III Abstraction and idealization

1 Introduction

A multitude of authors have contributed to debates over the use and alleged abuse of isolational practices, that is, idealization or abstractive reasoning. Isolation is here used as a general and rather inexact term. It is often referred to as the use of ‘closures’ in debates over methodological issues in economics. A quick glance over one of my bookshelves helps me to mention those making up just over the first half of the alphabet: Marcel Boumans, Nancy Cartwright, Victoria Chick and Sheila Dow, Bert Hamminga, Wade Hands, Daniel Hausman, Maarten Janssen, Theo Kuipers, Tony Lawson, Uskali Mäki, Thomas Mayer, Leszek Nowak. These are all scholars who have discussed economics at a meta-level and it is difficult to mention two authors using one such concept like ‘idealization’ in evidently the same way.

In the following section, I shall discuss the difference between horizontal and vertical isolations as introduced by Uskali Mäki, because his discussion of closures in economics is the most subtle I know of. Next, section 3 is to give a very specific meaning of the notion of idealization as horizontal isolation. I shall try to make this notion more precise than I did thus far. To this end, I shall make use of a well documented and often used case from physics. Section 4 takes another look at closures from the point of view of abstraction, or vertical isolation. It is often a prerequisite for policy relevant research to allow for some form – but not for all forms – of ‘unrealistic’ theorizing. The distinction between idealization and abstraction helps understanding how policy relates to theory. In addition, one common way of isolating fields of study from disturbing influences is the insertion of a vague ceteris paribus clause. In section 5, I aim to show that it is problematic to interpret the use of such vague clauses as a case of idealization. I shall distinguish between abstraction from explananda for which there is, and from those for which there is not an explanans available and claim that in using vague instead of well-specified clauses, economists tend to abstract rather than to idealise. The policy relevance of theories with such closures depends on the availability of additional theories.
2 Isolations: a simple taxonomy

Isolation is a common term for rendering unspecified sorts of closures. I shall introduce a basic taxonomy of vertical and horizontal isolations, a distinction proposed by Uskali Mäki.

2.1 Clauses concerning the ceteri

In the special sciences generally, and even more so in economics, there seems to be little agreement on the meaning of such terms as idealization, abstraction, ceteris paribus, concretization, and on what counts as unrealistic modelling. There are a bewilderingly many meanings in which the so called 'lack of realisticness' is discussed in the literature. As can only be expected, confusion is ubiquitous.¹

Ceteris paribus clauses tell us that, by assumption, certain possibly causally relevant variables take a limit value. Marcel Boumans uses a total differential to show how economists treat their cetera.² According to him, a causal and invariant correlation between two variables, y and x, can be written as:

$$\Delta y = \Delta x \left( \frac{\delta f}{\delta x} \right) + \Delta OC \left( \frac{\delta f}{\delta OC} \right)$$

in which OC is 'other circumstances'. So then the clause

$$\Delta OC = 0$$

means ceteris paribus. However, the assumption that

$$OC = 0$$

may better be labelled ceteris absentibus. Thirdly, social sciences use a ceteris neglectis clause meaning that a relation between two variables is relatively invariant as a consequence of the negligibility of the causal influence of the 'other circumstances':

$$\left( \frac{\delta f}{\delta OC} \right) = 0$$

In social science, the scope for experiment – for control – is very limited. Boumans notes that social scientists are therefore above all passive observers. Their models serve as virtual labs, which comply with the ceteris neglectis clause.

¹ Uskali Mäki has developed a taxonomy to weed out the ambiguities in the debate on the precise role of isolations and closures in economics: “‘is unrealistic’ has been taken to apply to representations that do not refer to anything real; do not represent any features had by their existing referents; are false; are non-observational; are non-comprehensive; are simple; are abstract; fail in empirical tests; are implausible; are practically useless.” Mäki (1992b), p.320.
² Boumans (2003), p.11.
I take Boumans’ total differential to illustrate the diversity of respective clauses that may be introduced in order to engage in an idealization. This means that, under certain conditions, a ceteris paribus clause, a ceteris absentibus clause, and a ceteris neglectis clause can all be instruments of ‘idealization’. But the notion of idealization has as yet not been made precise enough.

2.2 Horizontal and vertical reasoning

Note that, in the total differential, the use of these clauses, which I believe can all usefully be explicated as special cases of idealization, always involves a finite listing of the ‘other circumstances’. This is because without clarity as to precisely which variables are subject to the closure, it is impossible to know how ‘ideal’ the object of idealization is treated. Take the example of market demand. If market outcomes are different than expected on the basis of a market theory and a number of initial conditions, one can try to look for circumstances explicitly referred to in the clause so as to find the source of this deviation. The clarity of reference potentially may help to solve part of the Duhem-Quine problem if it ever comes to testing.\(^3\) The reference is clear so long as the clauses of economic theorems have a well specified content. With the reference of the clause well indicated, the idealization resulting from the use of such a clause renders a closure, *which does not increase the abstractive level* of the idealised theorem relative to the non-idealised claim we started with. That is why the epistemic operation under consideration here is coined ‘idealization’, and not ‘abstraction’.

I want to borrow Mäki’s own example to explain the difference. A demand function, which states a functional relationship between the quantity of a good or service \(q_1\) and its own price \(p_1\) and the prices of other but related goods \((p_2, ..., p_n)\), can be made more simple by rephrasing it in terms of a function of price only, under the force of the assumption that the prices of other goods do not change. In order to do so, the economist needs to introduce a clause concerning the causal influence of the prices of the other goods and services and the prices of substitutes. So the reasoning runs from:

\[
q_1 = f_1(p_1, p_2, ..., p_n)
\]

to:

\[
q_1 = f_2(p_1).
\]

In sum, well specified clauses help to make idealizations take form in economics and the level of abstraction does not increase by the use of such clauses. For this reason, Mäki calls this type of closure, or isolation, ‘horizontal’.

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3 Briefly, the Duhem-Quine problem is that falsification of theoretical hypotheses is logically impossible since the truth of an indefinite number of auxiliary conditions remains unsettled.
Vertical isolations, then, are those that do increase the level of abstraction of propositions. Mäki gives an example from demand theory. The formula:

\[ q = f(p) \]

is more abstract than:

\[ q = a + bp, \]

but this latter one is again more abstract than:

\[ q = 8.5 - 0.85p. \]

The move from the first to the third formula ‘is one of increasing concreteness’\(^4\) and the reverse way a case of abstraction. An economist – or indeed any cognisant agent – who abstracts from particular propositions is leaving out some spatio-temporal detail of what is referred to by the respective concreter or more abstract claims. The object referred to acquires more generality, as Mäki’s example clearly shows. Abstraction, then, is a sub-species of isolation and it epistemically moves in a vertical direction. The importance of the distinction between horizontal and vertical isolation becomes evident when one considers that de-isolation in one direction can be accompanied by isolation in the other direction.\(^5\)

### 2.3 Abstraction and its use in explanatory theories

To say ‘the rusting of an iron nail is an instance of oxidation’ has aspects of what above was identified as an abstractive move. This is because the properties of the process of rusting, which include the discoloration of the iron, the loss of integrity of the material and the swelling, are not referred to in a scientific description of oxidation. These concrete properties, accessible for direct observation, are abstracted from in the explication in terms of ‘oxidation’.

Of course, claims about oxidation are not directly implied by claims about rusting without a chemical theory that explains why rusting is in fact oxidising. Some more claims are needed to make it an abstraction in the sense I explained in this section. These very claims in the theory make possible a conditional of the form ‘if this nail rusts and if [the relevant chemical theorems], then this nail oxidises’. The reason why abstraction is scientifically so interesting in this case is that the similitude with quite another natural process now becomes apparent. Take the burning of a piece of wood. This is also an instance of oxidation. If stuck to the concrete descriptions of the rusting of nails and the burning of pieces of wood, viz. without the relevant theorems from chemistry, no living soul would see any similarities between the two processes. Fires strike us with their fierce properties of

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\(^5\) Mäki (1994a), p.152. Mäki takes an example from Haavelmo (1944), in which the author concretises (or de-isolates) and idealises at the same time. Mäki borrows the term de-isolation from Adolfo Garcia de la Sierna.
heat, light, and even danger, properties that are so very different to our senses than those of the slow process of rusting. In these examples of abstraction one can see the use of what I shall explain below as existential generalization: there are particular properties such that these help identifying oxidation, but in every instantiation of oxidation these properties can be different. Due to this, an uninformed description of the spatio-temporal detail of rusting and burning emphasises their differences and obscures their similarities. The more abstract descriptions of both as a process of oxidation makes us see their fundamental likeness.

It seems to me that this is what Böhm-Bawerk meant to convey as he stressed so often that the point of scientific (and by implication, economic) research leading to truth was to find deeper lying processes, the explanation of which would unify our vision of the more apparent phenomena. To give a unified description of social phenomena such as borrowing money and trading goods, abstraction was required. So forms of abstraction can be a tool in explanatory unification. However, I shall use abstraction in a very specific sense in section 4 below.

3 Idealization

In the course of the history of chemistry and physics three related laws have been discovered that constitute physics textbook knowledge today. They are obvious candidates to illustrate problems of idealization and abstraction. The laws concern the behaviour of gases in a closed container. The discoveries took place in an order from simple to more complex, and, as I shall maintain, from idealised to de-idealised. My aim will be to get an understanding of the difference between idealization and abstraction.

3.1 From Boyle to van der Waals – and back again

Robert Boyle is the British chemist (but born in Ireland) today considered the father of chemistry. For instance, he gave the first modern definition of a chemical element. Boyle’s Law appeared in a 1662 appendix to his New Experiments Physio-Mechanical, Touching the Spring of the Air and its Effects, (1660). (In fact, Mariotte was the original discoverer.) The 1660 text was the result of three years of experimenting with an air pump. The law states that the product of the volume of a container, such as a pump, and the pressure of the gas in the container is constant. In an equation:

\[ \text{Volume} \times \text{Pressure} = \text{Constant} \]

I do not wish to distinguish between description and explanation here. An abstract description of a real process will, as a rule, strike the scientist and the layman as explanatory because of the scope for unification that the abstractive move opens up. Strictly spoken, successful explanations are descriptions; they are very good descriptions, at least from an explanatory point of view.
\[ PV = c \]  \hspace{1cm} (1)

In other words, \( P_1V_1 = P_2V_2 \). But Boyle had some luck in his experiments. The container he used was by no means adiabatic. In consequence, temperature changes were offset nicely; so a spontaneous material isolation from these temperature variations and not any theoretical closure enabled him to discover his law.

The three gas laws: progressed de-idealization

Results of experimentation by Jacques Charles in 1787 (and, independently, by the French chemist Joseph Gay-Lussac in 1802) showed that there was also a fixed relation between the temperature of a gas and its volume, if the pressure was kept constant. Every degree Kelvin increase of temperature gave nearly a 0.4 per cent expansion of the volume. (The more precise present day textbook figure is 0.3663 per cent.) The combination of Boyles law and Charles’ Law leads to the Ideal Gas Law, which says that the product of the volume of a container with gas and its pressure divided by temperature is constant; or:

\[ PV = c^*T \]  \hspace{1cm} (2)

The constant \( c^* \) is generally written as \( nR \), i.e. the number of moles of gas molecules \( n \), multiplied by the ideal gas constant \( R \). It is most accurate at conditions that correspond to low pressure and moderate temperature, like the atmospheric conditions.

Nobel prize winner (1921) Johannes Diderik van der Waals modified the Ideal Gas Law in 1873. He did so by theoretical reasoning, not by experiment. The van der Waals equation is more complex but also (roughly) correct for a liquid: it is, in other words, not phase specific. This is because in a liquid phase, the size of (and the forces between) the molecules relative to the total volume of a mole of substance cannot be reasonably neglected any more and the van der Waals equation takes the properties of the individual molecules into account. The equation is:

\[ \left( P + a \frac{n^2}{V^2} \right)(V - nb) = c^*T \]  \hspace{1cm} (3)

in which \( c^* \) is a constant again generally written as \( nR \), \( a \) is a measure of the attraction between the particles due to pairwise attractive inter-particle force (an example of the van der Waals force), \( b \) is the volume enclosed within the molecules (per mole of substance, \( n \)).

However, the Ideal Gas Law is often used as a rough approximation in science and engineering calculations. It is said to be an idealised form of the law of van der Waals. If the non-zero size of the particles (causing repulsion) and their attraction are both assumed to have the limit value of zero, equation (3) reduces\(^8\) to

\[ R = 8.314472 \text{ Joule per degree Kelvin per mole.} \]

\(^8\) Reduction is used here in a somewhat vague sense, not necessarily in the more precise sense that laws can be reduced to explanatory theories.
equation (2). Moreover, if temperature is assumed constant in the Ideal Gas Law, equation (2) reduces to equation (1).

Idealization and falsity
Some considerations are in place. First, Boyle's law can be seen as expressing a range of instantiations of the Ideal Gas Law. At one chosen temperature (in the case of the actual experiment by Boyle, around room temperature\(^9\)) the Ideal Gas Law is instantiated in the form of Boyle's temperature specific Law. At another temperature it is instantiated again. Secondly, both the Ideal Gas Law and Boyle's Law are phase specific: they are not accurate enough for liquids. But note that they are not molecule specific. In contrast, the parameters \(a\) and \(b\) in the van der Waals equation have a value related to the sort of matter subjected to changes in temperature, pressure, and volume. So, as \(a\) and \(b\) are taken into consideration, the van der Waals equation is molecule specific. However, and this is a third point to note, the phase non-specificity of the van der Waals equation suggests that it represents a lawlike statement (in a Böhm-Bawerkian sense) more fundamental than the other two equations, or at least more unifying.\(^{10}\)

What connects the three equations is that they form a derivational sequence if some variables are assumed to have a limit value. This, then, must amount to idealization in the sense of the taxonomy I discussed in section 2. With the size of the molecules (or the repulsion force) and attraction forces assumed zero, we get the Ideal Gas Law. In turn, by experimentally holding temperature constant we get Boyle's Law. This is a case of limiting its change to a value of zero, or the use of a ceteris paribus clause – and, moreover, a case of material or experimental isolation. In sum, we get the following picture.

\[
PV = c^{\Delta T = 0} \quad PV = c^{T} \quad P + a \frac{n^2}{V} (V - nb) = c^{T}
\]

An arrow indicates what is derived under the assumption specified on top of the arrow. They point into a direction counter the historical development of physicist's understanding of the gas laws.

We can also think of this in terms of formulas at a higher level of abstraction, as follows.

\(^9\) An interesting aspect of the spontaneous closure that occurred in the experiments Boyle did over three years is the following. Suppose a scientist was not aware – as Boyle himself wasn’t – of the precise closure needed to get to the simple law that he discovered: the constancy of temperature. Would he not try to isolate as many possible causal influences as possible? In order to do so, the scientist would probably prefer to use insulating materials for the gas container, like some synthetic fabric and not a metal that conducts heat. But in that case the rise in temperature, triggered as pressure goes up, would not be offset in the way that it was in Boyle's experiments. It was the very lack of modern insulating materials – that is, his inability to carry through an isolation – that caused his luck and permitted him to discover the law.

\(^{10}\) The Böhm-Bawerkian sense in which it is more fundamental is that successful conceptual unification must be the product of successful research into what is a 'fundamental' aspect of reality.
The more abstract equations are entailed by the concreter equations, the latter entail the former. Hence, the step from $PV=c$ to $P=f_1(V)$ is deductive. It is truth preserving, for it only leaves out some hard detail from the description; it does not introduce the claim that such detail has in fact somehow vanished from our world. There has been, one could say, some ‘spatiotemporal’ detail left out; this is the precise form of the function $f_1$; or, in physical terms, the constancy of the product of $P$ and $V$ is disregarded. The same is true for functions $f_2$ and $f_3$. In section 0 I shall engage in further considerations about abstraction.

Reasoning along the arrows – from right to left – develops conditionally deductive. To deduce the Ideal Gas Law from the van der Waals law requires the truth of the (false) condition that $a$ and $b$ have a value of zero and to deduce Boyle’s law requires acceptance of the condition that temperature remains perfectly constant. Two issues now arise. Firstly, the introduction of a false condition touches upon a key issue in contemporary economic methodology. It is well known that many methodologists ask how blatantly false claims can help the science to produce true theories. The approach to sufficiently truthlike theories seems to require an increase rather than a decrease in the number of true propositions. As stated in the introduction to this chapter, this is the problem of how to deal with ‘closures’. There also is the logical problem, that when conditionals – conceived as material implications – have a false antecedent, logically, the conditional claims themselves are trivially true. My aim in this chapter is to solve both the more general and the logical problem. Secondly, there is an ambiguity between the process and the product of idealization. The sort of reasoning which goes under the name of idealization must be distinguished from the claim we have after carrying out an idealizational procedure. I shall deal with these issues in the respective order.

As to the first issue, of falsity, suppose that we believe that the van der Waals equation expresses a relationship true of the actual world (we do not; we know that the van der Waals equation is an approximation too). We can formulate the idealization of the van der Waals equation as a counterfactual:

“if the value of $a$ and the value of $b$ both were equal to zero, then the Ideal Gas Law would be true”.

Note that this is a subjunctive conditional with a false antecedent, which is precisely what turns it into a counterfactual. In which sense can we speak of the introduction of a false claim? It is important that the falsity is introduced before the entailment ‘then’. In using a counterfactual, it is as if we have stepped from the actual world to a hypothetical world, which is close enough to the actual world in the following respect. All physical laws are more or less the same as they are in the actual world (in ‘our world’) except that molecules are not subject to attraction and repulsion. Clearly, this hypothetical world is only logically and not physically possible. Therefore the description of such a world can be judged unrealistic. Strictly
spoken, the Ideal Gas Law would be true if the van der Waals equation plus the specified conditions were true. Likewise, Boyle’s Law is entailed by the Ideal Gas Law under the condition that temperature remains constant. So now I ask: given the physical (near) possibility of keeping T constant, can one simply say that in the idealization of the van der Waals Law toward the Ideal Gas Law there is plain falsity involved, whereas in the idealization of the Ideal Gas Law towards Boyle’s Law there is not?

Boyle did keep temperature roughly constant, so perhaps equally roughly the assumption of the constancy of temperature is physically possible to mimic. What really happened is that in compressing the container, temperature was in fact rising. But it went unnoticed as the variations in temperature were offset easily due to the lack of thermal insulation. So the gas temperature stayed on one isothermal curve during the experiments, once again roughly. The point is that the more trouble one takes to perform the experiment accurately, the better one approximates an isotherm. Ultimately, it is physically impossible to keep temperature constant other than by approximation. This, now, is true of the Ideal Gas Law as well. It is however a better approximation than the ideal gas law. It is physically impossible to exclude repulsion and attraction between molecules, but with a bit of effort, one can approximate such a situation, by working with gas under low pressure up to the point that the factors assumed to have the limit value cannot be materially be manipulated further as with helium gas. In this case there seems to be a *ceteris neglectis* clause involved, in the former case of keeping temperature constant a *ceteris paribus* clause.

Note that it is *the result of reconstruction* that Boyle’s law can be understood as an idealization of the Ideal Gas Law. Boyle himself did not know the need for the specific ceteris paribus clause, for he did of course not start reasoning from the Ideal Gas Law upwards to more idealised cases. He had just been experimenting within his focus of research: the relation between pressure and volume.

Let me now turn to the second issue, the process-product ambiguity. Depending on the intentions of the inquirer, the answer to the question ‘what is an idealization?’ can now plausibly both be ‘the reasoning process by which a scientist introduces a false clause into the antecedent of a counterfactual in order to arrive at a true claim about (an) hypothetical world(s)’ and ‘the form a lawlike proposition takes under the pressure of a false clause’ . The reasoning is that given the van der Waals law, if the clause $a=0$ and $b=0$ holds, the Ideal Gas Law follows deductively. The product of the idealization is the form the van der Waals law takes if $a=0$ and $b=0$, that is, the Ideal Gas Law. Indeed: the counterfactual associated with the reasoning process follows deductively from the van der Waals equation.

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11 Even the van der Waals equation is only approximately true, as can, for example, experimentally be shown with substances in a process of phase transition.

12 It is perhaps plausible to speak not of ‘the pressure of’ but rather of ‘the degree of freedom created by’ the false clause.

13 I thank Erik Krabbe for the formulation of the proof, in terms of the same the same possible worlds.
We now have, I believe, a background example against which we can study questions of truth and falsity in the use of closures and discuss my alternative version of idealization and abstraction.

### 3.2 Idealizational conditionals as conditional implications

The obvious occurrence of ‘falsity’ in scientific propositions is not just a reflection of the difficulty to create ‘nomological machines’ – as Nancy Cartwright calls these – in the natural or the social world. There is more to the common use of false clauses, that is, of idealizational theorising. This ‘more’ is that the make-up of non-actual but (physically, economically) possible worlds can be scientifically interesting, even if these hypothetical worlds are dissimilar in some relevant respects to the actual (or ‘real’) world. Why is this so?

I think the reason is this. I have just proposed to phrase idealizations as counterfactual propositions, the antecedent of which contains a false clause, that is, false with respect to the actual world. But, although the antecedent is false, the counterfactual itself may well be true! To show what this means I shall subject my general idea of idealizational propositions to a scrutiny somewhat more rigorously than I did so far.\(^\text{14}\)

In this subsection I shall propose an understanding of idealization in terms of hypothetical worlds. Next, I shall discuss the issue of the external validity of theories that idealise and provide a definition of ‘external validity’. Thirdly, the difference between idealization and abstraction will be taken into consideration once more, but now with some more precision.

In general, idealizations can be written in the form of a counterfactual ‘if D then if it were the case that … then it would be the case that DD’. Proposition DD is what results after the idealization of another proposition D. Above, for example, the van der Waals law is D and the Ideal Gas Law is DD. Furthermore, deliberate falsity is introduced in the open space of this counterfactual; without falsity the conditional would not be a counterfactual, but a subjunctive conditional.

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\(^{14}\) Quite some time after engaging in this idea I noted, very much to my surprise, that Ilkka Niiniluoto had proposed the same: to see idealizations in general as true counterfactuals with false antecedents. See Niiniluoto (1990). However, his formalization is strongly rooted in Nowak’s notion of Idealization and Concretization and, secondly, I here try to develop the idea further with respect to the special case of economics and its relevance for policy. Pietrosky and Rey proposed to link ceteris paribus-laws with subjunctive (rather than counterfactual) claims. See Pietrosky and Rey (1995), p.104.
Very successful experimental set-ups can be seen as hypothetical worlds “made” (nearly) actual, so that the antecedent, where the clauses are located, is (approximately) true. Such set-ups are precisely the nomological machines I understand Cartwright is referring to as showing (true) laws, which are not universal – the universality lacking precisely due to the spatio-temporal uniqueness of the experiments, or the instability of the material conditions that keep the details of the experiment together.15

In idealizations, the falsity is introduced in the antecedent as a consequence of the use of a well specified clause, CL. The clause may for example be a ceteris paribus clause, or a ceteris absentibus clause, or any other clause which deliberately describes a non-actual state of affairs. In my discussion of the gas laws, the clause was that the attractive forces between molecules and their repulsion both have a value of zero (in deriving the Ideal Gas Law), or that temperature remains constant while pressure and volume change (in deriving Boyle’s Law).

Thus, an idealizational counterfactual can be written like this:

\[ D\&CL \quad \square\rightarrow DD \quad (4) \]

The box-plus-arrow sign again distinguishes this conditional from the much weaker material implication. The conditional reads ‘if D is (were) true and if CL were true, then D would be true’. It interests us what is so special about CL. To make this clear, I shall now introduce some model theoretical notions in the spirit of Lewis and of Wolfgang Balzer et.al.18

A theory T (here taken to be a set of propositions) is phrased in a particular language, L. In other words, the language L generates a (large) set of models, M(L). Any consistent theory in L has models M(T) for which T is true. The set M(T), then, is a subset of M(L). The models of a theory T, elements of M(T), can be interpreted as hypothetical worlds; worlds that have properties described by T of which these hypothetical worlds are models.

A true theory – a theory any scientist with realist inclinations may be supposed to aim for – has (a set-theoretical representation of) the actual world among its models. That is what truth simpliciter means. I shall refer to the actual world by the symbol @, and to hypothetical worlds as w. Worlds w may be relatively similar to @ in that the same laws of nature hold in them, or that the same true propositions of economics are true of them. Hypothetical worlds w may also be very dissimilar to @, in that they are, for instance, physically impossible.

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16 In section 5 we shall see why a clause must be well specified in order to render idealizations.
17 In the treatment of the gas laws, even the most de-idealised van der Waals equation was only approximately true. But it is conceptually possible that D is true of the actual world. For our purposes the conditional can loosely be read as ‘if D is true, …’ so long as we read ‘if CL were true…’.
18 See Lewis (1973) and see Balzer (1982) and Balzer, Moulines, and Sneed (1987).
19 An inconsistent theory contains contradictions; hence, such a theory has no models.
The question, then, of what makes clause CL so special can now be answered. Like a theory, the propositions D, CL and DD have models on which these propositions are true. The point of CL is that among its models, the set M(CL), we do not find @. The actual world is not an element of the set of models of CL. The falsity of the clause CL – in the sense that it does not accurately describe the actual world – is not a nasty coincidence, or a necessary evil. On the contrary, we have seen that scientists – and surely economists – deliberately insert falsity into their theories, so as to acquire an idealizational description of reality. If an economist were able to specify all the causally relevant variables such that they would in conjunction be true of @, his theory would turn so complex as to become intractable.

The frequent use of ceteris paribus (and other) clauses in economics is an expression of the idealizational character of economic theories. Allow me to use a very simple example, which perhaps is instructive for its very simplicity. Economists may hypothesise that people will cut on many sorts of satisfaction of needs before they stop renting a house. In consequence, they will perhaps say that ‘ceteris paribus, the demand for housing in Amsterdam in relation to its price is inelastic’. If however demand for housing happens to be price elastic, it is not implied that the assumptions about the preference ordering is mistaken, or worse, that the theory of the market that is used in the background is wrong. It may be that other circumstances have changed. Suppose that around Amsterdam small towns and villages have developed cheap housing while public transport facilities to Amsterdam have improved. Under the pressure of rising house rents in the densely populated capital, people decide to move out. The ceteris paribus clause turned out false, because these circumstances typically are the ones that are supposed to be referred to in the clause. The formulation of the clause in this example may not look well specified at all – counter the condition I stressed above – but if an economist can roughly sum up which circumstances are supposed to fall under the clause, this will perhaps do well enough.

The point I want to make here is that scientists will not generally phrase the idealization as a counterfactual proposition of the form given here. They will rather mention the clause CL, insert a comma, and then claim DD; ceteris paribus, all F’s are G’s. We do not find much of the starting proposition D. This may belong to tacit knowledge or to background information, but more often, scientists do not know D, as was the case with the gas laws. (I shall return to this point in the next subsection.) My reconstruction of an idealizational reasoning step is to highlight the underlying structure of it.

I have so far stated that idealizations are a particular kind of counterfactuals. The clause CL helps formulating an idealizational proposition in the sense that CL is false (of @). However, I also stressed above that an idealizational move is a conditionally deductive operation. This can be written as follows.

\[ D \& CL \Rightarrow DD \]  (5)

The double arrow stands again for ‘implies’. The relation between on the one hand
the not-yet-idealised proposition D and the false clause CL and on the other the idealised proposition DD is that of entailment. The falsity of CL explains why an idealization can be interpreted as the counterfactual above. Nevertheless, we have noted that idealizations can be scientifically interesting because, as a counterfactual proposition, they can be true. So now we can ask a further question: In what sense can the idealizational counterfactual conditional – despite being counterfactual, that is, despite having a false clause in its antecedent – be true? For the answer to this question I need to develop some intuitions on external validity. I shall propose a strict definition of external validity which shares some morphological characteristics with Lewis’ definition of the truth of a counterfactual.

### 3.3 Economics and policy

In case anyone wants to use propositions of economics for policy, the clause CL is of course a nuisance, because its falsity creates a certain distance with the current make-up of the actual economic world. Nevertheless, the belief that a particular idealizational proposition is (approximately) true can be of utmost importance, both theoretically and in terms of policy relevance.

It is merely theoretically interesting if it helps explain observed phenomena. An example of idealizational theorems that are explanatorily interesting could perhaps be this one: ‘this group of high income earners cuts down in working hours as wages rise, because ceteris paribus, the labour supply curve is backward bending.’ If the ceteris paribus clause mentioned here amounts to saying that a specified number of variables remain constant, although it is clear that these variables will not remain constant at all, then this theorem is idealizational. The clause is true of hypothetical worlds – its models – that are dissimilar to the actual world. What is more, we are quite aware of this dissimilarity. Nevertheless it is theoretically interesting insofar as it gives even a partial explanation of observed phenomena.

The belief that the labour supply curve is backward bending can also be interesting in terms of policy relevance because it may help policy makers, say, to impose or (in case the observed behaviour of high income earners is considered undesirable) remove restrictions in a market that mimic the conditions expressed in the clause as much as possible or as much as socially desirable. But of course, not all interesting explanations have such a direct bearing on policy. The extent to which theorems of economics are relevant for policy depends, among other things, on their external validity. Therefore, I shall now expand on the concept of external validity.

**Idealizations: truth and external validity**

In methodological discourse about social science, the concepts of internal and external validity have a common but somewhat loose meaning. In order to develop
an understanding of the difference between idealization and abstraction I need to make the concept of external validity more precise.

The ‘internal validity’ of a study often refers to the correct use of data, or the absence of confounding variables. For instance, if there are non-random patterns in the groups of people that partook in the study, the study is internally invalid. The ‘external validity’, in contrast, refers to the generalisability of a study. When cause and effect relationships between the independent and dependent variables are demonstrated to be present in a certain experimental situation, i.e. a ‘nomological machine’ for which clauses CL are (approximately) true, the scientists who designed the experiment would like these relationships to be present outside the experiment too. Social scientists, for instance, want to say something useful about groups of people at large. An experimental study that allows its findings to generalise to people at large is said to be externally valid. Clearly, the concepts both of external and of internal ‘validity’ are gradual, not absolute notions. I want to give the concept of ‘external validity’ a somewhat different use. I shall give it a meaning in the model theoretical terms presented above, but the notion of generalisability remains part of it.

In a Lewis semantics for counterfactuals20 hypothetical worlds are hierarchically ordered. The hypothetical worlds that are relatively closer to ☶ are also the worlds that share more properties with ☶ than those that are more alienated from ☶: they display relatively many similarities to the actual world.21 According to the concept of ‘external validity’ I am putting forward here, an idealised proposition DD is more externally valid if the distance between ☶ and the models of the idealised proposition that occurs in the consequent, M(DD), is smaller.22 (This notion of external validity shares properties with the more traditional notion. Among other things, we can see that it is gradual too.)

External validity, then, is a likeness function, which maps ‘a degree of similarity to the actual world’ to the models of certain (sets of) propositions that we call externally (in)valid. This function can be seen as describing the distance of the worlds, in which these (sets of) propositions are true, to the actual world. Some sets of propositions are labelled theories and some theories are externally more valid than others, as these are true of possible worlds situated more closely to the actual world. As idealizations involve falsity in the way explicated above, the sci-

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20 See Lewis (1973).
21 Of course, there is no conceptual possibility to see a hierarchical order of worlds of which properties have been altered one-by-one. As Lewis noted, ‘if kangaroos had no tails, they would topple over’ and this is true in possible worlds that resemble ‘our actual state of affairs as much as kangaroos having no tails permits [them] to’ (Lewis 1973, p.1.). These possible worlds must somehow differ from ours in more respects than just the one under consideration, for in this counterfactual situation, the kangaroo tracks in the sand must have been produced by something else than their tails. (cf. Lewis 1973, p.9). For my present purposes, this is of no consequence. What matters is that close-by worlds have things ‘pretty much as they [actually] are’ ([ibidem]).
22 The distance d between single worlds is a function d(wi, wj). The distance between the actual world ☶ and a set of worlds V is the function d(☺, V) defined by min(d(☺, v) | v ∈ V).
entist using an idealised hypothesis (DD) is aware of the relative lack of external validity of this hypothesis. (Below I shall insist that knowledge of the precise content of the clause is essential.\textsuperscript{23}) But he may judge it valid enough for the purposes at hand.\textsuperscript{24}

The figure below makes the notion intelligible, showing that the nearest models of D, for which CL is true, are models of DD. In the proposed Lewis semantics, if the area in the figure indicated to be empty is in fact not, the counterfactual is false. This is because in such a case, given that the DD area is depicted as it is in the figure, the nearest D worlds for which CL is true are worlds where DD is not true. The elements of this empty set are conceptually impossible.

![Figure III.1: Sets of models of D and DD](image)

So here we can clearly see what it means for a counterfactual to be true, it only requires a restatement of the counterfactual. If D, and if it were the case that CL, then it would be the case that DD. This is the situation depicted in figure 1. Let us rephrase this in terms of the example used above. Given demand theory, if people put housing very high on their preference list (if D), and if it were the case that no development of satellite towns and of public transport took place (if it were the case that CL), then demand for housing would be and remain price inelastic (it would be that DD). The figure makes clear that if the counterfactual (4) is true then, and only then, seen from @, in the closest D-worlds where CL is true, DD is true. This is what the truth of a counterfactual amounts to in the Lewis semantics.

\textsuperscript{23} Thus, the clause must enable the scientist to judge whether ‘any counterinstance of the law [is] independently explicable’ (Pietrosky and Rey, (1995), pp.81 and 90).

\textsuperscript{24} In this way of putting it the reader may hear the resonance of some familiar statements done by Milton Friedman in his famous essay on the methodology of positive economics. But the idea of the falsity of assumptions or of hypotheses is fundamentally different here. In my treatment, it merely is the antecedent of a true idealizational conditional in which the falsity is involved. Therefore we speak of an idealizational counterfactual.
It should also be noted, secondly, that the models of the relatively non-idealised (or the not-yet-idealised) proposition D are closer to actuality than the models of the idealised proposition DD. This can be formalised with the distance relation just formulated. As @ is the model of true statements about actuality, it is to say that $d(\oplus, M(D)) < d(\oplus, M(DD))$.

Close inspection of the figure induces one to note, finally, that the set of models of proposition D – the proposition we had before the idealization – does not include @. However, it is not excluded a priori that the actual world is also an element of set M(D), viz. that D is true. In spite of this, I think that such a situation is unlikely. As we have seen in the treatment of the gas laws, even the van der Waals equation describes reality approximately only. If we assume, plausibly, that proposition D is an approximation of a true proposition or only partially true, then actuality is not to be depicted as an element of the set of models in which the (relatively) non-idealised proposition D is true.

One might wonder why, in case researchers have access to an un-idealised true proposition, they would want to idealise at all. As a first answer, note that the historical order in which science produces knowledge of the truth of these propositions is often reversed. Of the gas laws Boyle’s is the most idealised, but also the first known. Boyle did not have this access. But, in addition to this, idealised propositions – true in the Lewisian sense outlined – may be interesting even if the de-idealised alternative is available. The consequents DD of idealizations are necessarily true of their models, but they are not true simpliciter (or true of @), else they would not be the consequents of counterfactuals. Their falsity with regard to the actual world gives an instructive insight into what it is that makes, in the relevant respects, our actual world. Some detachment of complex knowledge of actuality, even if readily available, may help us see more simple patterns. Likewise, Margaret Morrison and Mary Morgan have noted that a ‘model’, in order to make us learn about the world and about a theory, must have a partial independence from both the world and this theory. For example, knowledge of an un-idealised true proposition may not be useful if we cannot connect it to further knowledge. In the same bundle of essays edited by Morgan and Morrison, Nancy Cartwright puts it as follows:

> In exact science we aim for theories where the consequences for a system’s behaviour can be deduced [...] But so far the kinds of concepts we have devised that allow this kind of deductibility are not ones that easily cover the kinds of causes we find naturally at work bringing about the behaviours we are interested in managing. That is why the laws of our exact sciences must all be understood with implicit ceteris paribus clauses in front.

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25 Morrison (1999), p.17. Note that the concept of ‘model’ as used by Morrison and Morgan is prone to cause confusion in the present context. I talk of idealizational propositions, like theorems, that are true of their models. For Morrison and Morgan a model can be a set of equations, a replica, a story, anything that mediates between theory and the world, is partially independent from both, and that has some autonomous elements too. Still, also in my more strict use of the concept it is plausible to speak of an ‘idealizational model’ in case it differs from @.
our best and most powerful deductive sciences seem to support only a very limited kind of closure.\textsuperscript{26}

Cartwright claims to disagree with Ronald Giere who, to her understanding, believes that ‘it is instead the truth of the hypotheses of the theory that should concern us since these indicate the degree of similarity or approximation of models to real systems’\textsuperscript{27}. It follows from my treatment above that I agree that it is the clause CL, not the theory itself, which determines the degree of similarity – or difference – to ‘real systems’ (or, in my terms, to the actual world). I baptised this degree ‘the degree of external validity’.

There is one more clarification to be given. It has to be made clear how the degree of external validity of the consequent relates to the truth of the entire idealizational counterfactual.

External validity of true counterfactuals and economically possible worlds
What does it mean to say that an idealised theorem of economics DD is externally valid? And, secondly, what does it mean to say that the (idealizational) counterfactual is true? We have just answered these two questions. The third question is how the answers to these two questions are linked.

To answer the third question, regarding the relation between external validity and the truth of counterfactuals, I define the set of ‘economically possible worlds’.\textsuperscript{28} These are such that they bear sufficient similarity to @ in the sense that the ‘laws of economics’ – as these are vigilant in our actuality and whenever such laws exist – are true in these worlds. One may plausibly maintain that there are no economic laws, neither phenomenal, nor theoretical, but that there are only physical laws.\textsuperscript{29} But this does not formally speak against the idea of a set of economically possible worlds. From a realist point of view, economics is an enterprise aiming to capture the boundaries between the economically possible and the economically impossible. The set of models that exactly exhausts all the economic possibilities is formed by those models, of which the strongest true economic theory is true. Of course, we do not know the strongest true theory; it is possible to be mistaken about it. No strand of realism is incompatible with fallibilism.

I can now say that an idealised theorem in economics, which is true of economically impossible worlds only, is externally invalid in the sense and to the extent that these hypothetical worlds differ from the actual world in their law-like structure. But economists model worlds in which agents have an infinite life span or who are endowed with infinite information processing capabilities. Such condi-

\textsuperscript{26} Cartwright (1999), p.254.
\textsuperscript{27} Ibidem, p.249.
\textsuperscript{28} According to what Kuipers calls ‘the nomic postulate’, confrontation of the set of conceptual possibilities with the domain of economic phenomena leads to the subset $E$ of economic possibilities or the intended applications. See Kuipers (2000), p.147 for a similar set-up of the subset $Ph$ of physical possibilities.
\textsuperscript{29} This means that the difference between the set $E$ of economically and the set $Ph$ of physically possible worlds is the empty set, so $E$ and $Ph$ are identical.
tions are incompatible even with the physical laws as these happen to take form in the actual world. The worlds economists model often lie somewhere in the large subset of physical (and, hence, economic) impossibilities. The idealising but true counterfactuals involved in this modelling practice specify distant hypothetical worlds for which the clause CL is true: the set M(CL) is not even a subset of the physical possibilities. Do such modelling practices amount to zero external validity, i.e. are they necessarily fruitless?

The answer must be subtle. Theories true only of economically impossible worlds are externally invalid in the sense that these worlds differ from @ in their laws. This is due to the sense of ‘external validity’ that I use. It does not follow that nothing can be learned from this modelling practice in economics. Some laws in such economically impossible worlds will be different, but others will not be different from the lawlike structure of the actual world @. In terms of the semantics here proposed, the following is the case. The closer to @ the models with, say, immortal agents are, the more their laws are like those in @. The point is which laws are different from those in @. To illustrate my point, let me use a brief exemplification of the so-called ‘irrelevance theorem’ of Nobel Prize winners Franco Modigliani and Merton Miller.30

Economically impossible worlds. The case of capital structure.

The ‘irrelevance theorem’ says that given a definite number of assumptions, the market value of a firm is equal to its discounted expected rate of return, regardless of its capital structure. This is due to arbitrage by investors who can choose to either invest their private capital in a mixed debt-and-equity firm or invest a mix of private capital and a privately borrowed amount in a 100% equity financed firm. The theorem means that it does not matter in what proportion the firm is financed by equity and debt; even an unlevered firm has the same value as a firm financed by debt alone. Two of the crucial assumptions are that the interest part of the corporate debt servicing are not tax deductible and that there are no bankruptcy costs. In later publications, Modigliani and Miller successively dropped these two assumptions in two steps. They so derived the theorems, respectively, that 100% debt financing maximizes the firm’s market value (step 1) and that there is an optimal capital structure at a particular debt-to-total-value ratio between 0% and 100% (step 2). What interests me in this case is not the two assumptions Modigliani and Miller dropped but the other assumptions, the ones they did not drop in the 1958 paper. Cools, Kuipers, and Hamminga, who treat the three capital structure theorems as a case of ‘Idealization and Concretisation’, list nine other assumptions31, one of which is that capital markets are frictionless. Without this assumption the arbitrage argument used in deriving the ‘irrelevance theorem’ does not work.

It may appear that the proposition about frictionless capital markets violates economic laws, so that the theory models worlds beyond the boundary between

30 Modigliani and Miller (1958). A correction appeared five years later in the same journal.
the economically possible and economically impossible. However, modern electronic information processing and the possibility of instant information flows are aspects of an actually changing physical and institutional environment, dissolving friction in financial markets. It follows that the assumption of the absence of friction may be interpreted as a proposition about initial conditions, rather than about economic laws. At least this seems to be the case with regard to capital markets. It is hard to know what is an economic possibility tomorrow. (I repeat that realism is compatible with fallibilism.) The same problem, of assessing whether the assumptions of a theory are non-actual so as to violate economic possibilities or just because the initial conditions are different, turns up with the other assumptions that Cools, Kuipers, and Hamminga list:

- Firms negotiate a risk-free rate;
- Individual people negotiate a risk-free rate;
- Risk-free debt and risky equity exhaust the financing alternatives;
- Firms operate in the same risk-class;
- Discounted cash flow behaves as a perpetuity;
- Equal access to information for insiders and outsiders;
- There are no agency costs, i.e. stakeholders receive their legitimate share;
- Complete contracts are enforced;

Without some conjectures about what it is that makes a generalization a law, it is pointless to decide which of these assumptions concern the lawlike make-up of the world and which only render clauses about initial conditions. What matters much more is the question whether the interesting aspects of the actual world come into focus by theorising about models with otherwise non-actual properties. And there is no a priori rule which tells us what aspect of an hypothetical world is interesting. This is to be decided by the theoretical economist who is driven by his curiosity for the comparison of formal properties of the actual world and the world he models.

The bottom line is that an idealizational counterfactual must be true and that an idealised theorem (the consequent part of the counterfactual) must have models that are sufficiently like the actual world, even if these models are, strictly spoken, economically or even physically impossible. The closer the models of this theorem are to the actual world, the more externally valid it is. But closeness to in itself does not entail the theorem being interesting. Whether a theorem is interesting remains a function of the research aims and the background information of the economists in question.

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32 Ibidem, p.211-212. I reformulated the assumptions.
4 Abstraction

Whereas with idealization there always is some form of falsity involved, this is not the case with abstraction. We have seen that abstraction merely involves the disregard for some (but not all) spatio-temporal detail. In consequence, the result of abstraction is always a weaker proposition. The relation between a concrete and an abstract proposition is that of entailment simpliciter.

4.1 Abstraction as existential generalization

Consider the example of the gas laws again. A restatement of Boyle’s law could be that the pressure of a mole of gas is a function of its volume. Analogously, a restatement of the Ideal Gas Law is that pressure is a function of volume and temperature, and the van der Waals equation can be restated saying that pressure is a function of volume, temperature, repulsive and attractive forces between molecules. These restatements are more abstract than the formulation under which the respective laws are generally known. They keep the precise form of the functions in a black box. It is possible, of course, to abstract from a proposition that is already false at the start. But in abstraction, there is no additional false claim involved.

I now come to what I have already hinted at: the facts that, first, abstraction is a merely deductive operation and, secondly, that the sort of epistemic move that materialises the entailment is that of an existential generalization. In case of the Ideal Gas Law, the restated form – that pressure is a function of temperature and volume – only implies that there is some function for which it is true that the law can be expressed. This is of course rather trivial. But many consequences of deductive reasoning schemes are trivial due to their being deductive. Abstraction is however interesting when compared to idealization. To show why, I shall confine myself to Mäki’s example quoted above. The relation of entailment that comes with abstraction is as follows:

\[ X_d = -0.85P+8.5 \Rightarrow \exists a,b(X_d = aP+b) \Rightarrow \exists f (X_d = f(P)) \]

In more general (one may say: abstract) terms the relation of entailment between the concreter starting point and the more abstract result can be written as:

\[ A \Rightarrow AA \quad (6) \]

As we can see, there is no introduction of a false clause. Any falsity of – any distance between @ and the models of – the abstract proposition must have been carried over from the antecedent of the entailment. In this sense, we can see again, abstraction is at least truth preserving.

We can immediately draw three conclusions about the external validity of abstract propositions. Recall that I defined external validity as a gradual notion, viz. as the distance between the models of an hypothesis or theorem and the actual world @. The first conclusion is that, as abstraction is at least truth preserving, ab-
stracted but externally invalid propositions derive their invalidity from the those
cconcrete propositions the former have been abstracted from. Secondly, and more importantly, abstraction as an epistemic operation is si-
lient about the degree of external validity of the resulting proposition. It is clear that
the abstract but true formulation of an actual state of affairs is perfectly externally
valid, because $@$ is an element of the set of models of this proposition. But without
a further specification of the extent to which a state of affairs is indeed a property
of the actual world, and not, counterfactually, of an hypothetical world, we do not
know anything about the external validity of the abstracted proposition. In com-
parison, idealization involves the explicit introduction of a false but well-specified
clause, which allows us to direct our attention to a finite number of causal vari-
ables that could be responsible for our idealised explanations failing to refer to the
actual world, or our predictions failing to be confirmed. A specified claim to falsity
helps us solve (part of) the Duhem-Quine problem, for it is logically possible to
check the truth of a finite list of propositions.\footnote{3} In laboratory settings, for example,
each causal variable can be considered for subjecting it to manipulations such that
the false proposition about it can be made (approximately) true. This is precisely
what has been done with the Ideal Gas Law.

It is the third conclusion, however, which is most of all interesting for issues
of policy relevance. In the act of abstraction, we have seen, we produce weaker
claims about the world. This means that the set of models of which these weaker
claims are true grows by the very level of abstraction. It is conceivable that, ulti-
mately, the actual world finds itself among the members of this set, even if the
abstractive operation took off at a proposition true only of some hypothetical
world. Or, to dwell on the example of the demand function, suppose, however
unlikely, that in $@$, demand behaviour with regard to a certain specified market is
such, that its proper function has a constant tangent, just as we have been doing all
along; and that the actual function satisfying the demand line is $X_d=-1.61P+8.2$. In
this case, the line $X_d=-0.85P+8.5$ does not accurately describe the actual demand
behaviour for the good in question. But $X_d=\alpha P+b$ does.

4.2 A concise antithesis of idealization and abstraction

Wrapping up, I see idealization as an epistemic move away from one logically
possible world to others and abstraction as moving from a smaller set toward a
superset of logically possible worlds. Possible worlds that differ in any minor re-
spect from our single actual world are hypothetical.

I propose to categorize idealization as an epistemic move, materialised by a
clause, which specifies the state of affairs in an hypothetical world in a transparent
– that is, well-specified – way. The idealised description of that state of affairs - the

\footnote{3} See footnote 3.
clause – lists the differences with the state of affairs in the actual world. In consequence, idealizations imply a claim about the relative external validity of the theorems derived. Furthermore, the level of abstraction of an idealizational conditional is left untouched, so idealization is a case of horizontal isolation.

Abstraction, in turn, increases the level of abstraction by definition. It is a vertical type of isolation and it cannot be taken to imply anything about the external validity of the more abstract proposition derived. If the starting point of abstraction – the more concrete proposition – has models at some distance to the actual world @, then the weaker entailments may be true of models that are closer to @. Consequently, more abstract theorems may or may not be true representations of the relevant state of affairs in the actual world. Furthermore, if the (relatively) abstract proposition AA has its roots in a (relatively) concrete and true proposition A about the actual world, the truth value is preserved. Abstraction is a deductive operation and the consequent AA is weaker than the antecedent A. Therefore, if the antecedent A is false, the consequent of the conditional may or may not be true.

Let us now return to economics. Uskali Mäki used the example of a demand function to illustrate the difference between horizontal and vertical isolation, and he coined the latter ‘abstraction’. I repeated the example in order to illustrate the same, but I called it the difference between idealization and abstraction. Further, I proposed what the clause is supposed to do and I put it into a semantics appropriate for the aims of this chapter. Now, according to the example, the proposition that the quantity demanded of a good is a function of the own price of this good is relatively idealizational compared to the proposition maintaining that it is a function of the own price and the prices of complements and substitutes (and, we may add, of the income of the demanders). Formally:

\[ q = f(p_1) \]

The step represented by the arrow is conditionally deductive, the condition is specified on top of the arrow. It is clear that idealization leaves the level of abstraction of the propositions in the antecedent and in the consequent the same.

In contradistinction, the proposition that the quantity demanded of a good is a function of the own price of this good is relatively abstract compared to the proposition that it is a specific function with a negative tangent (the function describes demand for a ‘normal’ – non-perverse – good), or with a function that specifies that the tangent is minus 0.85 and that quantity demanded is 8.5 units at a price of nil.

The idealization of income and other prices can also be carried out at a lower level of abstraction as was done above. Expanding on Mäki’s example, we could formalise it this way:
Thus, one can have an idealised and yet relatively concretised demand function.\textsuperscript{34}

4.3 Abstraction and policy relevance

Jokes that mock the supposed irrelevance and failing predictive power of economic research abound in the critical literature and, inevitably, on the internet. Mostly, the jokes express the rather common idea that, for an economist, real life is a special case for which theory cannot account. This is a sorry idea for whom hopes that economic theory can help economic policy advice. Allegedly, economic models are unrealistic. Economists are said to produce policy recommendations that they are unable to make operational. Economics is also said to be too 'abstract'. So what is wrong with abstraction in economics? To bear relevance for policy recommendations, an economic theorem must be weak enough to be true, and strong enough to have a bite. I shall first consider one side of this issue, the weakness part, and discuss what abstraction has to do with it.

Demand equations express behaviour. Assume that the income effect of a price change for a particular group of low-income consumers in the actual world is so strong as to cause a perversely related demand-price couple, as with so-called Giffen Goods. The related demand behaviour is then falsely described by a concrete and normal demand function (viz. with a negative tangent). But the more abstract formula, which merely says that ‘demand is a function of price and income’, may be true of this behaviour. In this sense abstraction can be said to sometimes also introduce truth, rather than that it only preserves truth.\textsuperscript{35} An abstractive move renders weaker propositions (in the consequent of the strict conditional) that are, by definition, true of more possible worlds than the more concrete propositions (in the antecedent of the strict conditional). But this notion becomes interesting if it is also noted that some weak propositions are strong enough to be interesting for policy.

This consideration brings us to the second, the strength part of the issue. If we allow for abstract but interesting propositions, we reach a remarkable conclusion. \textit{The more abstract a proposition, the greater the chances that it is true of actuality, so the more probable that it is a (true) proposition suitable for policy considerations.} This is remarkable given the profusion of jokes about the irrelevance of economics for our

\textsuperscript{34} This conclusion confirms an observation that Mäki does in his (1994), p.152. He says that ‘vertical de-isolation is often accompanied by horizontal isolation’. Note however that it runs counter the standard view of ‘Idealization and Concretisation’, which tells us that idealization and concretisation are opposite movements and that one first idealises, only to concretise later. See the appendices 7-8.

\textsuperscript{35} A possible confusion is over generalization and abstraction. Let me just note that (1) abstracted propositions are more general, but not all generalizations involve abstraction and that (2) abstraction is a deductive move while some forms of generalization involve induction.
lives. It is after all the level of abstraction of economic theory about which critics often jump to conclusions: that the use of abstract theory in policy matters necessarily presents an obstacle for a debate on policy intervention.

Under what conditions is a relatively abstract theorem interesting enough – that is, strong enough – to have a policy bite? It seems that this is a contextual matter. I do not believe we have the luxury of general guidelines for policy limits to abstraction. One could object that theoretical hypotheses, even if true, do not directly apply to the domains of our desire to intervene in the world. This objection has in fact been put forward by Cartwright in the context of natural science. But she uses the concept of ‘abstraction’ differently:

Many of our most important descriptive terms in successful physics theories do not apply to the world ‘directly’; rather, they function like abstract terms. I mean ‘abstract’ in a very particular sense here: these terms are applied to the world only when certain specific kinds of descriptions using some particular set of more concrete concepts also apply.36

The quote shows that there are two differences. Cartwright speaks of the abstraction of terms, not of propositions as I do and she uses the notion of applicability, rather than of truth as I do. The two items are related.

Let me first say something about the difference between abstraction of concepts and of propositions. The extension of a concept (Cartwright says ‘term’) consists of those concrete objects in the world that the term refers to. In turn, the intension of a concept is what we may call ‘the conceptual content’, i.e. what the term ‘means’. We see here Frege’s distinction between Sinn and Bedeutung. Clearly, abstract concepts have a wider extension and a narrower intension than more concrete concepts. But the matter looks differently in case of abstract propositions. The intension of a proposition is a function that assigns truth values to this proposition in particular contexts;37 the extension is the number of worlds on which the proposition is true. In other words, the abstraction of a proposition does not extend the reference to a greater set of objects in the actual world, but to more possible worlds. In my approach, more abstract propositions can be derived from more concrete propositions by the relation of existential generalization.38 Abstract propositions will more easily be true than concrete descriptions.

Concerning, secondly, the difference between applicability and truth, note the following. When Cartwright speaks of ‘applicability’ of terms she seems to mean the ‘reference’ of them. The so-called ‘applicability’ in this sense has to do with the extension of concepts (‘terms’). The quote from Cartwright above says that abstract terms are applied to the world only if there are propositions (‘descriptions’) with more concrete terms are available such that these concrete terms do apply. Compare this to my version. I say that the terms that figure in a proposition may well

38 Hamminga and DeMarchi stress the peculiar relationship between abstraction of concepts and of propositions. Their examples make use of derivability in terms of instantiation, not, as I do, in terms of existential generalization, which runs the opposite way. See Hamminga and DeMarchi (1994).
refer (‘apply’) even if the proposition with concreter concepts is not available (‘not true’).

Can we conceive any abstractions that, despite the decreasing strength that they carry, are interesting in the sense outlined? I do think so. It is a matter of political debate which ones are interesting and of scientific debate which ones are true. It is, in addition, a matter of philosophical debate whether any example of an abstract but interesting proposition is abstract enough to impress.

I would like to rhetorically stress that the point seems to be, not whether any such propositions are conceivable, but rather that it is difficult to believe that there are none such. Let me finish with some candidates, without further economic arguments. I offer them as suggestions for defence by economists. My aims are philosophical, not economic. The first two are mine. The following four are not mine. They all belong to the domain of macroeconomics.

The first is: ‘the peoples who engage in trade instead of in autarky will enjoy a greater welfare than those who do not.’ The second is: ‘there is a natural rate of unemployment, which is insensitive to budget policy’. I believe that these claims are true, generally subscribed to by the core of economists and relevant. So are the following four, expressed by Eichenbaum who listed ‘four widely agreed-upon propositions’ in macroeconomics\(^\text{39}\). I think that his list offers candidates for the predicate ‘weak enough to be true, strong enough to be relevant’.

(1) monetary policy is neutral in the long run;
(2) monetary policy is not neutral in the short run;
(3) persistent inflation is a monetary and not a real phenomenon;
(4) most aggregate economic fluctuations are not due to monetary policy shocks;

Then again, one may disagree over my list, or over Eichenbaum’s, or over both.

5 Vague qualifications

Many isolative clauses seem to tell us that some possibly causal factors are assumed to show no changes or to be plainly absent, whatever these factors are. If a ceteris paribus clause (or a ceteris absentibus clause) quantifies in an indeterminate way, it has an unclear reference: the factors in question are not explicitly listed at all. In contrast, a precise (or well-specified) ceteris paribus clause sums up, one by one, all phenomena that must be assumed, for instance, constant. A precise clause has a determinate reference, in the sense outlined above: the factors that are object of a false claim are listed. But what if in economic thought clauses are often in use that do not sum up the finite set of all possible causally relevant disruptions, how can we say that these disruptions are idealised? How must we understand that the

factors in question are referred to? The answer I shall give is that they are not referred to. This has an important consequence.

5.1 Hausman: Vague laws as inexact generalizations

Daniel Hausman has tagged the use of such clauses, i.e. without a clear reference, as *vague qualification*. He notes that, in economics, idealising conditions like the ceteris paribus clause are sometimes qualified precisely but more often vaguely. Vague clauses have an open domain: they are in use whenever it is uncertain which disturbances are to be idealised. In social science, this is typically the case.

He demonstrates it as follows. Take the law:

\[ \text{Ceteris paribus (C)} \text{ everything that is an } F \text{ is a } G. \]

Vague qualifications do not unambiguously separate between the F-worlds for which the law is true and for which also the C-clause is true and the F-worlds that have to be treated as an exception by the clause (because not-C is true in these worlds). In other words, F’s are G’s in all worlds, except in those worlds where, regrettably, G is not true after all. These turn out to be not-C worlds and the clause pushes them by the wayside. In addition, we do not know which worlds are C-worlds and which are not. This is the very reason why Hausman calls it an inexact law. If an inexact generalization in economics serves as a law, it has simply to be assumed that the (ceteris paribus) clause refers to a predicate, which, if added to the antecedent of this unqualified generalization, turns this generalization into an exact law. It is unclear which predicate does this. The economist does not know in this case which causally relevant variables will set in motion the disturbances of the phenomena described by the generalization. In brief, a vague ceteris paribus clause gives limit values to some variables, but it is not clear to *which variables*. This makes theories vulnerable to the empirical problems referred to by the Quine-Duhem thesis (see note 3).

I find this approach highly unsatisfactory, for it does not allow one to decide anything about the external validity of the alleged ‘law’. A vaguely formulated clause (henceforth labelled ‘VCL’) does not have terms that clearly refer to any of the specific spatio-temporal properties subjected to this clause. The use of a VCL does not meet the requirement I have mentioned above, that it amounts to a finite list of variables – of ceteri – that are to be assumed absent or to take a limit value, or to play any other role different from what they actually do.

More generally, it seems to me that, if a theory does not refer at all to some (large) set of causally relevant factors of an economic process, for example, because they are unknown, then, in a way, the theory seems to be abstracting from these details. But this appears to be at odds with the semantic analysis I have given so far.

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41 Ibidem, p.137.
After all, I have stated that the use of a clause gives rise to idealization, not to abstraction. Still, I do think it makes sense to somewhat stretch the concept of abstraction as developed so far and reserve a special place for VCL’s.

5.2 Abstraction as focussing in scientific practice

In order to illustrate my point, let me return to the story about the gas laws. Above I have already noted that the precise closure needed for Boyle’s experiments with the air pump was unknown to him in 1660. It was partly by luck that he had discovered an empirical relationship, which actually turns out not to be hard-wearing at all. In retrospective, knowledge of the Ideal Gas Law allows one to spot a well-specified ceteris paribus clause. The fact that Boyle’s law can be derived from the Ideal Gas Law by idealization is discovered by way of a reconstruction of the facts.

Indeed, thanks to the spontaneous material isolation, discussed earlier, Boyle could concentrate on the relation of the pressure of a gas with its volume. His luck had partly been triggered by his focus. As he could never know what clauses are involved in the resilience of gas behaviour along one isotherm, he can be understood to have in fact used a vague clause. And note that with such a VCL there is no well-specified claim to falsity involved. Hence, there was no clarity about the external validity of the lawlike relationship that Boyle thought to have discovered. It was not clear what closures were in fact needed for the resilience of the relationship. But such clarity is there now, so it appears that issues of external validity can be decided in retrospective.

Do the models of a theoretical hypothesis, hedged with a vague clause, have a specified distance to @? Apparently not, because the clause is vague precisely in the sense that this distance cannot be specified. But then, do these models form a superset of the set of worlds for which the theoretical hypothesis would be true if it were hedged by a specified clause? This is indeed the case because a specified clause fixes the distance to @. The vague clause invites the scientist to disregard some causally relevant variables and concentrate on a particular relationship hypothesised to be of interest – it includes anything, also the variables that could be subject to a specified clause.

Using a VCL shares many characteristics with abstraction, as follows from what I have said so far. Above I have characterised abstraction, in accordance with Mäki, as (1) vertical isolation and as (2) a case of existential generalization. Let me consider each in its turn.

(1) With regard to the aspect of vertical isolation, let me defend my view as follows. The use of vague clauses in the sense of Hausman enables the scientist to pick out whatever he believes is a crucial relationship for the explanandum that is subject to theoretical fascination. The theoretical hypotheses about these interesting

\[\text{See note 9 above.}\]
relationships have models for which – in the semantics presently discussed: worlds in which – they are necessarily true. My claim, then, that the use of vague clauses helps to abstract rather than to idealise is a claim about the relationship to the actual world, @, that the models of these hypotheses have. A vague clause attached to a theorem calls to disregard spatio-temporal detail and, thus, to consider abstracted aspects of the models of which the theorem is true. Whether the set of these models includes the actual world or not is a matter for consideration of discrete theoretical deliberations. Some of these deliberations may have resulted in a theory that now makes part of the scientist’s accepted background knowledge. Some are to result in future accepted theories.

(2) In connection with the aspect of abstraction being a case of existential generalization, let me suggest the following. When an abstracted theorem is true in a particular set of hypothetical worlds (but not necessarily of @) due to the fact that its more concrete counterpart is true of a proper subset of these hypothetical worlds, the theorem generalises over this subset. This is clear given that there are no clues provided of the distance relation of @ with the subset. To say that there is some domain for which it is true that an x having the property F must also have property G may seem trivial. But I see no reason to assume that this is more trivial than the use of a vague clause. The use of a vague clause as represented by Hausman is like saying that there is some domain of which x is a member and for which it is true that if x is an F, then it is a G.

\[ \text{VCL, } \forall x \left( Fx \rightarrow Gx \right) \Rightarrow \exists D, \forall x \in D \left( Fx \rightarrow Gx \right) \]  

(7)

Does the use of a vague clause not have too many characteristics of a closure typical of the idealizational description of non-actual states of affairs instead of a closure typical of abstraction? I do not think so.

5.3 The ‘Social Model’

Policy relevant theoretical hypotheses say something about how to deal with real life situations we might want to intervene in. Economic policy may for instance intervene in areas like market failures, inflation rates, and trade imbalances. If these theoretical hypotheses are hedged with an isolating clause, they are true of models other than the actual world if the clause does not actually hold. It is a prerequisite for the policy relevance of these hypotheses that we know precisely what they are hedged against. This is because only then the clause explains why observed social phenomena deviate from the economic quasi-reality of the theoretical models. We tend to call such deviations ‘disturbances’ and they need to be explained; they form an explanandum. In other words, even if our theoretical hy-

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43 It is of course dubitable whether inflation rates are phenomena. For an interesting treatment of this question, see Hoover (2001).
hypotheses aim to explain our actual world, the clauses that hedge them are explanatory with ‘disturbances’ as explanandum. But if the clause is indeterminate, it cannot serve as an explanans.

If the world we want to intervene in is full of ‘disturbances’ and if we have no determinate or precise clauses to deal with these, we feel the lack of sufficient information to explain what makes the real world so different from our models. We can only hope there is some theory capable of dealing with the multiplicity of phenomena that disturb our simpler theoretically established regularities. This additional theory may already exist as part of another discipline, so that it does not make part of the existing background knowledge of the economist. It may also be completely absent. It seems that interfield theorising is needed to deal with policy relevant phenomena that escape our explanatory hypotheses and their clauses that serve to hedge them.

The need to do interdisciplinary research has been stressed by many economists of heterodox breed. Those who feel that theoretical economics leaves too many aspects of the social world unexplained tend to be the same scientists who also look out for alternative intellectual sources.\textsuperscript{44} As it does not serve my present aims to go into this issue very deeply, let me just use one example set by a Dutch economist who contrasts purely economic models with what he calls ‘the Social Model’. Folmer calls for ‘a stronger integration of the social sub-disciplines than currently is the case.’

The proper approach is a simultaneous analysis and estimation of the integrated economic-sociological-psychological model, or, in other words, the Social Model. […] In case a study conducts surveys, information should be collected on economic as well as sociological variables as well as on the perception of these variables.\textsuperscript{45}

What Folmer calls the ‘Social Model’ could highlight a lot of the interrelationships between an observed and ‘disturbing’ phenomenon and abstract theory.

Let us summarise the results so far by way of the table below.

<p>| Ways to deal with a closure regarding policy relevant phenomenon Ph |</p>
<table>
<thead>
<tr>
<th>Explanans</th>
<th>Explanandum</th>
<th>Epistemic operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hypothesis X</td>
<td>Ph is an instantiation</td>
</tr>
<tr>
<td>2</td>
<td>Isolating clause to hypothesis DD</td>
<td>Ph is a disturbance</td>
</tr>
<tr>
<td>3</td>
<td>Hypothesis AA does not explain Ph</td>
<td>Ph is out of sight</td>
</tr>
</tbody>
</table>

\textsuperscript{44} A call for interdisciplinarity often comes with an even stronger rejection of mathematical formalism. See for example the online journal of the ‘Post-Autistic Economics Network’ (see http://www.paecon.net/). However, a possible limited or orthodox focus is logically independent from the ubiquitous use of mathematics in economic theory.

A phenomenon \( Ph \) may be explained by hypothesis X (row 1). But ever so often the explanation is not available. In such a case, the phenomenon is pushed aside, as it were, either by an idealising clause \( CL \), as represented in row 2. The clause explains why \( Ph \) is at odds with hypothesis DD: that is, DD is hedged by this clause. But \( Ph \) can also simply be neglected. In this latter case, the phenomenon constitutes no explicit part of the explanandum of any theory, even if, evidently, the phenomenon cannot but play some or another causal role in the world modelled (and quite probably in the actual world too). This possibility is mentioned in row 3. The hypothesis AA abstracts from the disturbing peculiarities of the phenomenon. Once the disregarded variables turn out to be relevant for the scientist’s aims after all, the economist hopes to draw from other theories that do take up the phenomenon in the explanandum. In order to do the job, these (possibly sociological or psychological) theories must give rise to theorems of type X. Folmer’s Social Model would in this case comprise the combined hypotheses X and AA.

It remains to be seen whether an appropriate background theory is always available. If not, one alternative option to deal with a phenomenon seems to be that the scientist explicates a (vague) clause after all. If this option is interpreted as a case of idealization, the clause has to be made precise. We have seen that, without a clause that is at the same time precise and within approximate reach of being made true, there is little hope for policy relevance. Without precision, viz. without appropriate specification of a finite list of variables, there is no way of finding out which ‘other circumstances’ must be checked to save the theory. In the following subsection I shall propose another alternative and call this option abstraction ‘ante explicationem’.

In the following subsection I shall call into consideration a case from the earlier treatment of Böhm-Bawerk’s Interest Theory.

### 5.4 Böhm-Bawerk: what closure is it that explains the explanandum?

Böhm-Bawerk developed the Austrian Interest Theory presupposing the truth of Menger’s Subjective Value Theory. He maintained that equilibrium market interest is equal to the ratio of the marginal yearly yield of lengthening the production period and the price of labour, according to a particular production function of the time needed for goods to mature while still in process.

However, changes in initial conditions, for instance in patterns of productivity and marginal costs, would, with a time lag, work their way to the results predicted by the Interest Theory. Especially the theory of perfect markets explains how production costs and market prices tend to converge, a phenomenon that has given rise to the allegedly mistaken conviction, among most of the Classical Economists, that the ‘law of costs’ be true. The amount of time needed for adjustment to new equilibria prevents these very equilibria to materialise phenomenally. And, as changes in initial conditions are profuse in reality, disequilibria shape our
view of the economy: a superficial scrutiny appears to deny the truth of the theorem of equilibrium interest. In order to be able to neglect these disturbances, Böhm-Bawerk assumed that the time of adjustment was nil, or its speed infinite, or that the course of time was altogether absent, or that the aforementioned initial conditions did not change, or perhaps something else. The assumption was implicit and, by any means, rather unclear. He did nowhere really mention that he wanted to leave the course of time out of consideration or explicitly assume the speed of adjustment to be infinite. He possibly was not even well aware that he isolated a system from influences from within that system. Whatever clause he assumed or did not assume true, he did presuppose the truth of the Subjective Value Theory, which explained the mechanism by which markets adjust to changes. And this Subjective Value Theory was not only in the back of his own but also in the reader’s mind, for the 160 pages in PTK preceding the treatment of the Interest Theory aimed to convince his audience of the Austrian idea that this is the ubiquitous economic mechanism establishing any market process.

Apparently, there are two explanations on offer as to which particular implicit closure it was – idealization or abstraction – that Böhm-Bawerk exploited. The first option is that it was an idealization serving to explain the effect of disturbing influences. In this case, then, there is a *ceteris absentibus* clause in use (absence of time) or perhaps a *ceteris paribus* clause that imposes a limit value to the variable in question (the speed of adjustment is infinite). Deviations from some predictable equilibrium were the object explained, or explanandum, and the idealizational use of a clause – an indication of the conditions that are admittedly not fulfilled in actuality – was part of the explanans.

The relevant theorem says that, given some initial conditions, a particular equilibrium interest level will come to be. But as the actual world might show some other outcome, the theorist is in need of an explanation for this deviation. He does not challenge the Interest Theory, but alludes to the disturbances, expressed by a clause, to explain the distance between prediction and actual outcome. In sum, an idealising clause excludes possible disturbances from a theory.

But as we have seen, Böhm-Bawerk, squarely in the tradition of Karl Menger, took these disturbances instead as explanandum of the mechanistic Subjective Value Theory, rather than of clearly explicated clauses that could otherwise hedge this theory. Assuming the truth of the Subjective Value Theory, an idealizational clause was not really needed in the Interest Theory. In other words, sluggishness of adjustment simply did not play any role, neither as an instantiation of a presumed lawlike generalization derived from the Interest Theory, nor as a disturbing candidate for idealization. For the explanation of interest, markets were interesting for their results, not for their adjustment processes.

My view is that the disregard for the actual deviations from what the Interest Theory puts forward as the truth serves to abstract the result of the adjustment mechanism on goods markets and on the labour market from the process of adjustment. This, then, is the second option and the one I prefer to explain how Böhm-Bawerk
brought about the particular closure. The advantage of abstraction by failing to explicitly refer by way of a specified clause is that the scientist is not impeded in theorising by his lack of comprehensive knowledge about the complex processes he is making an explanatory theory about.

I conclude that Böhm-Bawerk permitted himself the thesis that, given particular initial conditions, his theory predicted certain equilibria, regardless of the effect the course of time has on market results. He could do so because the equilibrium producing mechanics had already been described and explained by Menger’s theory. The so-called disturbances simply were not relevant to him any more: he abstracted from them. So also here – where unspecified and implicit clauses exercise their closure in the background – we can see the ignoring of spatio-temporal detail; we can see abstraction at work. The particular closure that Hausman discusses, the use of vague clauses, is not simply a case of horizontal isolation. It is more like abstraction.

5.5 Abstraction ante explicationem and abstraction post explicationem

I want to characterize Böhm-Bawerk’s reasoning strategy as abstraction post explicationem. This means that he abstracted from the course of time in his interest theory after the developments of Mengerian Subjective Value Theory, due to which he could be confident that the explanation of mechanisms, that take time to evolve, had been taken care of.

But note that an additional theory, which takes the detail of a deviant case as part of its explanandum, is not always available. Suppose that the economist needs such an additional theory and that actual disturbances imply the risk of falsification (without which there will of course be no problem). In this case he can only hope that additional explanations will be developed at some later day. The reasoning strategy now is one of abstraction ante explicationem.

This means that scientists may focus on the causal relationships that, so he hypothesises, will tell us much about phenomena that arose his curiosity, without paying too much attention to the many other variables that influence the phenomenon under study. If the ‘other variables’ are limited in number he could insert a clause to account for deviations from what he describes the world is like. But as they are, by default, too numerous to formulate a proper clause – a well specified clause – he can ignore them. Of course, the disturbing content of the actual world will often call for scientific attention. Suppose that the economist needs such an additional theory and that actual disturbances imply the risk of falsification (without which there will of course be no problem). In this case he can only hope that additional explanations will be developed at some later day. It may take long before an additional theory that takes this disturbing content as explanandum.

If the theorist wants to save both the theory and the phenomena, he will have to explain any deviations by reference to the idealising practice of economic
research. If, on top of this, the theory pretends to be relevant for policy, de-
idealization is a prerequisite. Cartwright calls this ‘customizing’. The policy
maker cannot abstain from considerations of how to deal with the circumstances
listed in the clause. He will above all be interested in the question whether these
circumstances can actually be given the (approximate) value they assume in the
idealization. As we have seen in the case of the gas laws, some approximation is
not excluded a priori, although it is clear that in economic policy – and in social
ingineering in general – this encounters practical, ethical, or legal difficulties. But
note that if we believed that the social world was unconditionally inaccessible for
making any inroads at all, there would be no point for any policy whatsoever.

Alternatively, I characterised Böhm-Bawerk’s reasoning strategy in the in-
terest theory ‘abstraction post explicationem’ because he could be confident that
some explanatory hypotheses had been developed before and that these hypothe-
ses satisfactorily explain how deviations come about, such that the theory at issue
can be saved. Every economist builds on former work and thereby assumes the
accepted theoretical hypotheses from the past. In general, Austrian mechanistic
market theories provide us with the tools to scrutinize the precise effect on market
outcomes of sluggishness and the time needed for deliberations by entrepreneurs,
workers, and consumers. An economist who dislikes Austrian economics, quite
regardless of his reasons, may not disregard time lags themselves but may never-
theless ignore the underlying mechanism that explains the time lags. He abstracts
from this mechanism. If he explicitly dismisses the truth of the relevant Austrian
hypotheses, his epistemic move can be classified as abstraction ante explicationem,
because we are not told what the lags’ provenance is, hence this explanation is to
be awaited. If, in contrast, he explicitly accepts such Austrian explanations, it can
be classified as abstraction post explicationem.

The distinction between ante explicationem and post explicationem reason-
ing brings in considerations about background theories and research aims. These
help solving the problem of inexact laws. They do so in the following way.

An inexact economic theorem is a product of abstraction ante explicationem.
The unknown and fuzzy set of details, captured by the vague clause, remain
unmentioned. It follows from my critique of Hausman’s discussion of vague qualifi-
cation that, in this case, this set of details is being abstracted from. More generally,
it follows that the judgement as to which epistemic operation is in use is a matter
of a background of research interests. The aims Böhm-Bawerk must have had in
mind can be found out on the basis of our knowledge of the developments of the
theory of the day and the tradition to which he belongs. Hausman believes that the
growth of economic understanding over time will decrease the vagueness of inex-
act laws. This is in entire agreement with a thesis I can now defend: that post ex-
pllicationem abstraction fixes part of the meaning of a clause by (possibly implicit) allusion

\[\text{Cartwright (1999), p.250.}\]
\[\text{Hausman (1992), p.136.}\]
to some existing theory. The more scientific knowledge expands, the more post explanationem allusions we will be able to allow; and the more precise our existing clauses can be made.

6 Conclusion

The efforts to make a gas law complex enough to deal with an idealizational clause involved in a simpler law provide an example of theoretical de-idealization in the course of the history of science. The clause attached to Boyle’s law is very specific although the relative constancy of temperature in the experiments was more or less a fortunate coincidence. The clause attached to the Ideal Gas Law is also well specified. The variables subjected to the clauses are undisputed referents of the terms in the idealizational law-like hypotheses; i.e. we know what these clauses are about. All three gas laws are approximately true, the extent to which the approximation is acceptable depending on the respective aims the engineers of the physical world happen to have in their (design) research.

The engineers of social science are the policy makers (or their advisers.) And social reality generally presents difficult cases of intervention. The mere fact that economic policy exists reflects that we believe to have at least some economic knowledge of what is economically possible and what is impossible. Even if our economic theorems are idealizational, we think that these are true enough. We also think that their external validity is such that, on these theorems, we can reasonably base decisions to intervene in economic processes. But we may be dead wrong in this belief. The idealizational clauses tend to be a nuisance. They describe non-actual states of affairs, and the scope for moulding the actual world such that it counts these states of affairs among its properties is very limited. We can try to reorganize a particular market such that it mimics a perfect market, but few markets can be made like a perfect market in all respects. We can also try to control a market and erect prohibitive tariff walls but contraband will make us face reality.

For social design research, it would be helpful if we could de-idealise entirely. De-idealised theorems would guide us in interventions. At least, one advantage of a well specified idealizational clause is that, if predictions concerning economic policy outcomes turn out wrong, the cause of deviant phenomena can be attributed to variables referred to in the clause. Specified clauses can therefore be taken to indicate something about the external validity of the idealizational theorem. In this chapter, idealizations are interpreted as counterfactuals. In their semantic status as conditionals, these can be true. Why? Because in the actual world we are able to imagine possible worlds; we can imagine the set of economically possible worlds (even if we do not know how to demarcate this set).

In contrast, abstraction, as outlined, involves no propositions about the external validity of the model in which the abstraction occurs. The object abstracted
from is an indeterminate set of details that presumably play a role in the possible world the concreter description is true of. So what is the relevance for our actual world of abstract theorems about a model world? The answer lies in the extension of abstract theorems. Abstract theorems count among their extension a set of possible worlds larger than those referred to by more concrete theorems. But this implies that abstract theorems tend to have a higher external validity than their more concrete counterparts. More strongly put, abstract theorems sometimes make a good chance of being true of the actual world.

The use of vague clauses in what apparently are idealizational theorems is to be interpreted as a case of abstraction, rather than of idealization. The reason is that vague clauses tell us nothing of the exact domain of models for which the theorems are true. This is a similarity with the case of abstractive scientific claims: one can abstract over propositions that are true of the actual world but also over those that are false, without being aware of it. This is what we see with theorems that are sustained by vague clauses too. The point of tacit or explicit ‘open clauses’ is not that a false clause is involved as such and that, hence, the theorems be idealizational. I want to show that the point is that there must be some explanans that takes the discrepancy between the state of affairs in actuality and the state of affairs pictured by the theory as explanandum. In the abstraction ante explicationem case this explanans has to be awaited. In the abstraction post explicationem case (part of) the deviant differences are explained by another, already existing, theory.