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## Humans in the perfectly competitive market

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# MEMORANDUM

No 02/2019  
February 2019

**Humans in the perfectly competitive market**

The seal of the University of Oslo is a circular emblem. It features a central figure of a woman in classical attire, holding a lyre. The text "UNIVERSITAS OSLOENSIS" is inscribed around the top half of the circle, and "MDCCCXXXV" is at the bottom. A small dot is positioned between the two text segments on the right side.

**Karine Nyborg**

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# Humans in the perfectly competitive market

## Report from a fictional field study

Karine Nyborg<sup>1</sup>

### *Abstract*

*The perfectly competitive market – a hypothetical situation free of market failure – serves as a benchmark for economic theory, providing the basis for the two fundamental welfare theorems. The radical abstractions of this idea makes it hard to grasp its full implications, however. In this essay, I explore the perfectly competitive market using literary fiction. Part I discusses fiction as a tool for economic theory. Part II is a science fiction story about two economists travelling to the perfectly competitive market for their honeymoon. Part III develops main theoretical insights emerging from the story. First, to preclude market failure, complete social isolation must prevail. Second, the requirements of symmetric information and no external effects are extremely hard to reconcile, leading to an impossibility result: if trade is permitted anytime, and deliberate, welfare-relevant learning is feasible, no perfectly competitive market can exist.*

**Keywords:** Welfare theorems; narratives; social interaction; symmetric information; complete contracts.

**JEL codes:** A11, A12, B49, D5, D60, D62, D82.

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*The word “model” sounds more scientific than “fable” or “fairytale” although I do not see much difference between them. The author of a fable draws a parallel to a situation in real life. He has some moral he wishes to impart to the reader. [...] Any fable can be dismissed as being unrealistic or simplistic, but this is also the fable’s advantage.*

Rubinstein (2006, p.881).

*When it comes to human lives, characterized as they are by contingency and narrativeness, stories are an indispensable way of knowing. That is why the quantitative rigor, policy focus, and logic of economics must be supplemented with the empathy, judgment, and wisdom that defines the humanities at their best.*

Morson and Schapiro (2017, p.2).

## Part I: Fiction and economic theory

Despite differences in style and content matter, economic theory has a lot in common with fiction: since its assumptions are often chosen for reasons other than realism, economic theory *is* a sort of fiction. Exploring the implications of a specific set of premises can be highly interesting in spite of – or even because of – these premises being purely hypothetical, corresponding remotely or not at all to the real world. The Arrow-Debreu model (Arrow and Debreu 1954) provides a prominent example of this: no decent economist would claim that its assumptions describe the world as we know it; yet it has become a centerpiece of economic theory.

Like the fiction writer, the economic theorist decides what rules, realistic or not, will govern the situation being envisioned, then exploring their implications: what can and cannot happen in this hypothetical world, given that one keeps strictly to the rules one has imposed? The language of mathematics can be extremely useful in this endeavor. Logical errors and qualifications escaping intuitive reasoning can be revealed by explicitly restricting the variables and mechanisms allowed to enter into an argument, thus preventing confusion caused by excessive complexity. For the very same reason, however, mathematical language may be less helpful in retrieving relevant implicit knowledge – that is, intuitive but possibly unarticulated insights.<sup>2</sup>

Below I explore, by means of literary fiction, the idea of a perfectly competitive market: a situation completely free of market failure, satisfying the requirements of the first fundamental welfare theorem. While the method is obviously unusual, the process of doing so turned out to reveal rather surprising – to me, at least – economic insights.

Using verbal analysis only, abstaining from mathematics as well as professional jargon, I made no attempt to translate the Arrow-Debreu assumptions (e.g., convex preferences) directly into the language of fiction. Instead, I rely on a narrative often presented to beginner economics students, in which the perfectly competitive market is defined by specific market failures being absent: no missing markets; no market power; no asymmetric information; no external effects; no public goods.<sup>3</sup>

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<sup>2</sup> “Thus, presenting the problem formally, as we do in economics, seems to obscure the real-life complexity of the situation for most students (including math students)” (Rubinstein 2006, p.879).

<sup>3</sup> Somewhat differently specified conditions might have preserved the main intention of ensuring efficient markets. In particular, ‘no public goods’ may be superfluous and would probably have been sufficiently covered by ‘no external effects’ and ‘no missing markets’.

Exploring the implications of these requirements using the tools of storytelling revealed a surprising impossibility result:

If i) trade is permitted at any time, ii) deliberate learning is feasible, and iii) new information may matter for welfare, no perfectly competitive market can exist.

The present essay should not be interpreted as an attack on economic theory as such. On the contrary, I consider the story below to *be* – although the form is unconventional – economic theory. Nor do I intend to argue that economists should use the tools of literary fiction regularly in their research. Such an exercise would not always be meaningful; moreover, being a fiction writer as well as an economics professor, I am presumably more drawn to such attempts than most.<sup>4</sup>

I do think, however, that economists should care about narratives – that is, the stories we tell ourselves and others to understand the world, imposing structures on our knowledge. The story presented below may help clarify, possibly modify, economists' own narratives about markets, perfect competition, and the fundamental welfare theorems.

Akerlof and Snower (2016) emphasize that narratives influence human decision-making by, e.g., focusing attention, shaping predictions, and establishing roles, power relations and social norms. In games of multiple equilibria, narratives can influence equilibrium selection by shaping beliefs and expectations. Shiller (2017) explores how contagious narratives may have set off several of the most dramatic macroeconomic fluctuations in the past. Benabou et al. (2018) and Foerster and van der Weele (2018a) discuss narratives as rationales for actions relating to moral or social implications; Hillenbrand and Verrina (2018) and Foerster and van der Weele (2018b) explore this in the lab, confirming that narratives influence generosity. Morson and Schapiro (2017a, p.1) argue that a dialogue between economics and the humanities would enrich economics, and that novels are “not just a literary form, but also a distinct way of understanding the social world”.

The works cited above are mostly concerned with narratives as determinants of economic behavior in general. Shiller (2017), however, pays considerable attention to the role of the narratives of economists in particular. The present text scrutinizes one such economist narrative by viewing it from a very unusual angle. Economists (including myself) tend to think of the perfectly competitive market as an intuitively simple, generally applicable, if unrealistic benchmark model, which at least approximates certain main features of real world markets. The narrative emerging from the fiction story below is quite different: a perfectly competitive market would have to be an astonishingly strange and complex place.

The story proceeds in the usual way for an economic theory piece: after a brief introduction, I (or rather, one of my characters) present the basic assumptions constituting my definition of the perfectly competitive market for the present purpose. I then explore the hypothetical world thus defined. To avoid complicating the story even more, I mostly ignore distributional issues. After the story itself, Part III of my essay explores the economics insights emerging from the story in more detail, including the impossibility result mentioned above.

Ok, off we go.

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<sup>4</sup> Fiction publications, reviews etc. are listed at [karinenyborg.com](http://karinenyborg.com).

## Part II: Adam in the perfectly competitive market<sup>5</sup>

I'm afraid that I'll be disappointed, Adam thinks, that's all.

The spacesuit is close-fitting and as rigid as a tin can, it's too late to wipe the sweat from his brow at this point.

In the all-encompassing suit, Susanne is hardly recognisable. Only her eyes are visible through the open visor, as impassive as always. Adam winks at her, and with delight he registers her winking back at him; there's no doubting the fact that she really has changed.

'Are you both ready?'

The guide's voice is loud and clear in their headset. Looking through the protective screen, Adam meets his gaze.

'Ready,' he replies.

The guide turns to Susanne.

'Ready,' she says.

'As mentioned previously,' the guide says, 'I'll be speaking to you through your headsets, but connection may be lost upon arrival. Return transportation departs on schedule. Don't be late.'

Adam waits impatiently for the visor to be sealed. He didn't request a guide; it was only at the insistence of the travel agency that they'd accepted one. Not that he can blame them, he hadn't mentioned the fact that he and Susanne are both specialists in the field of microeconomic analysis, that they fell for one another at a lecture on advanced consumer theory.

'Right,' the guide says, 'everything should be just fine. Have a good trip!'

He turns the large lever to the right with a click. A dark shadow glides into view, descending from above with a faint hum. Adam catches a glimpse of Susanne, her eyes wide open, as if she feels regret, then the shadow consumes his field of vision and everything turns black.

Susanne is never plagued by nerves.

The humming stops. The darkness is all-consuming. There isn't a sound to be heard.

Seemingly out of nowhere the drag begins, it tugs at him, a centrifuge, he feels dizzy, he's lost all sense of weight, up and down, instinctively grasping for Susanne's hand, where is it, where is she, how could they have chosen a honeymoon with separate transfers?

'Well, yes,' the customer service agent at the central branch had confirmed, 'you're right, it is mentioned on our website.'

She was small with dark hair, wearing a skirt and a red blouse bearing the firm's logo.

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<sup>5</sup> Translated from the Norwegian by Rosie Hedger.

‘But to be perfectly honest,’ she continued, ‘that’s largely for promotional purposes. To illustrate the breadth of our services, if you catch my drift. It’s rare that we ever send anyone there.’

He looked at her. She cleared her throat.

‘We’ve never sent anyone there,’ she clarified.

She turned to Susanne and flashed her a wide smile.

‘But,’ she continued, ‘we do have lots of other very exciting options. Hogwarts and Duckburg are our most popular destinations for the time being, particularly for families. Couples often choose the Garden of Eden, if they’re looking for something rural, or Valhalla, if they’re keen to visit somewhere with a little more entertainment and party spirit. But if I really had to recommend somewhere for a honeymoon,’ she continued, nudging Susanne’s shoulder in a familiar manner, ‘then I’d have to say, nothing beats Lothlórien.’

Susanne crossed her arms in silence. The customer service agent’s gaze wavered. Adam felt himself becoming uneasy; although he admired Susanne’s tendency to ignore social codes, it was an unfortunate fact that this trait did not often seem to improve her efficiency.

‘If it’s utopias you’re looking for,’ the customer service agent said, ‘we have plenty of tried and tested options in that genre. What about Plato’s Ideal State? The dictatorship of the proletariat? The latter is quite incredible.’

‘We didn’t come here to arrange to hear recommendations,’ Susanne pointed out. ‘We came to arrange our trip.’

The customer service agent pursed her lips and studied Susanne. She turned to Adam and took a step in his direction, partly obscuring Susanne before fixing her gaze on him.

‘The destination isn’t properly tested,’ she said. ‘Plus...’

‘Plus what?’ Susanne asked.

‘Well,’ the customer service agent continued, her gaze still firmly set on Adam, ‘it’s really not a destination that’s at all well-suited to a honeymoon.’

*I hope you are finding your transportation suitably comfortable.*

The guide’s voice breaks through the darkness, more distant now, metallic-sounding.

*Welcome to this trip to the perfectly competitive market. We will now make our way through some security procedures and kindly request your utmost attention throughout.*

The drag feels just as strong, but it’s steady, and the dizziness has subsided. Adam’s curiosity is gradually returning. Finally, he’ll personally experience this world that has fascinated him ever since he first embarked upon his studies, a world so utopian that someone with his childhood experiences could scarcely believe in it, if



not for the fact that its existence was mathematically proven all the way back in 1954: a society devoid of deception, suppression, coercion and intimidation.

*The following is a brief summary of information received during the booking process, and with which you should already be familiar. Our agency holds no liability for damages caused as a result of unforeseen events during your stay. Passengers are responsible for familiarising themselves with established practical and cultural differences prior to arrival. Be aware that for the destination to which you are now travelling, the cultural differences are unusually great: we do not speak of another culture, but of no culture whatsoever.*

*The perfectly competitive market is among the world's most influential utopias. In this fictional setting, the origins of which are often attributed to Adam Smith and his 'invisible hand', self-interest and social interest are one and the same — the pursuit of one's own narrowly selfish objectives is automatically also considered to be in the best interests of society.*

*Several different versions of this utopia exist, with the following in common: they are constructed in such a way that free trade can never be detrimental, only beneficial. This remarkable characteristic has made the fiction a core instrument for economic analysis. In fact, this is the very yardstick by which economists evaluate policy: where the real world deviates from the utopia, so-called market failure, political intervention may be necessary; where the real world aligns with the utopia, measures are deemed unnecessary, since the perfectly competitive market does, after all, function perfectly.*

*You are travelling to version 14b from our catalogue: a variety of the 'world without market failure' that universities around the globe introduce to new students of economics, and which forms a key part of every standard course in fundamental microeconomics.*

*'Hello,' Adam calls. 'Hello! Sorry. Please just skip all of this, we're familiar with it.'*

*Apologies. We are legally obliged to go through these points as part of our security procedures.*

*'Susanne!' he shouts. 'Make him stop!'*

*She can't hear you.*

*The guide sounds irritated.*

*You're interested in your own safety, I presume. Now, where were we? Oh yes. Tourist guides are not yet available. As such, we will briefly summarise the most important points included in the literature on this destination:*

*Anything of interest may be bought or sold at the market price.*

*Nobody can influence market prices. Everyone considers prices fixed.*

*There are no secrets: everyone has access to the same information.*

*External effects – influencing others, unless as part of a trade agreement – do not exist.*

*Public goods, which are accessible and may be freely used by all, do not exist.*

Adam groans. In spite of the overly-simplified approach to the subject, the information rattled off by the guide is no more inspirational than the usual introductions to its features: technical, unpoetic, lacking all perspective. Why doesn't he point out the fact that he's talking about a world devoid of *war*, for instance?

Adam is almost compelled to rebuke him, but holds his tongue; he's on holiday. He knows only one person who fully understands the perfectly competitive market, and who therefore also understands the symbolic nature of travelling together to a world of complete and utter openness, independence and freedom, and that person is Susanne. He thinks about the warmth of her body the previous evening, together under the duvet, both still catching their breath, when she had said:

'Adam. What do you think happens in the perfectly competitive market when tourists arrive?'

'Hmm?'

'All of the inconsistencies. What if everything just collapses?'

'Susanne. There are no inconsistencies. Its existence is mathematically proven.'

'But visitors haven't been factored into that.'

'Shhh.'

Adam wrapped an arm around her.

'Does your mind ever stop going over things?' he asked, chuckling.

Susanne rested her head on his shoulder and pulled the duvet over herself.

'Well,' she replied, yawning, 'I'm sure we'll be fine. Every world has its own inexplicable mysteries. Death. The infinite nature of the universe.'

And then she fell asleep, her arm across his chest, her forehead resting against his neck. But on his way home from work the next day, he had stood on the bus and reflected on her words and had realised that it appealed to him, this idea that the perfectly competitive market shared traits with death, with the infinite nature of the universe. The bus crept along at snail's pace in the direction of the crossroads, his fellow passengers huddled tightly all around him with their accompanying sweat and bad breath, and he realised that he would escape all of this in the perfectly competitive market, that traffic jams and queues of any kind are classic examples of external effects, as are sweat and bad breath. And the bus turned towards Skøyen and his fellow passengers' heads blocked the view through the window, but between them he caught a momentary flash of sea, sky, sunshine twinkling on the ripples, a few gulls soaring in the breeze high above. A trailer obscured the view, then the traffic at a standstill dissolved; the bus inched towards the toll booth, but the image of the gulls, so free, independent, it lingered in Adam's mind, reminding him of their imminent

voyage, and of Susanne: the most astute member of the department, wonderful, remarkable Susanne, the woman to whom he was now married, the woman who had succumbed when he had promised her this honeymoon; and he recalls her surprise at his suggestion, the unfamiliar softness in her expression. We're going there tomorrow, he thought, Susanne and I.

*Much like journeys to the past, journeys to the perfectly competitive market remain at an experimental stage.*

The pull he feels is only vaguely distracting now, as if he had forgotten to eat.

*Surface contact between the fiction and our world is unexplored. It is not known whether tourists are subject to the local laws of nature and are able to adapt to these. For instance, we do not know whether visitors instantly and automatically gain insight into the local population's knowledge, and, if so, if they are able to handle such vast quantities of data.*

Amateur, Adam thinks. Why should anyone know *everything* others do? It's sufficient to know what one *needs* to know, anything that might prove meaningful for potential transactions.

*You are now in the process of landing. We wish you a pleasant stay. Welcome to the perfectly competitive market — happy shopping!*

The drag has stopped. He feels a momentary tremor, as if from a distant explosion; then, only intense silence.

Adam tries to turn, to look around, but the suit is too tight, too rigid, and everything remains entirely black.

He sits in silence and waits for his visor to open; he thinks of the sea and the gulls, of Susanne, sleeping, her cheek resting on his shoulder.

It's strange that it should take such a long time.

Patience has never been Adam's forte; what's more, his scalp has started to itch, a prickling sensation, and fairly intense at that. He longs to step out of the suit, to ruffle his hair, to rub his palms against his cranium. Perhaps it's much like ordinary flights: queues to the gate, absent ground crew, baggage delays. Well, it can't be queues, at any rate.

'Hello,' he says into the microphone. 'Sorry. Could you open up soon?'

Nobody responds. The prickling sensation doesn't seem to be dwindling; this is no ordinary itch, more like a buzz, a hum, like an enormous swarm of bees, creeping, crawling, around his skull, inside of it. He's sweating, more than before now, his forehead, his neck, his armpits, he wants to reach for his visor and force it open, but his arms grind to a halt as soon as he tries to move: the spacesuit is inflexible, rigid, tightly-fitted around every last inch of him.

'Susanne, is your visor open? Can you see anything?'

Adam's mouth is dry. The prickling has spread to his throat, his eyelids, his ears; he tries to concentrate, to take a deep breath, but it does no good, the air in the suit is stale, spent.

'Susanne?'

It can't have been the intention that they should spend this long inside their suits.

'Hello,' he calls out in a restrained manner. 'I'm going to need more oxygen soon. Can someone get me some oxygen?'

Adam recalls something the guide had said before they left, *you may need this on throughout your stay*, but he can't have been talking about the spacesuit, surely, being sealed inside a human-shaped tin can for the duration of his honeymoon? Ha ha.

'Hello!'

His lips are numb. He does his best not to give in to hysteria, he's not hysterical, he's just confined, blind, deaf, alone, under attack from this itch, suffocating.

'Let me out!'

His scream is muffled inside the snug helmet. He wants to kick, to thrash with his arms, what's happening to him, to Susanne, the swarm of bees rush around him, outside of him, prickling, stinging, what kind of practical joke is this, who's rigged this up, why won't anything work, why doesn't he understand anything, microeconomics is his field of speciality but never has he ever heard of people being sealed inside spacesuits in the perfectly competitive market.

'Susanne! Help!'

He's breathing far too quickly. He needs to pull himself together. He needs to save oxygen, this is his honeymoon, his honeymoon with Susanne; and there's a lot to be said about Susanne, but she's the one for him, the one he wants to be with, he's dying inside this human-shaped tin can without her and the only positive in all of this is the fact that he and Susanne managed, at least, to become husband and wife before it was too late.

*That is, if marriage entered into within a society with such primitive laws is considered legally-binding here.*

For a brief moment, he forgets to hold the swarm of bees at bay, to shield himself from them. Terror-stricken, he feels the horde merge with his thoughts, flooding his consciousness, submerging it; he gasps, feels something slip away, break free – then fall into place.

An immense clear-sightedness overwhelms him.

He knows everything.

He is in the perfectly competitive market. Everything that one person knows, he is also privy to – because what kind of information *can't* be viewed as bearing significance, directly or indirectly, for one potential transaction or another?

And the marriage contract with Susanne - it's entirely incomplete! Should they smile when they wake up? Should she step out of bed with right or left foot first? Who should take responsibility for opening the carton of milk? How close-shaven should he be, what compensation will he owe if he forgets to comb his hair or bestows a kiss without the requisite degree of passion? Hardly a thing at all is specified in their contract.

A relationship like that would be littered with external effects! All valid contracts must be fully-specified.

He sees everything, knows everything: green peas grown by the first grade sell for eighteen kroner per kilo, the yellowhammer's song costs forty-four kroner per minute, daylight is priced at fifty-eight kroner per day. Assembly-line workers are being recruited for sector fifteen with a reimbursement of twelve kroner per hour, depending on experience, with four kroner extra for those in good spirits, six kroner extra for long eyelashes. The supply of young men with immaculate skin on the marriage market is limited, the market clearing price correspondingly sky-high. Fresh air, with immediate delivery, is available at a cost of four kroner per cubic meter.

He closes his eyes and suppresses a wheezing cough as he struggles for perspective, to see the whole.

He can see it.

It is logical, beautiful, held together by a glorious sense of simplicity: like the equations in the articles that he and Susanne publish (separately — she'd never accept him as co-author, his contributions lack significance).

Of course people are sealed off from their surroundings! How else might absolutely *everything* be bought or sold? The sight of frosty grass, for instance, or misty sky, or wet asphalt, not to mention a glimpse of the sea, of the gulls: how could such things be bought or sold at market price if passers-by could experience them for nothing?

No: everything of potential value must be screened off from those who haven't paid for it.

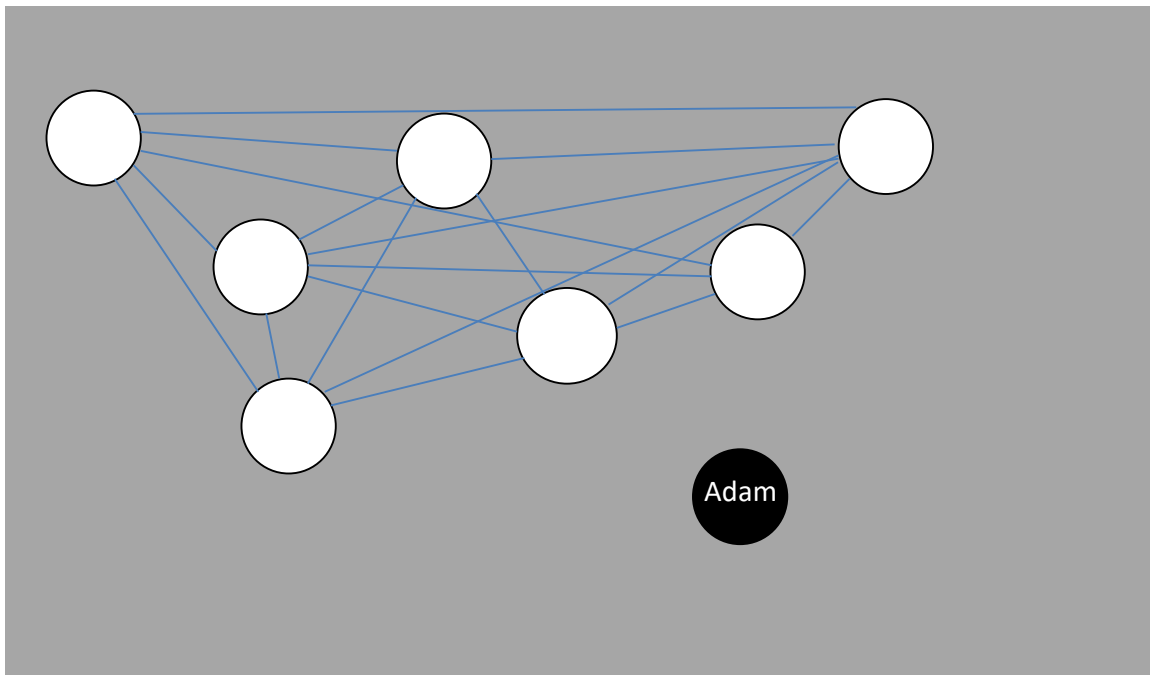
Hence, the spacesuit — immovable, rigid, sealed off from all access to air, sound and light.

How could it be possible that he, a researcher, has overlooked something so obvious? He's even requested, in his complete ignorance, to be allowed to 'get out', as if there was anything resembling 'out' here, as if all of those things that he thinks of as 'out' — shared surroundings, views, light, air — aren't actually public goods that do not exist!

*The perfectly competitive market is occlusion.*

Why has nobody ever pointed this out to him? Why has he never seen it so much as hinted at in the literature?

The outline of a diagram appears in Adam's mind, a structure that is marvellous in its very simplicity:



The diagram is schematic and, naturally, understates the number of private properties, as well as ignoring variations in size, shape and content, ranging from spacesuits like his own to the playgrounds of the wealthy, with marble pillars and intricate interior architecture – but none of this is important.

The focus is the hermetic shells, the bubbles, which serve to separate each individual. Without these, the perfectly competitive market could not exist. These are what secure the right to property, prevent freeloading, and shield the individual from the influence and interference of others.

And outside of these, in between them, there is but one thing, indicated by the lines in the diagram: the flow of trade.

Trade requires transport. Free movement, for example in cars or helicopters, is naturally quite impossible. People might crash or get in the way of others, therefore constituting external effects; what's more, there is no 'out' in which to freely move. Physical movement occurs via conveyer tubes – flexible, hermetically sealed pipes that can be extended or shortened, much like a telescope. The pipes extend between properties in which trade agreements are made, against the payment of market rent to coordinate owners along the line ('land owners' would be a misleading term, given that there is no outdoors and hence no land to own).

The insight feels immense, limitless: like being on top of the world, gazing out and seeing everything there is to see, understanding everything, like descriptions Adam has heard of taking heroin, he's never experienced anything like it, never felt anything quite like it, he and Susanne will be able to talk about this for weeks, years to come, to share memories of this vast, boundless clarity, to publish articles on it, to

publish together, anywhere they like, *American Economic Review, Quarterly Journal*!

If they get home.

Because now he can no longer suppress his gasps, his chest aches and a high-pitched whistling rings in his ears, and he realises that he'll pass out before long; in his unconscious state he'll be unable to enter into contracts, without contracts he won't be able to get hold of any oxygen, what did it cost again, four kroner per cubic meter, in the local currency, he doesn't have any of the local currency, what does he have to offer, assembly-line work? Himself?

Can *people* be sent via conveyor tubes?

Can one person make it into another's bubble?

Yes! That's the only way everything can be bought and sold, even services that require a personal presence — hairdressing, sex, marriage! When several people are together in the same room, they will naturally influence each other: contact, sound, smell, aesthetic enjoyment or displeasure. And so to ensure that all of these elements are considered part of trade and do *not* represent external effects, contracts that allow access to another's bubble must specify conduct, behaviour and emotional reaction to each and every kind of situation, specified in the most minute detail.

But shared surroundings — morning light through the curtains, the scent of green soap — aren't these public goods that do not exist?

Well, yes and no. Are they really public goods, if access to them is a fully-specified traded commodity?

This is a question of definition. As with other questions of definition, one version of the perfectly competitive market exists for every alternative definition; and fortunately, thanks to Susanne's intervention during the booking process, Adam and Susanne find themselves in version 14b, not 14a.

In version 14a, which happens to be the version most thoroughly explored in Adam's own lectures, there are no public goods, irrespective of whether access is traded. Only now does he realise that trade in services that require personal presence are, as a result, quite impossible. What's more, in version 14a, mutual sensory experiences do not exist at all. Things of that kind would be considered local public goods, which do not exist. In version 14a, everyone is therefore eternally separated in their own individual, hermetically-sealed bubbles.

But how, then, is it possible that everything of interest can be bought and sold? Simply because nobody in version 14a is interested in any kind of personal contact.

In fact, version 14a of the perfectly competitive market is the mental equivalent of a black hole: everyone possesses the same knowledge. That knowledge is therefore a public good. But there are no public goods, and there is, therefore, no such thing as knowledge.

The individual in version 14a of the perfectly competitive market is, therefore, neither aware of this fact, nor anything else at all, for that matter.

But he and Susanne aren't there. They are in a significantly more flexible version, namely version 14b! And Adam has a great number of things he can sell; he can work, he looks good – hey. Wait a minute.

What's this?

What on earth.

It can't be.

Is Susanne on the marriage market? Well, perhaps not all that surprising – but with *her own property*?

Adam chuckles and then coughs in quick succession. How incredibly ignorant he's been: how little he has understood, and what a great deal he has *misunderstood*! She had told him once, when he praised one of her analytical arguments, that she comes from here: Yes, she had said, I was born and raised in the perfectly competitive market. And he had assumed it was a joke – but has Susanne ever been in the habit of making jokes?

This is incredible. Brilliant.

Has he misconstrued things? No. Her property has room enough for the two of them.

Reaching an agreement is an easy matter. Her offer reflects the equilibrium price: he's young and he's never had a pimple. He suggests a number of additions and minor alterations, then accepts all of her conditions, every last detail, he doesn't even try to haggle, why would he haggle with her, this is exactly what he wants, this and nothing else. He signs the contract – it's sufficient simply to think it, a physical signature is redundant here, where everyone possesses the same knowledge: the entire population are immediately made aware of both the requirements and his acceptance, should the need for verification arise.

The visor opens.

Air flows into the helmet, cool, stale, like in a cave.

He breathes deeply, quickly drawing in as much air as possible. The suit loosens, opens.

Adam steps out cautiously. He is in a pipe, dimly-lit, tall enough that he can stand at full height, wide enough that he can move through it, a conveyor pipe, and not just any conveyor pipe; this pipe, pursuant to the marriage contract to which he has just agreed, is his very own conveyor pipe: the lowest standard, with coordinate rent covered for the first passage.

He takes a deep breath and starts walking; before long he breaks into a run. Susanne is standing in the doorway. He can see her from a distance. The door closes behind him once again and he's there, inside, in her arms, her warmth, her scent, jasmine, allspice, the fragrances of her perfume contractually stipulated, he had always believed it to be cinnamon, but who cares, it's the scent of Susanne.

They clasp one another with an unusual intensity, tearing one another's clothes off, running their fingers through one another's hair, just as specified in their



contract. And the feeling of being watched, seen by everyone, can only be compared to the time that he and Eva, the girl next door, his only childhood friend, were playing doctors in a tent in the garden at the age of eight, the yellow afternoon sunlight glowing through the canvas tent, and they opened the tent zip and tumbled out onto the grass only to discover the circle of girls from their class standing outside, laughing.

He is awoken by the sound of rain.

Adam pulls the duvet up slightly and moves closer to Susanne, as agreed upon. She is sleeping. The sound of falling rain is true to nature; her speakers are outstanding, and the same can be said for the rest of her equipment too, all types of weather in refreshing combinations; temperature and oxygen levels to suit the activity underway at any given time; clean, clear colours.

Even here in the darkness beneath the duvet, they're with him, the thoughts of the other seven billion inhabitants of the perfectly competitive market – just as his thoughts are with them. It's strange, he thinks. At home, we share our external features but cannot share those inside of us; here things are entirely the reverse.

An incredible combination: in peace and quiet, but never alone.

He reaches out a hand and finds the control panel, lowering the volume of the rain, turning on the windows. Clouds appear, building in form and depth, setting in motion. The room grows lighter, and he can see the ceiling, the walls, the chest of drawers: all these impressions legally bought and paid for.

Susanne is sleeping. She lies on her side in a light nightdress, her shoulders brown from the sun, her hand beneath her cheek. She likes the nightdress, too; it was the thing with the hand under her cheek that had been costly.

Fully-specified contracts covering all eventualities are incredible things; at home he constantly had to wonder what she dreamt about, what kind of mood she would be in when she woke up, what he should say or do.

But he needs to get up now. This is no holiday: access to Susanne's domain required more than simply good skin, his entire working capacity was part and parcel of their agreement. Today's job as an assembly-line worker has already been arranged, with full specification of all characteristics of the workplace and every influence of sense impressions between himself and other workers.

It's annoying that he can't work as an atomic physicist or a lawyer now that he finally has the knowledge that these roles require. But unfortunately others share this knowledge, too; moreover, the demand for lawyers is low in a society without secrets.

Adam hesitates for a second or two. He doesn't want to get up, he wants to lie there by Susanne's side for just a little longer. He pulls himself together and pushes the duvet to one side. As his feet touch the floor he feels a shudder, a subdued unrest, like distant thunder. He looks up, taken aback; the trembling subsides, and yet something feels different, as if the quality of the colour all around him has faded.

He kisses Susanne's cheek, as agreed, and gets up. She grunts, half-asleep, blinks a few times, then curls up in the foetal position, fists clenched beneath her chin, her elbows poking out, before stretching, yawning.

It's staggering, Adam thinks, that they even had to specify when and how she would wake up, and that she really does wake up that way – nothing whatsoever happens here by chance. The latter point is highly surprising: fieldwork is definitely undervalued as a research method in the field of microeconomic theory.

Adam has often told his students that uncertainty and random events present no problems in the perfectly competitive market. It's simply a case of ensuring that contracts are conditional, he has explained, as follows: 'If Susanne wakes up at 07:51 and grunts, Adam should kiss her on the cheek. If she wakes at 07:52 and grunts, he should not kiss her. If she wakes at 07:52 and does not grunt, he should kiss her forehead,' and so on. In such a way, even chance can be incorporated into fully-specified contracts.

What Adam hasn't thought about, apparently along with everyone else at home, for that matter, is the following. Let us assume that Susanne wakes up in an arbitrary fashion – that she pulls a face, for instance – and that Adam is standing nearby and registers this fact. In that moment, he will know about her expression. And, because all information is shared, everyone else will know with immediate effect, too, this new information forced upon them without them either having asked for or accepted it, without it having been articulated in any trade agreement: a startling example of external effects that do not exist.

This, Adam realises, is just one more consequence of the perfectly competitive market's inbuilt but sadly unrecognised inconsistency: common knowledge is a public good. Public goods do not exist.

In version 14a, the mental black hole, events can be as random as they like. There, new information has no effect whatsoever – every individual person's head is entirely empty regardless. But here, in version 14b, in Susanne's hermetically-sealed property, every observation of unforeseen events would impose new information on others, inside other bubbles. All privately observable events are, therefore, pre-determined; everything there will ever be to know about these, is already known.<sup>6</sup>

Imagine how astounded his colleagues at home will be when he points out this fact!

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<sup>6</sup> In contrast, in a third version, 14c, the concept of chance exists, and this world is therefore not pre-determined. All agreements that will ever be entered into are established at the beginning of time, by means of conditional contracts (much like those Adam explained to his students). After this, no decisions of any kind are ever made. For the rest of time, the inhabitants' lives roll on precisely in line with those first, unalterable contracts. New information is spread to everyone here in the same way, but it doesn't matter, because such information can have no influence on any transactions: there are no more transactions. Version 14c is, nevertheless, not particularly popular as a starting point for economists' evaluation of policy, since version 14c allows for no decisions to be made, political or otherwise, unless one finds oneself at the beginnings of time.

The weather on the monitors has cleared up. The clouds are white and dainty: fair weather clouds. In the top corner of the window image, three gulls move across the sky, distant, lifelike.

Susanne is sitting up in bed. She smiles, running her fingers through her hair. Adam smiles back at her, eyebrows slightly raised, as specified, Susanne, beloved Susanne, what a relief it is to be together again, gazing at one another for a few seconds, as stipulated in their contract, savouring the sight of her brown eyes, just a millisecond too long.

And in that moment he feels the trembling return, like a distant rumble.

‘Adam,’ Susanne says quickly. ‘We need to talk.’

Her voice is muffled, as if there’s something wrong with the audio.

‘Talk?’ Adam repeats, surprised.

Nobody talks here. There’s no need for talking here.

‘You’re not very well-integrated, Adam,’ she says. ‘There’s a lot you just don’t *understand*.’

He’s taken aback. Susanne’s hair is dishevelled, a tuft sticking out just by her ear. Does the contract specify that?

‘And you need to understand how things work here,’ she says.

He stares at her hair; he suddenly knows precisely what she’s going to say.

‘But, Susanne,’ he stammers. ‘You can’t just throw me out. We’re married!’

‘All of your contracts are annulled.’

Her expression is blurred, unclear. Perhaps he needs spectacles.

‘You’re completely unpredictable,’ she says, a hint of frustration in her tone, ‘entirely incapable of keeping to a contract! You’re reluctant to get up in the morning! You stare at me for too long! Why? Don’t you see that for every one of your uncontracted whims, *everyone* here is shaken, shocked! *What’s this?!* they think, *are those two influencing each other beyond the terms of their agreement? But isn’t the perfectly competitive market perfect?* You are creating tidal waves of external effects, over and over again!’

The colours in the room are translucent now, the contours indistinct. Adam blinks and rubs his eyes.

‘I thought you’d be as well-integrated as I was,’ Susanne continues, ‘that you’d fit right in, like I did in your world.’

Adam recalls the looks his colleagues had exchanged behind Susanne’s back, the students’ petrified expressions during her lectures; he says nothing, she looks dismayed.

‘This whole fiction is in the process of dissolving, Adam, all because of you!’

‘Me?’

Susanne throws her hands out in disdain, where is her infamous lack of expression now? She really *has* changed.

‘Well, *us*, then!’ she shouts. ‘I did my bit when we came here — a one-off event! A calculated risk! We both knew that the combination of their knowledge and ours was bound to create a myriad of external effects the moment we landed!’

This is a thought that had never struck Adam.

Susanne stares at him, terrified.

‘Didn’t it? Really?’ she says.

Among the well-integrated, all knowledge is shared. However, quite a bit of it is accessible to the poorly-integrated too; which is why Adam knows that it isn’t his indifference that scares her, the fact that he had overlooked the knowledge externalities bound to occur upon landing: his ignorance can be explained very simply by the fact that his earthly origins have neither trained him in mind-reading, nor in perfectly competitive market practice.

The scary part, for Susanne, is that *she* hadn’t registered his ignorance. And for Susanne, born and raised in the perfectly competitive market, this can really mean only one thing.

‘Adam, I loved you. That’s how well-integrated I was.’

He can hear the strain in her voice, her attempts to conceal that which cannot be hidden, just as nothing can be hidden here: the fact that she’s been in exile for too long, that she’s become integrated in another world, that she no longer fits in here.

He reaches out for her; he feels nothing, as if she’s not really there.

‘And now, for example,’ she continues, unruffled, ‘you’ve got a pimple on your forehead. How could someone like you enter into a fully-specified contract? Someone with no control over body or mind?’

‘Don’t you feel that way anymore?’ he whispers. ‘Don’t you love me?’

He tries to catch her eye, but he can’t, everything has become unclear, a film out of focus.

‘But Adam. What does that mean, to love?’

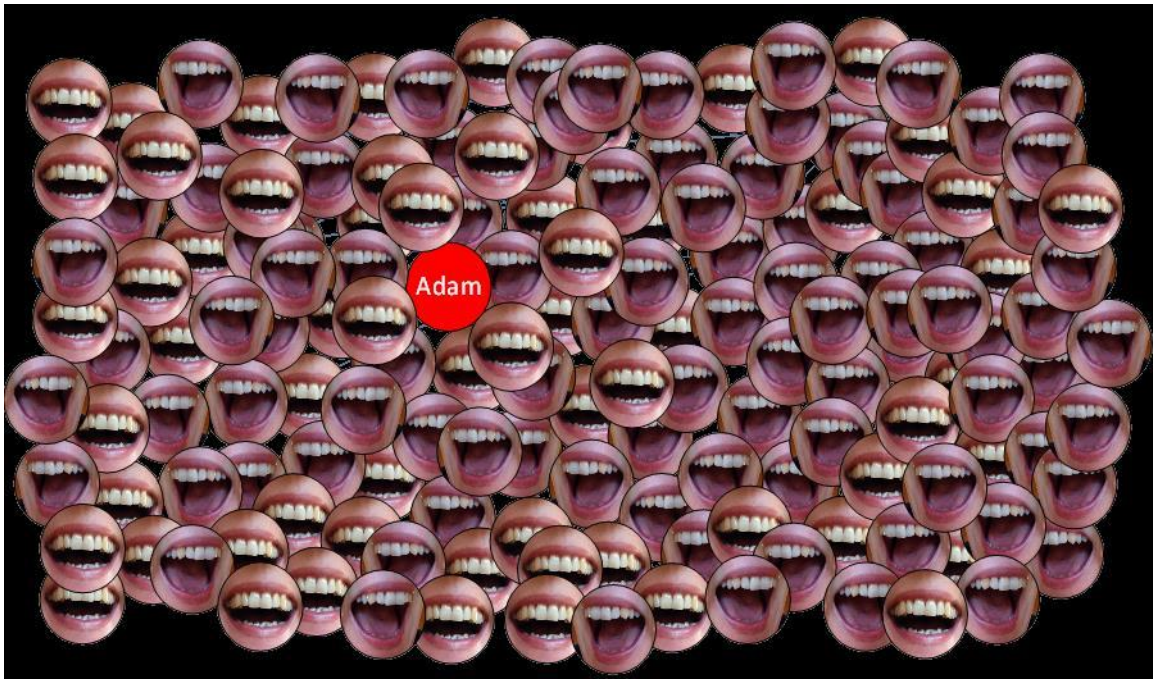
She speaks slowly, condescendingly, as if to a dim-witted child. He focuses on his shoes, bending over, trying to tie his lace.

‘To be irreplaceable to one another, perhaps?’ she suggests.

The lace is difficult to grasp; he’s lost all feeling in his fingers.

‘To be there for each other, unconditionally?’

The yellow afternoon sun glows brightly through the canvas tent, illuminating Eva, eight years old, lighting up her smile, her bright eyes. And the buzzing around Adam returns, it’s worse than ever, a ringing in his ears, a reverberation throughout his brain: people young and old, male and female, from every remote corner of the perfectly competitive market, they laugh uncontrollably, heartily, at him: the man who believes that love is possible here, in the perfectly competitive market.



‘I think you’re mad,’ Susanne says, smiling and drying the corner of her eye. ‘Think for a moment. A good that isn’t for sale? Market power in the sex market?’

Her words ring deep, unarticulated, slipping, like a record grinding to a halt. He reaches out for her, wants to shout that she must come home with him, that she at least has to lend him money for the coordinate rent, that the return transport won’t be here for another six days. But no sound escapes his lips. Her image becomes distorted, everything is hazy. Gravity must be out of order, too, he needs something to hold onto, staggers towards the door, grasps the door handle, it’s not there; the cold and smell of earth hit him all the same.

He turns. She’s gone. The door is gone. All trace of Susanne, of Susanne’s hermetically-sealed shell, gone.

He fumbles blindly for the walls of the pipe. He finds nothing, feels nothing, nothing beyond gasping for air, nothing beyond the sense of being devoured by an endless, bottomless hole.

It is perfectly dark, perfectly silent.

Where is he?

What has happened?

Is he still in version 14b of the perfectly competitive market, with nobody willing to trade with him?

Has he been sent to version 14a – the mental black hole?

Has he destroyed the perfectly competitive market for good? Is this Armageddon?

He doesn’t know. But neither does it make any difference; for him, the consequences are exactly the same.

And in the wake of this insight, another thought follows, a thought that shakes him, casts him into existential doubt, forces him to question whether his life and all of its work might have been based on a misunderstanding, an error.

He recalls the guide's words: *where the real world deviates from the utopia, so-called market failure, political intervention may be necessary; where the real world aligns with the utopia, measures are deemed unnecessary, since the perfectly competitive market does, after all, function perfectly.*

It is as if the words were lifted from one of his lectures, completely in line with his own conviction. Until now. Because now it occurs to him that this fundamental reasoning has, in one way or another, led him astray; though he can't pinpoint how, he feels that this honeymoon perhaps hasn't been completely perfect, that it might be nice, now, to see some kind of political intervention.

But he makes it no further than this in his thinking. This is the moment at which the oxygen levels in Adam's blood fall below critical levels for normal brain function. In a flash, just as his consciousness fades, the brain's dying synapses create one final, lifelike notion: strangers huddle tightly all around him, he can feel the warmth of their bodies, the smell of their sweat, their breath, and as the bus moves at snail's pace, he catches sight of something between their heads, blue sky, a flash of light on the sea, a gull. And Adam's final realisation is also his greatest: he misses the Skøyen rush-hour traffic.

### Part III: Discussion and conclusions

While writing the above story, I had to ask myself for every new sentence: *does this break at least one of the conditions?* Almost always, the answer was ‘yes’, requiring further rewrite and search for possible solutions. In the absence of mathematical proofs, I cannot guarantee that I have overlooked something; nevertheless, the following is a summary of what I found.<sup>7</sup>

#### Isolation

It seems impossible to escape that in a perfectly competitive market, each individual must – at least until appropriate trade agreements have been made – be completely isolated from others.

This does not necessarily mean that people must be locked into hermetically sealed shells, like in the story. Depriving people of all sensory abilities would also do the trick, as would being alone in the world.

The necessity of isolation can be explained in several ways, but is related to at least three of the listed market failures. First, if two or more individuals are together in one place, any shared surroundings (a nice view, the color of the ceiling, noise, music, temperature, humidity, smells) – are (local) public goods.

Second, if shared surroundings are affected in welfare-relevant ways by behaviors not internalized through contracts with everyone present (e.g., someone has painted the ceiling), this involves externalities, potentially affecting well-being as well as behaviors. Furthermore, any non-contracted, welfare-relevant aspects of social interaction itself (a passer-by smiling; a person standing too close; students looking bored during your lectures) involve externalities.

Third, isolation may be required to prevent missing markets, by ensuring that everything of interest can be bought and sold at the market price. Isolation not only protects the individual from being influenced by others in non-contracted ways; it also prevents others from free-riding on the individual’s assets (e.g., enjoying a person’s beauty without paying him), allowing producers to collect the market price.

#### Trade and transaction costs

If individuals were to be isolated from each other, it is not obvious how trade of physical goods, or services involving personal presence, could take place. First, such trade would presumably require transportation, which is typically fraught with external effects. Second, bringing suppliers and demanders together may compromise the need for isolation discussed above.

In the story, transportation happens by means of conveyor tubes, the use of which requires payment of a time- and location-specific market rent preventing congestion. However, this solution is rather unsatisfactory, since it involves transaction costs. While the story itself makes no mention of transaction cost being prohibited, allowing them would be at odds with the spirit of the Arrow-Debreu model. If transaction costs are to be avoided, I see no other solution than teleportation.

Even with teleportation, there are obstacles: trade in any labor or other service requiring simultaneous presence of several individuals in the same location – e.g., hairdressing, health care,

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<sup>7</sup> Readers who have not familiarized themselves with Part II may find some explanations below too brief; if so, I recommend going back to the story, in which further explanation is provided.

construction teamwork – would break individuals’ isolation, thus necessarily involving local public goods.

Hence, let us assume that public goods are allowed as long as they cannot lead to inefficient trade. Simultaneous presence of several individuals in the same location may then be feasible, but would require extremely detailed contracts to prevent external effects: all potentially welfare-relevant aspects of all interactions and surroundings must be covered by fully specified contracts between everyone present.

### **The troublesome inconsistency: symmetric information and no external effects**

An important requirement for perfect competition is symmetric information: any information potentially relevant for trade must be known by everyone potentially involved in that trade.

Can we limit what sort of information is relevant? This turns out to be hard. First, given that all joint activities must be governed by fully specified contracts, almost anything could be relevant for a trade agreement between almost anyone. Second, if some knowledge is not shared on the grounds of being irrelevant, there would be asymmetric knowledge about what is not shared, and whether this is indeed irrelevant.

Thus, let us proceed on the assumption that ‘no asymmetric information’ requires all knowledge to be shared. This makes knowledge a pure public good: non-rival, non-exclusive. In the perfectly competitive market, however, public goods do not exist.

At the outset, this makes the whole construction, as defined by the five requirements of the story, logically inconsistent.

The fundamental problem is the following. By choosing to learn something new, the individual creates external effects: her new knowledge is imposed on everyone else, although they may not (at least not all of them) have agreed to (or paid for) a contract specifying this.

If, in contrast, the new information were *not* shared with others, the individual’s learning would cause asymmetric information.

Uncertainty is particularly troublesome in this context. The outcomes of random events cannot be known in advance. Hence, observing such outcomes involves new knowledge – thus leading to information externalities.

If one insists on a strict interpretation of ‘no public goods’, this inconsistency can only be overcome if there is no knowledge. Trying instead to resolve the inconsistency in more reasonable ways, let us assume that any of the mentioned market failures are allowed under circumstances precluding inefficiencies in trade. I can then see four possible solutions.<sup>8</sup>

**Solution 1:** *All contracts are made at the beginning of the world* and cannot be renegotiated.

Learning affects others, since knowledge is a public good, but will not affect trade – since there is no more trade.

With this solution, random events may occur and be deliberately observed, and can be handled by means of contingent contracts. This is essentially the solution of the Arrow-Debreu model, in which contracts are implicitly entered once and for all before the uncertainty is realized.

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<sup>8</sup> I am grateful to Ken Arrow for outlining Solutions 1 and 2 to me.



**Solution 2:** *All knowledge is present at the beginning of the world, and never changes.* Knowledge is a public good, but since no learning occurs, there are no external effects.

With this solution, random events can only occur if they are not observed. Any such observations would yield new knowledge and thus externalities. The observable world is, consequently, predetermined.

**Solution 3:** *New information, if it arises, matters to no-one.* With this solution, learning is allowed precisely because it is inconsequential. But if learning occurs only for matters of no concern, Solution 3 is hardly distinguishable from Solution 2. With respect to all observable and welfare-relevant variables, the world is predetermined.

**Solution 4:** *New information, if it arises, is provided simultaneously to everyone by nature.* That is, learning is possible, but not by individual choice. Any learning is simply a random event, involving no externalities. Since everyone learns the same information simultaneously, information is kept symmetric.

Whereas each of the above suggestions solves the logical inconsistency, none of them are, of course, even slightly realistic. I summarize the above argument as follows:

***Proposition 1 (the third theorem of welfare economics):***

*If i) trade is permitted at any time, ii) deliberate learning is possible, and iii) new information may matter for welfare, no perfectly competitive market can exist.*

In the present context, the proof can obviously be verbal only. Its logic rests on the discussion above: under the conditions of Proposition 1, symmetric information and absence of external effects cannot hold simultaneously.

**Narratives about market efficiency**

I know of no economist who claims that the real world is like the perfectly competitive market. Nor do economists typically conduct their analyses as if this were the case: studying the implications of asymmetric information is, for example, central in modern microeconomics.

I have, however, often heard good economists claim that the perfectly competitive market represents an approximation to the real world, or a simplification of it. Such narratives turn out to be rather misleading: a world with no free, spontaneous social interaction, no shared outdoor areas or willful learning, but with free access to every other person's thoughts, hardly resembles anything one might experience in real life.

Obviously, my story neither disproves nor disputes previous mathematical results such as those by Arrow and Debreu (1954), Arrow (1951), and others. The relevant question is rather whether the assumptions underlying the two fundamental welfare theorems are consistent with the narratives of trade in human societies economists often seem to have in mind when discussing those theorems.

Proposition 1 above points out that even in theory, a perfectly competitive market may be logically inconsistent. In practice, it is obviously infeasible under all sorts of circumstances. We share outdoor as well as indoor environments. Teleportation is not, as yet, possible. Humans are social animals – to the extent that when alone, trying to think of nothing in particular, our minds are spontaneously drawn to social relations (Lieberman 2013). Externalities, thus, are everywhere. Humans are not mind-readers; hence asymmetric information is always present too. We form social bonds, making

individuals unique to each other, not easily replaced by others with similar characteristics – meaning that market power is everywhere as well.

The first fundamental theorem of welfare economics is often presented as saying that the market equilibrium is Pareto efficient, provided that certain assumptions are fulfilled. Given Proposition 1 above, an alternative and perhaps more helpful statement is the following: the first fundamental theorem of welfare economics establishes that to guarantee market equilibrium efficiency, extremely strict assumptions are needed.

### **Social interaction in markets**

Economists' notion of perfect competition was hardly contrived of to analyze the private family sphere, with which my fiction story is largely preoccupied. Note, however, that this is not the source of the story's absurdity. Had the tale taken place in a market context, such as the factory floor or at the hairdresser's, it would presumably have become equally bizarre.

Absurdities arise because external effects, asymmetric information and other market failures are integral parts of normal human interaction, shaping behavior wherever people meet and relate to each other – within and outside of markets. The problems discussed above are thus likely to be present in most markets, but may be of particular importance where human interaction is an essential part of the transaction – e.g., in labor markets and markets for personal services.

Social interaction is involved in all socially learnt and culture-specific behaviors, of which many affect markets: leadership styles, teaching styles, clothing styles, dietary customs, and so forth. Examples of economic implications of social interaction are numerous, including conspicuous consumption (Veblen 1899); housing market segregation (Schelling 1978); fair wage-setting (Akerlof 1980, Bewley 1998); crowding phenomena like waiting lines in restaurants (Becker 1991); customs, fads and subcultures (Bernheim 1994); cooperation and revenge (Rabin 1993, Sobel 2005); employee motivation (Benabou and Tirole 2003, Dur and Delfgaauw 2008, Brekke and Nyborg 2010); social norms, conventions and coordination equilibria (Bicchieri 2006, Young 2015, Nyborg et al. 2016), to mention some.

One aspect of social interaction that still seems understudied in economics is the phenomenon of bonding. Precisely because it is vital to human well-being, social bonding is likely to lead to severe inflexibility in markets such as labor and housing markets. For example, befriending one's colleagues bestows market power on one's employer; similarly, landlords gain market power if their tenants, or tenants' children, befriend the tenants next door.

### **Final remarks**

The fiction story about the perfectly competitive market comprising Part II of this essay proceeds much like a standard economic theory paper: it specifies its assumptions early on, then exploring the logical implications of those assumptions. This yields several rather surprising insights, some of which may have been difficult to see using a more conventional approach. In particular, if trade can occur at any time, and deliberate, potentially welfare-relevant learning is feasible, no perfectly competitive market can exist.

Some may object that taking the assumptions of no market failure literally, like I have done here, is unreasonable. For example, some of the external effects caused by normal social interaction may be minor, only marginally relevant to markets. Nevertheless, adopting a flexible view of one's assumptions is not the usual standard in economic theory. Modifications of assumptions should be explicit; complications cannot be dismissed by hoping that their importance is limited.

While representing a useful benchmark for theory, the perfectly competitive market constitutes neither a normal nor an attractive situation. Where two or more human beings are present, market failures will be present too – partly because what we call ‘market failures’ comprise fundamental building blocks of normal social life. Even after appropriate redistribution, the level of social welfare in a perfectly competitive market would presumably be extremely low, since everything that is welfare-enhancing but might mess up market efficiency would be missing: love and friendship; parks, forests and lakes; philharmonic concerts and soccer matches; outdoor cafes, sunny beaches. In the perfectly competitive market, nothing is lost in free trade – but there was never all that much to lose.

The first fundamental theorem of welfare economics is often presented as saying that – in the absence of market failures – the market equilibrium is Pareto efficient. However, if trade is permitted at any time, deliberate learning is possible, and new information may matter for welfare, one cannot, even in theory, exclude the presence of market failures. Another interpretation of the first fundamental welfare theorem is, thus, that it demonstrates why markets are never guaranteed to work efficiently.

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