cap \theta_e(\varepsilon)$. Notationally, we are suppressing the function T and equilibrium-selection rule e in defining this set. The projection of $\theta(\varepsilon, \tau)$ onto dimension j is $\theta_j(\varepsilon, \tau) = \{\theta_j, (\theta_j, \theta_{-j}) \in \theta(\varepsilon, \tau)\}$.

We are now prepared to define the monotonicity of equilibrium-selection rules. An **equilibrium selection rule, e, is increasing in τ for** ε if for all $\tau' > \tau$, $\theta_j(\varepsilon, \tau) \subset \theta_j(\varepsilon, \tau')$ for all j, and it is **decreasing in τ** for ε if, $\theta_j(\varepsilon, \tau') \subset \theta_j(\varepsilon, \tau)$ for all j. Given an action profile ε, if e is increasing in τ for ε, we say that **equilibrium selection rule e increasingly favors ε in τ**. If e is decreasing in τ for ε, we say that **equilibrium selection rule e decreasingly favors ε in τ.**

Example I: Risk Dominance in Coordination Games

Consider the following two-player coordination game where each player can choose to invest or not invest as in Section two of the paper

	Invest (I)	Not Invest (NI)
Invest (I)	β, β	$-\alpha, 0$
Not Invest (NI)	$0, -\alpha$	0,0

and the equilibrium-selection criterion e of risk dominance. In this game, $\theta_e\big((NI, NI)\big) = \{(\alpha, \beta): \alpha \geq \beta\}$. When $2\beta \geq \alpha$, the cost-minimizing subsidy that ensures that (I, I) is the unique equilibrium of this game (assuming that when indifferent, players play I) is to subsidize either player an amount α for playing I, so the minimum subsidy costs are $\tau = \alpha$. When $\alpha \geq 2\beta$, we can think of the optimal subsidy as being $\tau = 2\beta$ (i.e., this is the subsidy that makes I most appealing subject to the constraint that total surplus when (I, I) is played, $2\beta - \tau$ is nonnegative.

The projections of $\theta\big((NI, NI), \tau\big)$ are:

$$\theta_\beta\big((NI,NI),\tau\big) = \{\beta: (\alpha,\beta) \in \theta((NI,NI),\tau)\} = (-\infty,\tau]$$
$$\theta_\alpha\big((NI,NI),\tau\big) = \{\alpha: (\alpha,\beta) \in \theta((NI,NI),\tau)\} = (2\beta,\tau]$$

and $\theta_j\big((NI,NI),\tau\big) \leq \theta_j\big((NI,NI),\tau'\big)$ for all $\tau' \geq \tau$ for j. As the cost minimizing subsidy increases, so does the set of parameter values for which a risk-dominance selection rule will select the inefficient equilibrium. In this sense a risk-dominance equilibrium selection rule increasingly favors (NI,NI) in τ.

Example II: Basins of Attraction in Coordination Games

Consider an equilibrium-selection rule e that chooses NI if NI has a larger basin of attraction according to an alternating best-response dynamic process. That is, consider a process that starts with a pair $b^0 = (b_1^0, b_2^0)$ and iterates according to one of the following two operators

$$\tilde{b}^{2\ell-1} = \big(\tilde{b}_1^*\big(b_2^{2\ell-2}\big), \tilde{b}_2^{2\ell-2}\big)$$
$$\tilde{b}^{2\ell} = \Big(\tilde{b}_1^{2\ell-1}, b_2^*\big(\tilde{b}_2^{2\ell-1}\big)\Big)$$

or

$$\hat{b}^{2\ell} = \big(b_1^*\big(\hat{b}_2^{2\ell-1}\big), \hat{b}_2^{2\ell-1}\big)$$
$$\hat{b}^{2\ell-1} = \Big(\hat{b}_1^{2\ell-2}, b_2^*\big(\hat{b}_2^{2\ell-2}\big)\Big)$$

In this game, both of these operators converge. Define $\tilde{b}^* = \lim_{\ell\to\infty} \tilde{b}^\ell$ and $\hat{b}^* = \lim_{\ell\to\infty} \hat{b}^\ell$.

We say that b^0 is in the **basin of attraction for *NI*** if $\tilde{b}^*$= $\hat{b}^*$= (0,0), b^0 is in **the basin of attraction for *I*** if $\tilde{b}_1^* + \tilde{b}_2^* = \hat{b}_1^* + \hat{b}_2^* = c$. b^0 is in **neither basin of attraction** if either $\hat{b}^* > \tilde{b}^* = (0,0)$ or $\tilde{b}^* > \hat{b}^* = (0,0)$. Graphically, restricting the contract space to allow for $b_i \in [0,c]$, the following figure describes the basins of attraction. The orange regions are the basins of attraction for NI, and the green region is the basin of attraction for I. Points in the black regions are in neither basin of attraction.

The area of the basin of attraction for NI is $4\left(c - \frac{B}{2(1+k)}\right)^2$ and the area for the basin of attraction for I is $\left(\frac{B}{1+k} - c\right)^2$ where B is the benefit accruing from investments in integrated care. The basin of attraction for NI is larger than the basin of attraction for I if $c(1+k) > \frac{2}{3}B$. In this game, $\theta_e(NI) = \left\{\left(\frac{B}{2}, c, k\right): c(1+k) > \frac{B}{2}\right\}$ and $\theta_e(I) = \left\{\left(\frac{B}{2}, c, k\right): c(1+k) \leq \frac{B}{2}\right\}$.

When $B - c(1+k) \geq 0$, the cost-minimizing subsidy that ensures I in all equilibria in this model is $\tau^* = c(1+k) - \frac{B}{2}$, paid to either payer when investment occurs. When $B - c(1+k) < 0$, set the subsidy equal to $\tau = B$. Since c and k always show up as $c(1+k)$ we can define $K = c(1+k)$ as a parameter of the model. Thus we can define the projections of $\theta(NI,\tau)$ in two dimensions

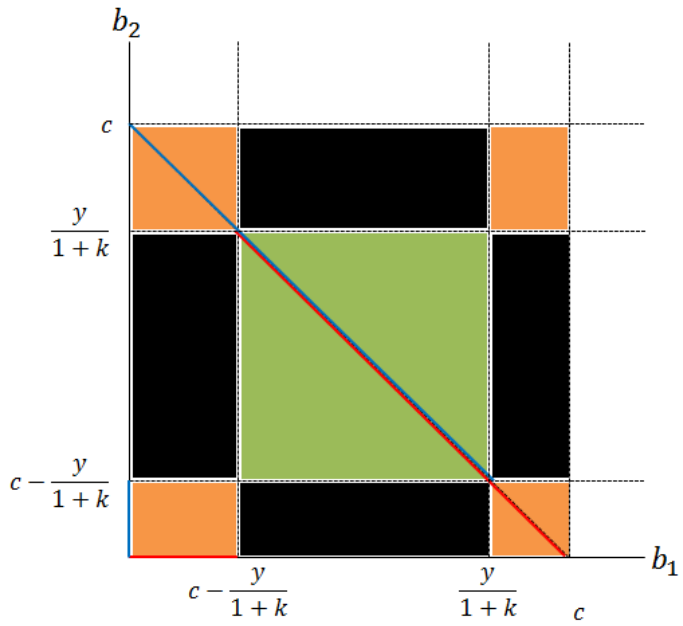
$$\theta_{B/2}(NI,\tau) = \left\{\frac{B}{2}: \left(\frac{B}{2}, K\right) \in \theta(NI,\tau)\right\} = [0,3\tau]$$
$$\theta_K(NI,\tau) = \left\{K: \left(\frac{B}{2}, K\right) \in \theta(NI,\tau) = [0,4\tau]\right\}$$

Under this transformation of the model, it is still the case that $\theta_j(NI,\tau) \leq \theta_j(NI,\tau')$ for all $\tau' \geq \tau$ for $j \in \left\{\frac{B}{2}, K\right\}$.

Similarly, we could define the projection of $\theta(I,\tau)$ as

$$\theta_{B/2}(I,\tau) = \left\{\frac{B}{2} : \left(\frac{B}{2}, K\right) \in \theta(I,\tau)\right\} = [3\tau, \infty]$$
$$\theta_{K}(I,\tau) = \left\{K : \left(\frac{B}{2}, K\right) \in \theta(I,\tau) = [4\tau, \infty]\right\}.$$

We therefore have that the basins-of-attraction equilibrium-selection rule both increasingly favors NI and decreasingly favors I in τ.



with $y \equiv \frac{B}{2}$

Appendix II:

In this Appendix we offer proofs of results needed to establish Proposition 1 in section 4.2.

Lemma A1: Characterizing the Sequence of Subsidies that Elicit Efficient Contracts in Each Period: If τ satisfies $\underline{\sigma}_T^*(\tau, L) = \bar{\sigma}$, then τ must strictly exceed some vector that contains blocks of length J^k with J_0^k zeros, followed by J_1^k $\bar{\tau}$'s , followed by J_2^k α's, followed by J_3^k $\underline{\tau}$'s , where $J^k = J_0^k + J_1^k + J_2^k + J_3^k$ and $J_0^k \leq 1$ and $J_2^k \geq 1$, where for comparison, $\tau_0 = 0$.

In order to establish this claim, we proceed by iterating best-reply correspondences beginning with the lowest strategy $\sigma^0 = (0,...,0)$. Since this is a finite super modular game, by Vives (1990) and Milgram and Roberts (1990), this "Cournot tatonnement" converges monotonically upward toward an equilibrium point (and indeed, its limit is the least equilibrium point). We will show necessary conditions that the subsidy sequence must satisfy in order for the sequence to converge to $\bar{\sigma}$.

Proof of Lemma A1: We will compute $\sigma^k = \underline{BR}(\sigma^{k-1})$, where $\underline{BR}(\sigma) = \times_{t=1}^{T} \underline{BR}_t(\sigma)$ and $\underline{BR}_t(\sigma)$ is the least element of P_t's best reply correspondence. Given $\sigma^0 = (0,...,0)$, $A_t = H$ is P_t's unique best reply if $\tau_t > \alpha$. Let $T^1 = \{t : \tau_t > \alpha\}$. Let $\sigma_t^1 = 1$ if $t \in T^1$ and $\sigma_T^1 = 0$ if $\tau \notin T^1$.

Given σ^k and corresponding T^k, construct σ^{k+1} and T^{k+1} as follows. If $t \in T^k$, then $t \in T^{k+1}$.

If $\tau \notin T^k$, there are four cases to consider, depending on the strategies of the neighboring generations. Case 1: if $t-1,\ t+1 \in T^k$, then $t \notin T^{k+1}$. Case 2: if $t-1 \in T^k$ and $t+1 \notin T^k$, then $t \in T^{k+1}$ if $\tau_t > \underline{\tau}$. Case 3: if $t-1 \notin T^k$ and $t+1 \in T^k$, then $t \in T^{k+1}$ if $\tau_t > \bar{\tau}$. Case 4: if $t-1$, $t+1 \notin T^k$, then $t \in T^{k+1}$ if $\tau_t > \alpha$.

By construction, if $T^k = T^{k+1}$, then it is either the case that $t \in T^k$ for all t or if not, then for any $t \notin T^k$, (1) if $t-1 \in T^k$ and $t+1 \notin T^k$, then $\tau_t \leq \underline{\tau}$, (2) if $t-1 \notin T^k$ and $t+1 \in T^k$, then $\tau_t \leq \bar{\tau}$, (3) if $t-1 \notin T^k$ and $t+1 \notin T^k$, then $\tau_t \leq \alpha$. In other words, if the lowest equilibrium is not $\bar{\sigma}$, then for any payer P_t who does not choose $\sigma_t = 1$, it must either be the case that payer P_{t+1} also does not choose $\sigma_{t+1} = 1$ and the period t subsidy is not enough to persuade payer P_t choose $\sigma_t = 1$ despite this. Or it must be that payer P_{t-1} also does not choose $\sigma_{t-1} = 1$ and the period t subsidy is not enough to persuade P_t to choose $\sigma_t = 1$ despite this. Or it must be that P_{t-1} and P_{t+1} choose, respectively, $\sigma_{t-1} = 0$ and $\sigma_{t+1} = 0$, and the period t subsidy is not enough to persuade payer P_t to unilaterally choose $\sigma_t = 1$.

This in turn implies that if τ satisfies $\underline{\sigma}_T(\tau, L) = \bar{\sigma}$, then τ has to strictly exceed some vector that contains blocks of length J^k and has J_0^k zeros, followed by J_1^k τ's, followed by

J_2^k α's, followed by $J_3^k \tau$'s, where $J^k = J_0^k + J_1^k + J_2^k + J_3^k$ and $J_0^k \leq 1$ and $J_2^k \geq 1$, where for comparison, $\tau_0 = 0$.

Bibliography

Acemoglu, Daron and Matthew O. Jackson. 2011."History, Expectations and Leadership in the Evolution of Social Norms."*NBER Working Paper Series* 17066:.

Baicker, Katherine and Amitabh Chandra. 2011."Aspirin, Angioplasty, and Proton Beam Therapy: The Economics of Smarter Health Care Spending.".

Baicker, Katherine and Helen Levy. 2013."Coordination Versus Competition in Health Care Reform."*N. Engl. J. Med.* pp. 1-3.

Baker, Laurence; Kate Bundorf and Anne Royalty. 2014. "Measuring Physician Practice Competition using Medicare Data, " Working Paper, Stanford Medical School, .

Battigalli, Pierpaolo and Giovanni Maggi. 2002."Rigidity, Discretion, and the Costs of Writing Contracts."*Am. Econ. Rev.* 92:4, pp. 798-817.

Bernheim, B. D. and Michael D. Whinston. 1986."Common Agency."*Econometrica* 54:4, pp. 923-42.

Bernstein, Shai and Eyal Winter. 2012."Contracting with Heterogeneous Externalities."*American Economic Journal: Microeconomics* 4:2, pp. 50-76.

Besley, Timothy and Stephen Coate. 2001."Lobbying and Welfare in a Representative Democracy."*Rev. Econ. Stud.* 68:1, pp. 67-82.

Blumenthal, David. 2011."Wiring the Health System — Origins and Provisions of a New Federal Program."*N. Engl. J. Med.* 365:24, pp. 2323-9.

Burns, Lawton R. and Mark V. Pauly. 2012."Accountable Care Organizations may have Difficulty Avoiding the Failures of Integrated Delivery Networks of the 1990s."*Health affairs (Project Hope)* 31:11, pp. 2407-16.

Burns, Lawton R. and Mark V. Pauly. 2002."Integrated Delivery Networks: A Detour on the Road to Integrated Health Care?"*Health Affairs* 21:4, .

Cebul, Randall D.; James B. Rebitzer; Lowell J. Taylor and Mark E. Votruba. 2011."Unhealthy Insurance Markets: Search Frictions and the Cost and Quality of Health Insurance."*American Economic Review* 101:5, pp. 29,1842-1871.

Cebul, Randall D.; James B. Rebitzer; Lowell J. Taylor and Mark E. Votruba. 2008."Organizational Fragmentation and Care Quality in the U.S. Healthcare System."*The Journal of Economic Perspectives* 22:4, pp. 93-114.

Centers for Disease Control. 2010."National Ambulatory Care Survey: 2010 Summary Tables.".

Cooper, Russell; Douglas V. DeJong; Robert Forsythe and Thomas Ross. 1992."Communication in Coordination Games."*The Quarterly Journal of Economics* 197:2, pp. 739-71.

Cooper, Russell; Douglas V. DeJong; Robert Forsythe and Thomas Ross. 1990."Selection Criteria in Coordination Games: Some Experimental Results."*The American Economic Review* 80:1, pp. 218-33.

Crosson, F. J. 2009."Medicare: The Place to Start Delivery System Reform."*Health. Aff. (Millwood)* 28:2, pp. w232-4.

Crosson, Francis J. 2009."21st Century Health Care- the Case for Integrated Delivery Systems."*New England Journal of Medicine* 36:14, pp. 2-1324.

Cutler, David. 2010."How Health Care Reform must Bend the Cost Curve."*Health Affairs* 29:6, pp. 1131-5.

Cutler, David and Steve Walsh. 2014."Will the Country Look to Massachusetts again?"*The Jama Forum* .

Cutler, DM and F. Scott Morton. 2013."Hospitals, Market Share, and Consolidation."*JAMA* 310:18, pp. 1964-70.

Dixit, Avinash; Gene M. Grossman and Elhanan Helpman. 1997."Common Agency and Coordination: General Theory and Application to Government Policy Making."*Journal of Political Economy* 105:4, pp. 752-69.

Frandsen, Brigham and James B. Rebitzer. 2014."Structuring Incentives within Accountable Care Organizations."*Working Paper, Boston University School of Management* .

Harsanyi, John C. andReinhard Selten. 1988. *A General Theory of Equilibrium Selection in Games.* Cambridge, Mass.: MIT Press.

Kirchsteiger, Georg and Andrea Prat. 2001."Inefficient Equilibria in Lobbying."*Journal of Public Economics* 82:3, pp. 349-75.

Milgrom, Paul and John Roberts. 1990."Rationalizability and Learning in Games with Strategic Complementarities."*Econometrica* 58:pp. 1255-78.

Moses H, III, Matheson DM, Dorsey E, George BP, Sadoff D,Yoshimura S. 2013."The Anatomy of Health Care in the United States."*JAMA* 310:18, pp. 1947-64.

Prat, Andrea and Aldo Rustichini. 2003."Games Played through Agents."*Econometrica* 71:4, pp. 989-1026.

Rebitzer, James B. and Mark E. Votruba. 2011."Organizational Economics and Physician Practices."*National Bureau of Economic Research Working Paper #17535* .

Robinson, James C. 1999. *The Corporate Practice of Medicine : Competition and Innovation in Health Care.* Berkeley, Calif.: University of California Press.

Ross, Joseph S. 2002."The Committee on the Costs of Medical Care and the History of Health Insurance in the United States."*Einstein Journal of Biology and Medicine* 19:pp. 129-34.

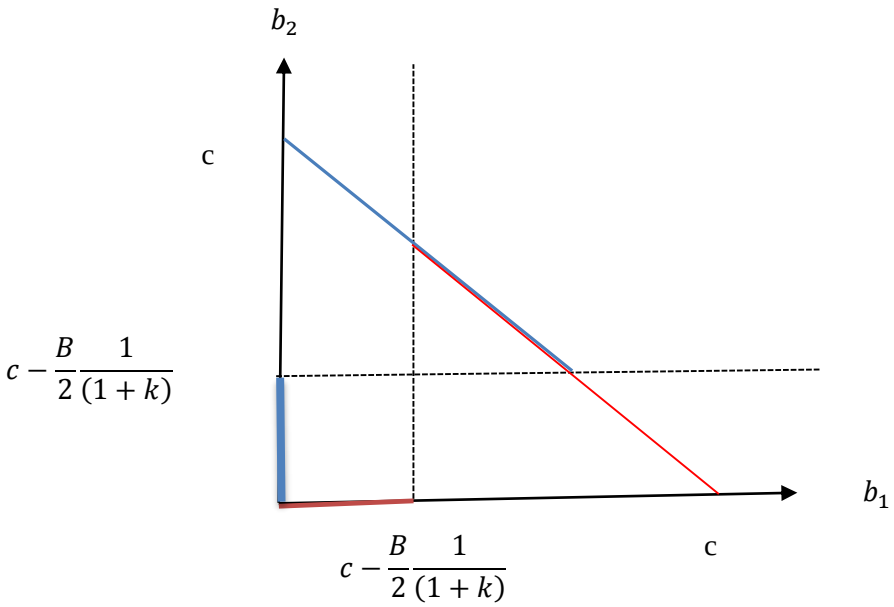
Sakovics, Jozsef and Jakub Steiner. 2012."Who Matters in Coordination Problems?"*Am. Econ. Rev.* 102:7, pp. 3439-61.

Stigler, George J. 1958."The Economies of Scale."*J. Law Econ.* 1:pp. 54-71.

Vives, X. 1990."Nash Equilibrium with Strategic Complementarities,"."*Journal of Mathematical Economics* 19:pp. 305-21.

Figure 1:

Equilibria in a Static Common-Agency Model with Discrete Up Front Investments in Integrated Care



Variables b_1 and b_2 is the share of cost savings shared with providers and B are the expected cost savings. Variable c is the cost of the discrete investment providers make in integrated care and k is the insurers' costs of negotiating and implementing cost-sharing contracts. The blue and red lines represent the best response of each payer to the other payers' choice of incentive. Equilibrium occurs where the two colors overlap.