Axiomathes (2017) 27:685–697
DOI 10.1007/s10516-017-9333-7

ORIGINAL PAPER

Cournot's Notion of *Hasard*: An Objective Conception of Chance

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Received: 14 November 2016 / Accepted: 8 March 2017 / Published online: 15 March 2017
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Abstract According to Antoine Augustine Cournot, chance events are the result of the intersection between independent causal chains. This coincidental notion of chance is not a new one, but—as Cournot remarks—it comes from Saint Thomas Aquinas, Boethius, and more probably from Jean de La Placette. Such a conception of chance phenomena seems to be very important, not only because it is closely related to the Principle of Causality, but also since it grounds Cournot's theory of objective probability. Starting from Martin's work (Probabilités et Critique Philosophique selon Cournot. Vrin, Paris, 1996), the main attempt of this survey is to endorse the idea that Cournot's coincidental notion of *hasard* is *objective*, that is it is ontic (i.e. it comes from some real feature of the world) and it does not depend—in some sense—on our degree of knowledge. In order to do that, a central role in the discussion will be given to the meaning of the independence between the intersecting causal chains and to Cournot's conception of causation.

Keywords Chance · Independence · Global · Local · Causation · Objective

1 Introduction

As Julienne Junkersfeld (1945) maintains in his book, «if one consults standard dictionaries for the definition of the word "chance", he finds that, according to good usage, it may have many different meanings».[1]

[1] Junkersfeld (1945, p. 1).

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Sometimes, for example, the expression "happening by chance" refers to phenomena which are fortuitous in a fundamental way, sometimes it refers to phenomena which are epistemically fortuitous.

The following Henri Poincaré's passage may be useful to clarify the distinction between a fundamental notion of chance and an epistemic one:

> Et alors si le mot *hasard* est tout simplement un synonyme d'ignorance, qu'est-ce que cela veut dire? […] Il faut donc bien que le hasard soit autre chose que le nom que nous donnons à notre ignorance, que parmi les phénomènes dont nous ignorons les causes, nous devions distinguer les phénomènes fortuits, […], et ceux qui ne sont pas fortuits et sur lesquels nous ne pouvons rien dire, tant que nous n'aurons pas déterminé les lois qui les régissent.[2]

What precisely is fundamental chance according to Poincaré? Fundamental (i.e. objective) chance is something which goes beyond our ignorance and, at the same time, comes from some real feature of reality. Conversely, in the case of epistemic chance, something seems to happen by chance only because one does not have a complete knowledge about what is observed.

This enquiry takes into consideration Cournot's notion of *hasard*, according to which chance events are simply the effect of the fortuitous intersection between independent causal chains. This notion of chance seems to be very important, not only because it is closely related to the Principle of Causality, according to which whatever comes to exist has a cause, but also since it grounds Cournot's theory of objective probability. More precisely, according to Cournot, chance must be objective in order to guarantee the objectivity of probability:

> Affirmer la réalité objective du hasard, c'est pour Cournot, montrer que la probabilité peut s'appliquer au réel pour mesurer non pas notre degré de croyance an la réalisation possible d'un événement, mais la possibilité effective de cet événement.[3]

The main attempt of this survey is to endorse the idea that Cournot's conception of chance is *objective*, that is it comes from some real feature of reality, and it is independent of our ignorance.

In order to show that, I will firstly present Cournot's definition of *hasard*, trying to investigate its origins. Secondly, I will illustrate which kind of independence between the intersecting causal lines is at the centre of this coincidental conception of chance. Finally, Cournot's view of causation will be presented.

2 Cournot's Conception of Chance and Its Origins

According to Cournot's definition of chance,[4] intersections between independent causal chains are the origin of accidental events:

[2] Poincaré (1912, p. 3).

[3] Martin (1996, p. 107).

[4] As already well illustrated in Martin (1996), Cournot presents his idea of chance mainly in the Chapter IV of the *Exposition* and in the Chapter III of the *Essai*.

> Les événements amenés par la combinaison ou la rencontre de phénomènes qui appartiennent à des séries indépendantes, dans l'ordre de la causalité, sont ce qu'on nomme des événements *fortuits*, ou des résultats du *hasard*.[5]

Before Cournot, almost the same view can be observed in Jean de La Placette:

> Pour moi, je suis persuadé que le hasard renferme quelque chose de réel et de positif, savoir, un concours de deux ou de plusieurs événements contingents, chacun desquels a ses causes, mais en sorte que leur concours n'en a aucune que l'on connaisse. Je suis for trompé si ce n'est là ce qu'on entend lorsqu'on parle du hasard.[6]

This coincidental conception of chance goes probably back over Saint Thomas Aquinas, who—in his commentary on Aristotle's Metaphysics—says that if we treat chance beings as things produced by per se causes, many things can be by chance, such us the intersection between independent causal lines.[7]

As Cournot highlights, the core of this conception of *hasard* consists of the independence of the intersecting causal chains:

> Il faut, pour bien s'entendre, s'attacher exclusivement à ce qu'il y a de fondamental et de catégorique dans la notion du hasard, savoir, à l'idée de l'indépendance ou de la non-solidarité entre diverses séries de causes […].[8]

To better clarify this point, let us consider one Cournot's example.[9] A Parisian decides to go for an outing and takes a train to reach the desired location. The train goes off the rail and the Parisian is the poor victim. In this case we have an intersection between two independent causal lines: the Parisian in the train and the train which goes off the rail.

In Fig. 1, the intersection between A and B represents a coincidence, a coincidence which has—as its proper consequence—the Parisian's death. The dotted parts of the arrows in the figure represent the two independent causal histories of A and B.

To sum up, coincidences are events that can be divided into components independently produced by some causal factor.

3 Global Independence Versus Local Independence

After briefly illustrating Cournot's conception of chance and its origins, then, we may say something more about the independence between the intersecting causal lines, which is—as Cournot maintains—at the core of the coincidental conception of chance.

[5] Cournot (1843, p. 55).

[6] De La Placette (1714, p. 7), end of the preface.

[7] For an extended enquiry see Junkersfeld (1945).

[8] Cournot (1851, p. 56).

[9] Cournot (1851, p. 52).

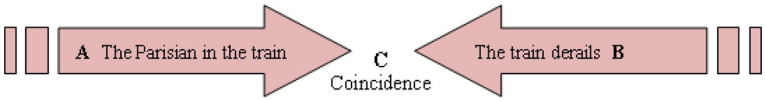

Fig. 1 Cournot's example of hasard

As illustrated by Alessandra Melas (2015), when we deal with the independence between the causal lines involved we think about two main possibilities:

- The independence is GLOBAL: there is not any direct, or indirect, causal link between the causal lines we are taking into consideration, and the intersecting causal lines involved do not share any direct, or indirect, common cause in their past.
- The independence is LOCAL: there is some indirect, but not direct, causal link between the causal lines we are taking into consideration, or the intersecting causal lines involved share some indirect common cause in their past.[10]

Following Melas (2015), in order to specify the meaning of the word "direct", it may be useful to employ the definition of what Patrick Suppes calls "direct causes":

> […] An event $B_{t'}$ is a direct cause of A_t if and only if $B_{t'}$ is a prima facie cause of A_t and there is no t'' and no partition $\pi_{t''}$ such that for every $C_{t''}$ in $\pi_{t''}$
>
> (i) $t' < t'' < t$,
> (ii) $P(B_{t'}\ C_{t''}) > 0$,
> (iii) $P(A_t|C_{t''}\ B_{t'}) = P(A_t|C_{t''})$.[11]

So that a direct causal link between, for example, A and B is a link that is not intercepted by any intermediary I^n; and a direct common cause D of A and B is a common cause that is not intercepted by any intermediary A^n between A and D, or by any intermediary B^n between B and D. The following figures can make that more clear (Figs. 2, 3, 4, 5).

Whereas an indirect causal link between A and B is a link that is intercepted by some intermediary I^n; and an indirect common cause D of A and B is a common cause that is intercepted by some intermediary A^n between A and D, or by some intermediary B^n between B and D. The following figures can make that more clear:

Now, according to Melas,[12] we can explicate the GLOBAL independence between two processes, A and B, which belong to different causal chains in the following terms: A and B are globally independent if there is not any direct, or indirect, causal link between them, and they do not share any direct, or indirect, common cause in their past.

In this case A and B are probabilistically independent, in a way that:

[10] Melas (2015, p. 76).

[11] Suppes (1970, p. 28).

[12] Melas (2015, pp. 78–79).

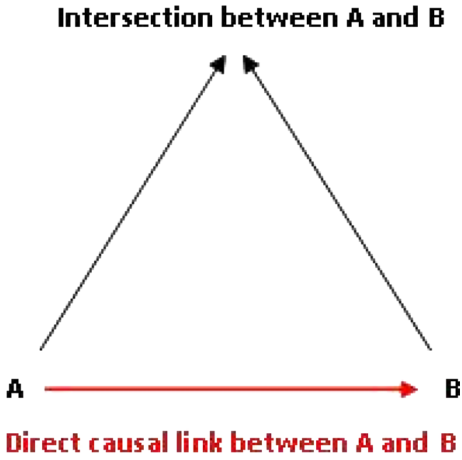

Fig. 2 Direct causal link (Melas 2015, p. 77)

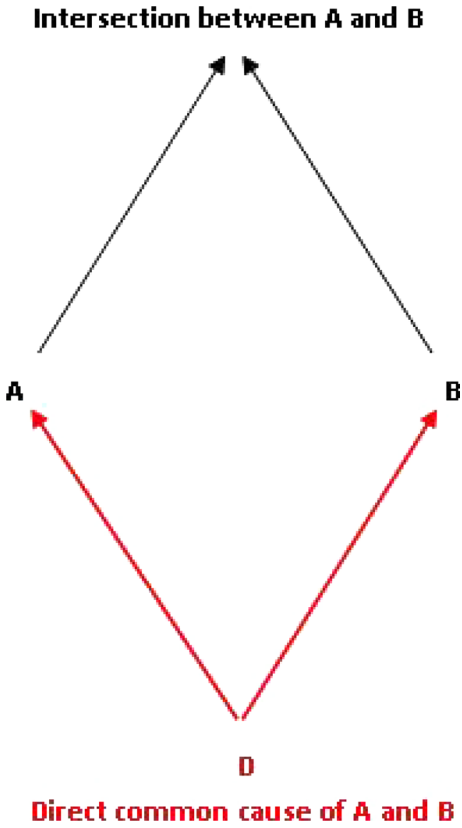

Fig. 3 Direct common cause (Melas 2015, p. 77)

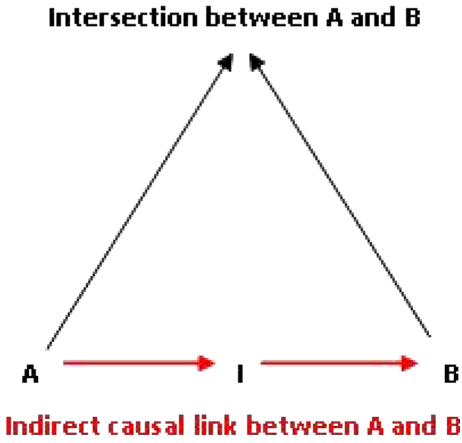

Fig. 4 Indirect causal link (Melas 2015, p. 78)

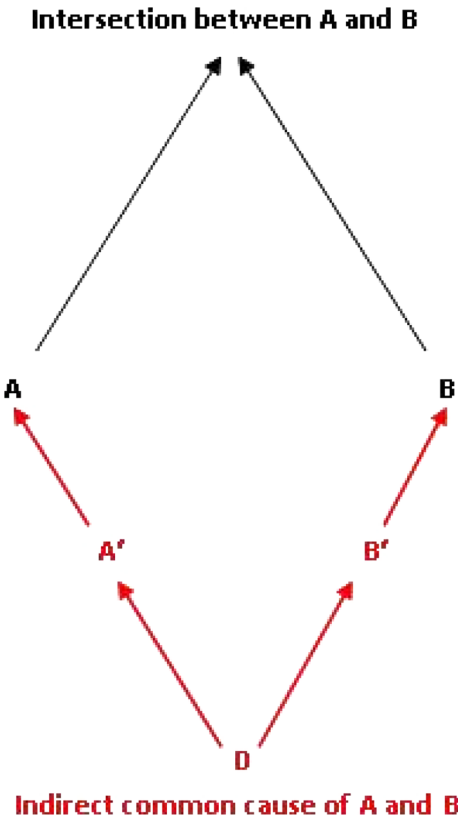

Fig. 5 Indirect common cause (Melas 2015, p. 78)

$$\mathrm{P(A/B) = P(A)}$$

and

$$\mathrm{P(B/A) = P(B).}$$

where the probabilistic independence between A and B is not due to any intermediary I^n of A and B. So that, the following is not true:

$$\mathrm{P(A/B \wedge I) = P(A/I)}$$

and

$$\mathrm{P(B/A \wedge I) = P(B/I)}$$

Moreover, the probabilistic independence between A and B is not due to any screening-off common cause D in the past of A and B.[13] Hence, is not true that:

$$\mathrm{P(A/B \wedge D) = P(A/D)}$$

and

$$\mathrm{P(B/A \wedge D) = P(B/D)}$$

Therefore, in the case of a global independence, the probabilistic independence between A and B is not conditional, but it is absolute.

Conversely, according to Melas,[14] the LOCAL independence admits the existence of ancient common causes, and indirect causal links between the processes involved: A and B are locally independent if there is some indirect causal link between them, or they share some indirect common cause in their past.

So that, given some intermediary I^n of A and B:

$$\mathrm{P(A/B \wedge I) = P(A/I)}$$

and

$$\mathrm{P(B/A \wedge I) = P(B/I)}$$

Moreover, given any indirect common cause D of A and B, some intermediary A^n between A and D, and some intermediary B^n between B and D:

$$\mathrm{P(A/B \wedge B' \wedge A' \wedge D) = P(A/B' \wedge A' \wedge D) = P(A/A' \wedge D) = P(A/A')}$$

and

$$\mathrm{P(B/A \wedge A' \wedge B' \wedge D) = P(B/A' \wedge B' \wedge D) = P(B/B' \wedge D) = P(B/B')}$$

In the case of a local independence, the probabilistic independence between A and B is not absolute, but it is conditional. In fact, A and B are independent given

[13] In effect, given a screening-off common cause, A and B are probabilistically independent of each other.

[14] Melas (2015), 79–80.

some intermediary between A and B, or some intermediary between a common cause D and A, and a common cause D and B. So that, the next inequalities are true:

$$\mathrm{P(A/B)} \neq \mathrm{P(A)}$$

and[15]

$$\mathrm{P(B/A)} \neq \mathrm{P(B)}$$

If we now ask the question: Would we say that a particular event happens by chance if we knew that the independence between the causal lines involved is local? The reply may be given as follows: we would say that events such those are not really fortuitous, and this is because the independence between the causal lines involved is not absolute, and the causal lines considered share the same causal history.

Conversely to that, a conception of coincidence that comes from a global independence between the causal lines involved seems to admit some kind of real chance.

However, as it is illustrated in the next section, that is not all of the story.

4 Cournot's Hasard and the Local Independence

As we have already seen, according to Cournot, chance events are not uncaused but—in general—they are simply the result of the intersection between independent causal chains.

However, which kind of independence is the Philosopher talking about? Since we want to show that Cournot's defends an objective conception of chance, it can be supposed that—according to the Philosopher—it may exist some kind of global independence between the causal lines involved. In fact, only a conception of chance that comes from a global independence between the causal lines seems to guarantee the existence of real chance.

However, as well illustrated by Thierry Martin,[16] Cournot does not consider the causal lines as necessarily globally independent of each other. More precisely he says that some causal chains are independent of each other if they develop «sans avoir les unes sur les autres la moindre influence, ou sans exercer les unes sur les autres une influence qui puisse se manifester par des effets appréciables».[17]

Nevertheless, Cournot continues to consider *hasard* as real. How is this possible?

Even a local/conditional independence can involve—in some sense—a real kind of chance. In fact, the more the intersecting lines are diverging, that is the more numerous are the intermediates I^n between them, and the intermediates A^n and B^n between them and a possible common cause D, the less they affect each other and

[15] For a more extended discussion on this, see again Melas (2015).

[16] Martin (1996, pp. 155–170).

[17] Cournot (1851, p. 34).

the more they are independent of each other.[18] It can be admitted, then, a certain *objective* degree of independence.

So that it is not difficult to see that in Fig. 6 *A* and *B* are more independent of each other than in the case in Fig. 4:

And it is not difficult to note that in Fig. 7 *A* and *B* are more independent of each other than in the case in Fig. 5:

That means that it can be established how much some causal lines are independent of each other, in a way which is—in some sense—independent of our degree of knowledge. The greater is the number of the intermediates between *A* and *B*, or between *A* and *B* and their common cause *D*, the more *A* and *B* are *objectively* independent of each other.

A local independence between the causal lines involved can implicate an objective degree of independence, and then admit an objective notion of chance.

5 Cournot's Conception of Causation

According to Cournot's view the word "cause" is used:

> Pour désigner tout ce qui influe sur la production d'un événement, et non plus seulement pour désigner les causes proprement dites, ou les causes efficientes et vraiment actives.[19]

More precisely, Cournot includes inside the (*lato* sensu) notion of causation all of the conditions and circumstances that make the action of the cause possible. But what are these conditions and circumstances? They are said to be the reason of the action of the cause. In his *Essai*, in a discussion concerning the Principle of Causality, Cournot says:

[18] It can be invoked Salmon's theory (1984) of *causal influence* to clarify what "affecting each other" means. According to Salmon, *A* and *B* affect each other if there is a causal influence between *A* and *B*, that is a causal process that connects the two events. Causal processes are the means by which marks are transmitted and—then—the means by which causal influence is propagated. A mark consists, in general, of a modification of a characteristic Q into Q', introduced into a process *P* by means of an interaction at a point *A*. A mark, which manifests over an interval that includes both *A* and *B* (with $A \neq B$), is transmitted to point *B* if *P* manifests the modification Q' at *B* and at all stages of the process between *A* and *B* without any additional intervention.

Hence, it can also be said that the more are the additional interventions—that is the causal intermediates—between *A* and *B*, the more the causal influence between *A* and *B* changes along its path.

Moreover, according to Salmon, a process is also capable to transmit a *probabilistic* causal influence. More precisely, processes are capable to transmit *propensities*, as probabilistic dispositions. So that, a hammer falling down from a roof has a propensity to hit a passer-by walking in the same direction of the hammer. As the hammer falls, however, it loses energy and its propensity to hit the passer-by changes along its trajectory.

Hence, it can also be said that the more are the causal intermediates—that is the additional interventions—between the trajectory of the hammer and the passer-by, the more the probabilistic casual influence of the hammer to hit the passer-by changes along its path.

As it will be more clear in the next sections, Salmon's ontic view of causal propagation is perfectly compatible with Cournot's conception of causation.

[19] Cournot (1851, p. 37).

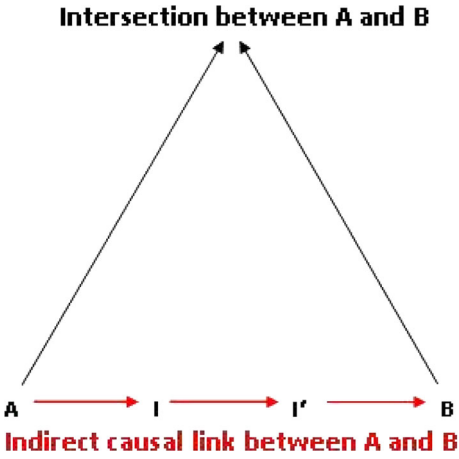

Fig. 6 More indirect causal link

> De même que toute chose doit avoir sa raison, ainsi tout ce que nous appelons événement doit avoir une cause.[20]

Hence, the Principle of Causality seems to be only a particular application of the Principle of Reason.

Cournot's distinction between cause (*stricto* sensu) and reason can be summed up in this way: a cause is—in some sense—a physically powerful thing, that is something which has the physical power to produce something else; differently, a reason is something which has an explicative function.

At first sight, cause (*stricto* sensu) and reason appear to be two different things: the farmer seems to be a physical thing, the latter does not. So that causation (*lato* sensu) looks like a non-totally physical and ontic thing.

However, it is very interesting to point out the fact that Cournot gives a physical meaning to the notion of reason as well.[21] Following what Martin already said, Cournot's distinction between reasons and causes is the same as the distinction between regular causes and accidental causes:

> Si on considère un événement fortuit et répétable, comme celui auquel donne lieu le jeu de pile ou face, on doit distinguer, dit Cournot, des causes régulières ou permanentes, qui demeurent identiques pour toutes les épreuves (la régularité ou l'irrégularité de structure de la pièce) et des causes fortuites ou accidentelles, qui varient avec chaque épreuve (la direction et l'intensité de la force impulsive).[22]

[20] Cournot (1851, p. 33).

[21] Cournot (1872, pp. 9–19).

[22] Martin (1996, p. 124).

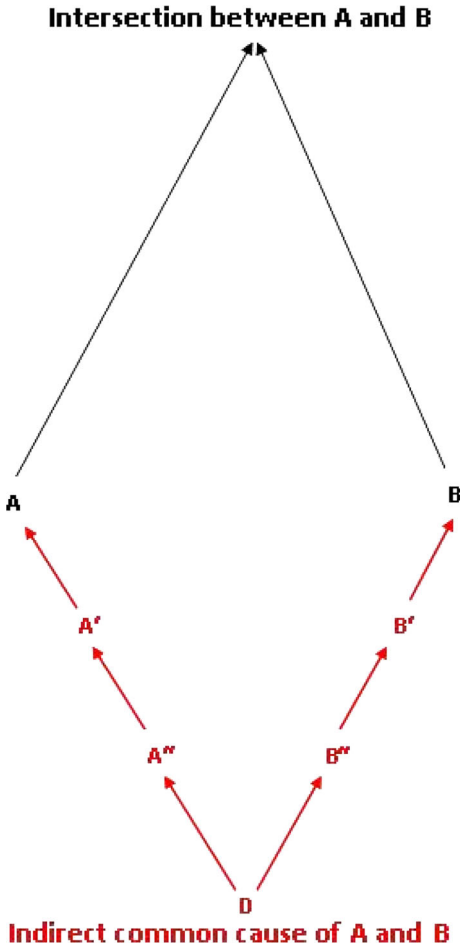

Fig. 7 More indirect common cause

So that each event is brought about by the combination of regular causes and accidental causes, which are both physical/ontic causes.

6 Cournot's Hasard and the Intersections Between Physical chains

At the very beginning one could think that in Cournot the discussion moves from an ontic level to an epistemic one.

In fact, as it is well quoted by Martin:

> Cournot le précise clairement «le mot de hasard n'indique pas une cause substantielle, mais une idée».[23]

[23] Martin (1996, p. 113).

And:

> En toute rigueur, pour Cournot, un événement n'est jamais le produit *du* hasard, ni produit *par* hasard.[24]

What does it mean? Is not chance something that comes from some real feature of reality?

According to Cournot's view, chance is not something like a new force, or physical objet. This is exactly what Cournot wants to say when he states that the word "*hasard*" does not indicate a substance, but it indicates an idea. More precisely, as it has already shown, chance is not—following Cournot—a single thing, but it describes a situation and it can be defined as what comes from the intersection between independent chains.

Clarified that, now the problem is a new one, that is to see whether the intersecting chains are physical things or not.

In order to do that it could be useful to quote again the definition of *hasard*, that one finds in the *Exposition*:

> Les événements amenés par la combinaison ou la rencontre de phénomènes qui appartiennent à des séries indépendantes, dans l'ordre de la causalité, sont ce qu'on nomme des événements *fortuits*, ou des résultats du *hasard*.[25]

In the *Essai*, there seems to be a change in that definition, a change that is proposed in the *Traité* in the following way:

> L'idée de hasard est l'idée d'une rencontre entre des faits rationnellement indépendants les uns des autres […].[26]

There is a passage from a causal independence to a rational independence. Then, given that, are the intersecting chains still real processes? The answer to this question is positive. As it has already said in the previous section, Cournot gives a physical meaning even to the notion of reason. More precisely, Cournot's distinction between reasons and causes is the same as the distinction between regular causes and accidental causes, which are both physical processes.

Hence, it can be concluded that chance—according to Cournot—comes from some ontic feature of reality, in a way that chance can be an objective thing.

7 Conclusion

In this paper, I have shown that Cournot's view of chance is *objective*. More precisely, it has been illustrated that, according to Cournot's conception, *le hasard* is produced by the intersection between *objectively* independent[27] *physical/ontic* chains. To sum up, I have stated that:

[24] Martin (1996, p. 113).

[25] Cournot (1843, p. 55).

[26] Cournot (1861, p. 62).

[27] As already seen, it can be recognized some objective degree of independence.

1. It can be established how much some causal lines are independent of each other, even if they are not totally independent, in a way which is—in some sense—free from our degree of knowledge.
2. Cournot considers chance as a situation that comes from some ontic features of reality, that is the intersecting physical lines.

Many problems concerning chance are still open. It remains, for example, to be seen whether there is a relation between this causal conception of chance and other notions of chance.

Further investigations along this line will be the object of developing papers.

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