Is growth underestimated?

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One possible interpretation of the slowing of economic growth is the so-called "mismeasure-ment" hypothesis. Growth is still thought to be sustained, but in forms that escape traditional data sources: dematerialisation and accelerated renewal of a large number of goods and services, a growing disconnection between their price and their value-in-use, with new free services being a borderline case of this disconnection. The measurement of growth is also likely to be disrupted by the effects of globalisation. It allows rapid and artificial re-allocations of revenues from production, with the risk of "mirror biases": growth artificially overestimated in some countries and underestimated in others.
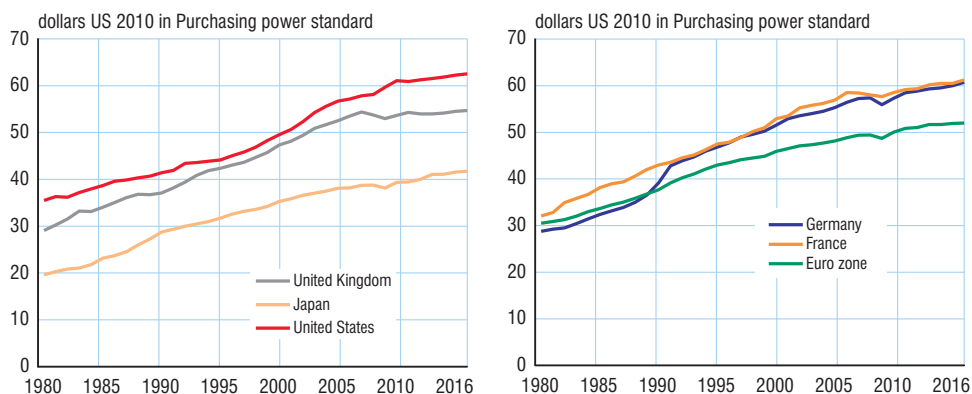
This kind of conjecture re-opens questions than have been regularly debated since the creation of the national accounts: the scope of GDP, the practice and theoretical basis for volume/price decompositions, the relevance of the notion of "domestic" product. Answering these questions means clarifying what we want to measure and for what purpose. National accounting serves to adjust cyclical macroeconomic policy and to manage and monitor public finances. It is also intended to provide information on the rate at which the population's living standards are improving. The problems of measurement do not raise the same issues according to the use concerned, and it is by no means obvious that they have intensified over the recent period.

Questions to be weighed against the uses made of GDP

Economic growth has seen a marked downturn over the last twenty or so years (*figure 1*). This phenomenon appears to be a persistent trend and not only due to the 2008-2009 crisis and its consequences. In the case of France, a simple visual extrapolation suggests that hourly labour productivity is currently about 20% less than it would have been if it had continued to grow at the same rate as the average over the years 1980 to 2000. Byrne et al. [2016] or Syverson [2017] give comparable orders of magnitude for the United States: a slowdown of about 19% in 2015 according to Syverson, or $3,400 billion of "missing output" out of a GDP of $18,000 billion. The same calculation applied to France would have given on the same date a figure of €400 billion, for a total GDP of €2,181 billion. The fact is that this slowing is often perceived as contradictory with a flow of innovations that shows no sign of drying up. We would seem to be facing the same paradox as that identified by Solow at the end of the 1980s: new technologies that we see all around us, except in the growth figures. Before starting to probe the slowdown in productivity, the first question is therefore whether part of the phenomenon is not related to a measurement issue: effective growth may still be sustained, but taking forms that escape the statistical system, with the "missing output" therefore being an artefact.

1. Labour productivity per hour worked

dollars US 2010 in Purchasing power standard

dollars US 2010 in Purchasing power standard

United Kingdom
Japan
United States

Germany
France
Euro zone

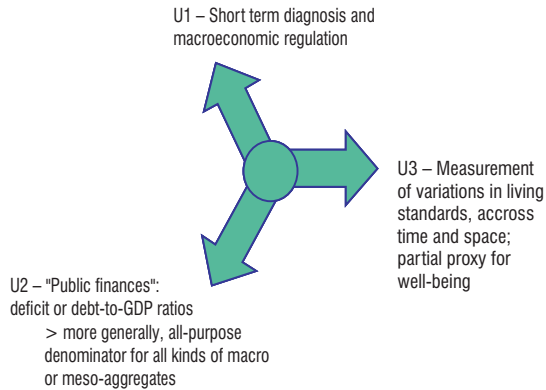Source: Bergeaud, Cette and Lecat [2016].

This hypothesis places considerable emphasis on the problems of measuring the digital economy, but the issue is a more general one. It is that of the ability of national accounting to account for an economy in which goods and services are renewed at a fast pace and take more and more varied forms, some of which escape the traditional pattern of commercial exchanges. The problem is both that of the scope of GDP - is it still adequate? – and that of measuring the "volume" of what is produced within that scope [Bean, 2016; Coyle, 2016; Aghion et al., 2017; Feldstein, 2017].

In addition to these issues, there can also be the growing difficulty of locating exactly where production takes place. What GDP seeks to measure is output in a given territory. Yet a production that is becoming more and more intangible is increasingly difficult to locate, with the possibility of artificially amplifying growth in the countries where firms choose to locate their intangible assets, counterbalanced by apparent reductions in growth in the other countries. An emblematic example has been provided by the uncommonly high growth rate posted by Ireland between 2014 and 2015, due to multinationals moving to this country revenues unconnected to any production actually taking place in Ireland. In this particular case, it is likely that the corresponding revenues were initially located in countries where they were poorly recorded or not recorded at all, in which case the transfer probably did not have a negative effect on the growth recorded elsewhere in the world. But, as a general rule, this type of transfer can cause "mirror biases": growth overestimated in the receiving countries corresponding to the same amount of "missing output" in the countries where these revenues should normally have been located.

The aim of this report is to review the situation with regard to these issues. Reference will be made to the uses of GDP as the measurement problems do not equally matter depending on which of these uses is being given priority. Three main uses or classes of uses can be identified (*2 figure*). The first (U1) is to help with the adjustment of cyclical macroeconomic policy. It played a large role in the development of national accounting. The second (U2) is the use of GDP as a reference denominator for a large number of macroeconomic magnitudes. The example that naturally comes to mind is that of the government debt or deficit-to-GDP ratios, but GDP also serves as a denominator for many other indicators: foreign trade, distribution of value added, production structure, etc.

Finally, GDP per capita or some of its derivatives are used as indicators of populations' living standards, to the point where they are sometimes interpreted as indicators of well-being.

2. National accounts: several uses

U1 – Short term diagnosis and
macroeconomic regulation

U3 – Measurement
of variations in living
standards, accross
time and space;
partial proxy for
well-being

U2 – "Public finances":
deficit or debt-to-GDP ratios
> more generally, all-purpose
denominator for all kinds of macro
or meso-aggregates

Source: authors.

On this point, we know of course that economists and national accountants have long converged on the fact that GDP is not a measure of well-being [Vanoli, 2002], it is at most one of its components, but a component that is often considered important enough to make it an informative proxy of this well-being. Several characteristics of GDP can be explained to a large extent by this living standard/well-being use that we will call use U3. The extension from market GDP to overall GDP including the output of government entities allows their contribution to the population's standard of living to be included. The inclusion in GDP of imputed rents that homeowners pay fictitiously to themselves contributes nothing to uses U1 and U2, but makes more sense with regard to objective U3: we do not want a GDP that would suggest that living standards fall when the proportion of homeowners increases, as it would be the case if only monetary flows between landlords and tenants were taken into account. It is also this use U3 that justifies the efforts made to adjust GDP per capita for purchasing power parities, with the aim of better measuring international differences in living standards.

It is with reference to these three uses that we will discuss the three main measurement problems raised here. We will start with the issue of volume/price decomposition, then move on to that of the location of production, before discussing the limits of the scope conventionally applied to GDP: should we and can we do away with them?

Volume/price decompositions and the renewal of goods and services: how are these handled?

The aggregates used in national accounting are expressed alternatively in value or in volume. It is volumes that tell us whether economic growth is positive or negative and its speed. But the notion of volume is an abstract notion [Vanoli, 2002] which is both difficult to evaluate and to interpret. This is all the more so as the transition from values to volumes is a complex operation that cannot be boiled down to a simple division of the former by a general price index. Different indices and their subcomponents are applied item by item: components of the consumer price index (CPI) for most of the items making up household final demand, components of the industrial producer price index (IPPI) or the industrial selling price index (ISPI) for output, investment, exports and imports, and estimation by residual for the price of intermediate consumptions.

This report is not the place to go into the detail of these operations[1], and it will therefore concentrate on the general principles. Whatever the indices used, measuring a volume involves aggregating the quantities of a large number of goods and services. The methodology is well established in the simple case of an unvarying list of goods and services. The change in prices is in this case the average of the changes in the prices of goods weighted by their quantities and, symmetrically, that of the quantities is the average of the changes in the quantities of each product, weighted by their prices, the combination of the two reproducing the global change in values. The results may differ according to the price system that is used as the reference, but thanks to the practice of chain-linking annual changes in prices and volumes, this is now only a second-order problem. The weightings of the prices or quantities are reviewed each year, which makes it possible to take account of most of the substitution effects that result from variations in relative prices. By substitution effect we mean the fact that an individual may compensate for the increase in the price of a good by partly changing to substitutable goods with less dynamic prices, so as to moderate her loss of well-being. This brings us close to the theoretical notion of the "constant-utility" price indexes [Magnien and Pougnard, 2000; Sillard, 2017], a term that clearly indicates the connection between the notion of volume and the notions of "utility" or well-being derived from baskets of goods produced or consumed. A volume is not a measure of well-being, but it is impossible to conceptualize outside of any reference to this notion of well-being.

What complicates the exercise is the renewal of goods. This problem is all the more present as it is on this renewal that a large part of growth depends [Lequiller, 2000]. This problem is of course not ignored by the national accounts and price statisticians. They use various techniques, whilst trying to mobilise the one best suited to each scenario.

A first possibility is to add the new product to the list of products already tracked in the index, without worrying about the question of the overlap or the substitution effect with existing products. Once this product has been included, the changes in its price are tracked with a weighting that changes according to its share in household budgets, by simple application of the chain-linking principle. What is going to be ignored is only the way this product has contributed to the living standard until the date following its first year of inclusion in the index, since it is only from that date that the change in its price will be taken into account. It is considered that this loss of information will remain limited if the products in question are very innovative products whose first placing on the market is at a very high price with a low initial diffusion. One might think of the effects of the first video camera, the first DVD player, the very first smartphone. What it is important to capture for these products is the subsequent drop in their price and the democratisation that goes with it.

The case of goods that are only partially innovative is more problematic as it raises the question of the comparison with goods already in place. The typical case is that of the appearance of a new generation of an existing product. This is one of the ways in which the progressive diffusion of goods that were initially very innovative occurs: it is not only the same good that sees its price progressively fall, but also new generations of that good that succeed each other. Here, the issue is to identify what in the apparent price differences corresponds to genuine price differences and what corresponds to differences in quality. The default method is the overlap method, which makes the assumption that all the differences in price during the period of coexistence of the two products correspond to differences in quality. The assumption is that, if a new good is a substitute for an existing good, the prices of both will have to adjust to be competitive, in a way that will spontaneously take account of the differences in quality: the price of the old product will not have to adjust if a lower price for the new product corresponds to a lower quality good[2], or if its higher price corresponds to a better service rendered. On the

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1. See Aeberhardt and Bidault [2018] for a full presentation of the volume/price decompositions in the 2014 base of national accounts.
2. This case is not marginal: according to Guédès [2004], 39% of new products show a reduction in quality rather than an increase.

other hand, it will have to go down if the new good has a better quality/price ratio. It is this transmission effect that will enable the overall impact of the new good on the average price paid to be tracked. This is only an hypothesis of course. It will be brought into question when certain prices are not set by the effects of competition. The case of the price of taxis is one example. When private hire vehicles (PHV) develop, the price of taxis does not change, because it is regulated. The introduction of PHVs, which have been added into the CPI as a new product, therefore did not have any downward impact on the price of road passenger transport as, in the absence of market prices, the statisticians had no way of measuring the difference in quality between PHVs and taxis. The alternative would have been to consider them as the same good, but that would also have been debatable as the two services are not entirely substitutable. It is also possible to have the case of the producer of a new good playing on the attraction of novelty to temporarily overprice this good, without the service rendered being equal to this new price, before progressively revising its price downwards: in this case the method will diagnose stability then a fall in the price at constant quality where in fact there was a rise then a return to the original level. Conversely, the producer could underprice the good to establish it on the market, then revise its price upwards. On average across all the scenarios, it is impossible to say which of the different biases will predominate, but the fact that they vary between negative and positive argues in favour of the reduction of the overall bias.

To better manage these successive generations of products rendering services of the same nature, an alternative method is the hedonic pricing method. The principle is to evaluate the quality of successive generations of equipments by a few objective characteristics that can be tracked over time and for which it is possible to measure how they are valued by consumers, by analysing the instant price differences between products with variable levels of these characteristics. The advantages of this technique were much vaunted during the first information and communication technology (ICT) revolution, whose effect was particularly linked to the increasing power of equipments. In France, first attempts took place at the beginning of the 1990s [Moreau, 1992] and the hedonic method has been applied to the prices of microcomputers and their peripherals.

But this hedonic pricing method is also not without its limits. First of all, it is also based on the assumption of competitive markets: this assumption is necessary for the instant price differences between goods with variable characteristics to properly reveal the value of those characteristics. The method can also overestimate the contribution of new products if the increase in capacities only has a low impact on the service rendered to users. Neither does it deal with qualitative changes such as the addition of a new feature. And it only applies to products whose quality can effectively come down to a restricted set of such features. This explains why in fine it is used more for more traditional goods, firstly housing and also certain types of household electrical appliances: it is on these goods that INSEE has targeted its use. On the other hand, it is clearly inapplicable to new economy services such as mobile phone contracts, which are difficult to sum up with a small number of characteristics. For these services, the direction taken in France has been rather to approach the notion of a so-called "constant-utility" price index or, more precisely, a "constant-use" index, calculating how much the expenditure needed to continue benefiting from an identical service changes from one year to another [Magnien, 2003]. To do this, standard consumption of telephone services profiles are identified and, within the contracts on offer on each date, the cheapest is selected. It is the average change to this minimal cost that is used to measure the change in the price.

This alternative method also requires several precautions. The modelling of this optimisation behaviour of consumers involves certain simplifications that are not without an effect on the measurement of the price index. For example, supposing that a consumer changes his or her contract as soon as a cheaper offer becomes available is not realistic and risks overestimating the gain actually drawn from changes in pricing, at least in the short term. To limit this problem, it is supposed that the mobility only occurs between contracts offered by the operator where the
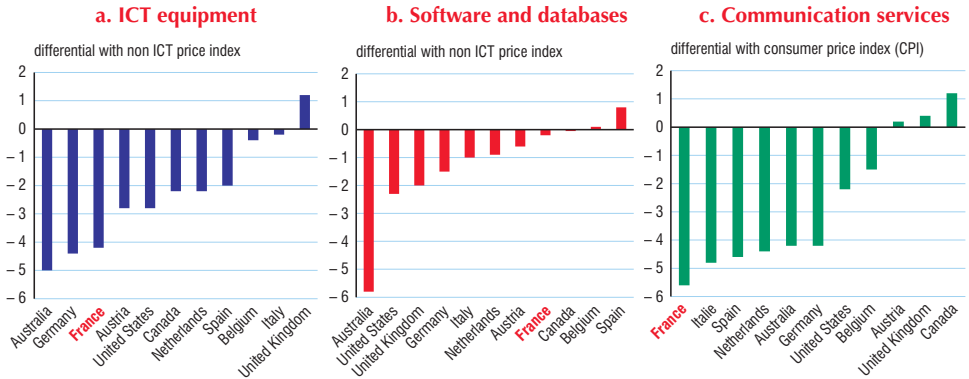
individual is already a customer, therefore not taking account of mobility between operators, which amounts to treating each operator as if it were offering a different product. This assumption was quite valid with the initially highly segmented structure of the mobile phone market, with high costs involved in migrating between operators, due in particular to the non-portability of phone numbers. It is also acceptable when the competition is stable and forces operators to align their pricing offers. However, it posed a particular problem when a fourth mobile phone operator appeared on the French market in 2012-2013, the problem being of the same type as that mentioned above for PHVs. This operator immediately garnered a large market share, reducing the average price effectively paid, to the point where it led to a nominal reduction in turnover in the sector, but without there being a comparable immediate reduction in the prices of the existing operators. As long as the prices of these other operators had not adjusted, dividing a nominal turnover figure that had fallen by a price index calculated on the operators in place led to a drop in volumes, which was the opposite of the impact that was expected of this opening up of the market. This temporarily led the national accounts to take a direct approach to the volumes, their evaluation on the basis of quantity indicators such as the length of phone calls and the number of text messages sent [Bessone et al., 2014].

All these examples illustrate well both the difficulty of the volume/price decompositions and the efforts that are made to deal with them as well as possible. New products are effectively taken into account, and the method of dealing with them that appears the most appropriate is chosen on a case-by-case basis, subject to feasibility. The sources of bias nonetheless remain numerous, mainly due to the non-competitive functioning of the markets. One way of evaluating their aggregate impact is to compare the changes in prices estimated by different techniques in different countries or difference producers of data. This method will not allow bias to be quantified that is shared by all these countries or producers of indices, but it can nevertheless provide some interesting diagnostic information. It is this method in particular that was used by Lequiller [2000] to evaluate the implications for the measurement of growth of the greater use of hedonic methods observed in the United States at the time: he had found that neutralising the difference in methods between France and the United States only led to a revision of French growth by + 0.04% a year over the period 1995-1998.

For the recent period, this benchmarking method has been systematically applied to the main countries in the OECD [Ahmad et al., 2017]. The approach is to use for each of the goods or services in the new economy the smallest change among all the changes in prices evaluated in the different countries of the OECD. Significant discrepancies are in fact observed from one country to another for the prices of investment in ICT assets, software and databases and for the prices of communication services (figure 3). It is noted that France is one of the countries that has recorded significant reductions for both ICT equipment and communication services. The prices of the "cheapest" country on each item are then applied to correct the real GDP of all the countries (figure 4). Three correction scenarios are applied according to whether the correction concerns only final demand prices, only the prices of imports, or the two together. The distinction is important because correcting an overestimation of only import prices leads to downward rather than upward revisions of the volume of what is produced in the country, at a given volume of final demand. The correction made to the annual GDP growth rate ranges from 0.02 to 0.37 points if only the final demand price is corrected (0.16 points for France), from 0.02 to 0.22 points if both the final demand price and that of imports are corrected at the same time (0.12 points in the case of France).
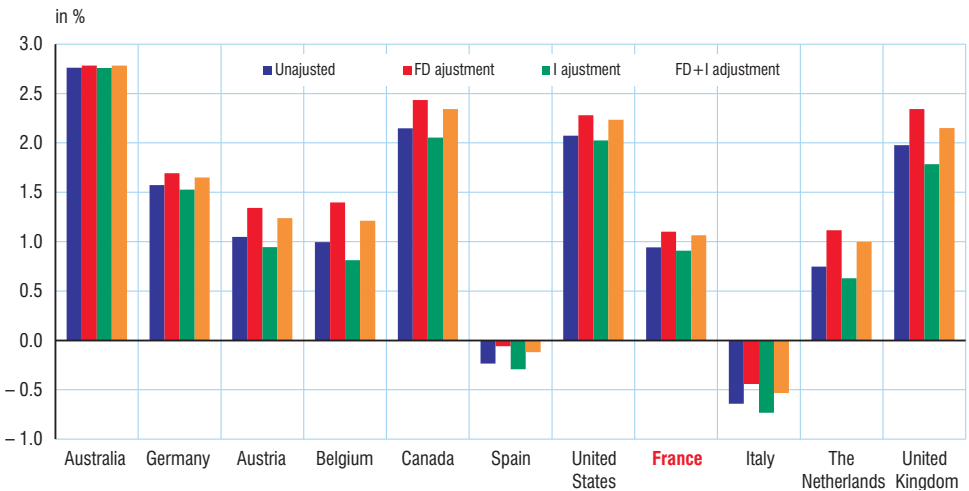
A case study applied to the United States also sheds some interesting light on the matter by relativising, as Lequiller [2000] did, the impact of the use of the hedonic methods. Byrne et al. [2016] propose various corrections to the growth rates observed over the periods 1995-2004 and 2004-2014 using evaluations of prices of ICT goods and services based on more in-depth calculations than those the Bureau of Labor Statistics (BLS) is able to implement within the

3. National price indices: investment in ICT assets and consumption of communication services

a. ICT equipment
differential with non ICT price index

b. Software and databases
differential with non ICT price index

c. Communication services
differential with consumer price index (CPI)

Source: Ahmad, Ribarsky and Reinsdorf [2017].

4. GDP growth unajusted and adjusted using lower bound national price indexes
Average annual growth rate, 2010-2015

in %

Legend: Unajusted ; FD ajustment ; I ajustment ; FD+I adjustment

Countries: Australia, Germany, Austria, Belgium, Canada, Spain, United States, **France**, Italy, The Netherlands, United Kingdom

Note: FD adjustment = final demand prices only ; I adjustment = import prices only ; FD+I adjustment : both adjustments
Source: Ahmad, Ribarsky and Reinsdorf [2017].

timeframe and with the limited means available for the production of its price index. The adjustments are quite significant, bigger than those obtained by Ahmad et al. [2017], but rather lower in the second subperiod: they add between 0.27 and 0.49 points of average annual growth to apparent labour productivity between 1995 and 2004, and only 0.13 to 0.19 points over the period 2004-2014: one reason for this fall is that, from one period to the other, a growing share of these products have become imported goods.

A third calculation has been done by Groshen et al. [2017] which combines and updates different estimates of the biases that can affect the prices of all types of goods and services, including health expenditure in particular, an area in which the measuring of quality effects also represents an important issue. They find an overestimation of price dynamics of up to 12%

a year for the price of computers and their peripherals, of 6.5% a year for the services rendered by the internet and between 0.5% and 1.2% a year for different items of medical expenditure. These biases are important, especially the first ones, but once weighted by the shares of these items in total expenditure, the correction of the bias is only 0.4 point of growth per year, and this correction is relatively stable between the subperiods 1995-2004 and 2004-2014.

Finally the same order of magnitude is arrived at by Reinsdorf and Schreyer [2017], who looked at three types of bias: insufficient control of the effects of quality in the renewal of digital goods and services, the impact of the replacement of conventional goods by digital goods (CD and DVDs by streaming services) and, finally, the way digital technologies facilitate the consumer's trade-offs between varieties of the same good or the same service. They apply high estimates of these biases to a classification of goods and services according to the degree to which they are exposed to them. The maximum total bias is again of the order of 0.4 point of annual growth.

A point these calculations have in common is the role of the effects of weighting: the biases are probable on a certain number of items, but even when they are given large magnitudes, the macroeconomic impact is dampened by the fact that they only apply to a limited part of consumption or production. The effect obtained is therefore insufficient to explain the slow-down in growth, even in the highest assumptions, all the more so when it turns out that biases of a comparable magnitude existed prior to this period of slowdown. This is also the dominant message of more theoretical approaches that move further away from the concrete calculation of prices by the national statistical institutes: they also conclude that the mismeasurement is relatively permanent (*box 1*).

Box 1

Mismeasurement and renewal of products : theoretical approaches

Several studies have attempted to give orders of magnitude to the phenomenon of mismeasurement by combining empirical data and theoretical models of the process of renewal of goods. These theoretical models start from the principle that the aim of measurement is to quantify the change in the utility that the average consumer gets from her baskets of goods. They therefore explicitly pull in the direction of a "well-being" reading of national accounting that goes beyond what the latter claims to measure.

Broda and Weinstein [2010] estimate this type of theoretical model by using scanner data that includes both prices and quantities of goods purchased. These data allow them to emphasise the scale of the phenomenon of the appearance and disappearance of goods. The change in their price index is 0.8 points less than that of the consumer price index (CPI) measured by the Bureau of Labor Statistics, an order of magnitude that was already the one proposed in the 1990s by the Boskin report [1996]. They observe that this gap widens (respectively narrows) during periods of economic expansion (respectively economic slowdown), the reason being that periods of expansion favour the appearance of new products. Redding

and Weinstein [2016] go further by proposing a notion of the price index that generalises the traditional notion of the constant-utility price index. Their generalisation also consists in authorising agents' changes in preference in response to distortions in pricing systems. Their price index thus includes two corrections: the first relates to the entry and exit of goods and the second to changes in preferences.

Aghion et al. [2017] for their part make a connection between this issue of the renewal of goods and the issue of Schumpeterian creative destruction. For this they distinguish between three types of innovations: firstly, active firms innovate on the products they already produce (innovation by incumbents), secondly already active firms and firms wishing to enter the market innovate on products previously offered by their competitors (which corresponds to the normal process of creative destruction) and finally, new products are created ex nihilo (increase in the number of varieties of goods).

Aghion et al. [2017] suppose that the national statistical institutes (NSIs) correctly measure the impact of innovation by incumbents but apply the change in prices observed on existing products to

products arising out of creative destruction and new products. Now, these goods are of higher quality as they have supplanted pre-existing competing products. Their price should therefore be corrected by a higher quality effect. This overestimation of prices by the NSIs is said to lead to the underestimation of growth in real GDP. The "missing growth" is all the more significant, the greater the leap in quality between the new goods and the existing goods. On American data, they find that GDP growth was probably underestimated by 0.6% a year over the period 1983-2013, including 0.7% a year over the period 1983-1995, 0.4% a year over the period 1996-2005 and 0.7% a year over the period 2006-2013. A recent transposition of French data gives an equivalent order of magnitude: missing growth of about 0.4% a year over the period 2006-2013 [Aghion et al., 2018].

However, the way the national accounts take account of the renewal and the improvement in the quality of goods differs from that presented in Aghion et al. [2017]. The distinction between goods introduced by existing firms and goods introduced by new firms only applies to the part of the volume/price decomposition that rests on the producer price or industrial selling indices. It does not apply to the components of GDP that are deflated on the basis of the CPI since the latter treats all new goods in the same way, regardless of their origin. The authors also assume that the contribution of new goods is limited to their impact on introduction. Whereas in fact,

a large part of the price reduction effect occurs during the life cycle of these goods, in a way that is mechanically captured by the NSIs. The aggregate estimated by the authors is, moreover, a CES function on a continuum of goods with an elasticity of substitution that is uniform across all these products, which is a very strong stylisation of what the national accounts measure, with results that turn out to be quite sensitive to the calibration of this elasticity of substitution. In practice, the chain-linking of the indices accounts for progressive substitution patterns that are better founded empirically. Finally, and this is a remark that applies to all of this literature, the mismeasurement of prices highlighted by Aghion et al. [2017] goes against the gap that generally exists between perceived inflation and its measurement by statistical institutes, with the CPI being generally suspected of underestimating the rise in prices rather than overestimating it.

Thus, even if these studies offer avenues for further research, it is difficult to draw any firm conclusions on the biases that are thought to affect the measurement of prices and that of growth. In fact, the biases that these approaches evaluate are more likely to be permanent structural biases that have not been specially amplified over the recent period. It is possible that national accounting is structurally "missing" a part of the positive effects of creative destruction, but this phenomenon is most likely not a new one. If so, the slowdown in growth remains a real phenomenon.

So what have we learned on this issue of the volume/price decompositions, with regard to the uses of national accounts mentioned above? In any case it is neutral for use U2: the debt-to-GDP or deficit-to-GDP ratios are calculated directly from the nominal values, with no influence of the volume/price decompositions. The measurement error on this decomposition is potentially more damaging to cyclical macroeconomic management. An incorrect measurement of inflation distorts the targeting of monetary policy, an underestimated growth figure can lead to overestimating the need to support activity. However, concerning the need to support activity, this is not assessed solely on the basis of the level of real GDP observed. Macroeconomists are more interested in the gap between this growth and its potential level. The latter is itself difficult to evaluate, but the measurement of its gap with real GDP is a priori not very sensitive to biases in volume/price decompositions that are relatively stable over time or evolving slowly, as seems to be the case.

What remains is the risk of underestimating the upward trend in productivity and the population's living standards, which brings us back to use U3, but this is only one aspect of the wider issue of measuring the pace at which living conditions are improving, which also raises the question of the scope of GDP. We will come back to this is the third section, after addressing the issue of the location of production.

A production that is more and more difficult to locate?

The issue of the location of activity is not a new subject either [Lipsey, 2010], but it became unexpectedly topical on the occasion of the publication in July 2016 of the first revision of the Irish growth figures for the period 2014-2015. Their first estimate based on the quarterly accounts showed a growth rate of 7%, the first estimate of the annual accounts took this to 26.3%, or + €67 billion, with just as spectacular changes in several other national accounting indicators thrown in: 97.8% growth in industrial output, 102.4% for exports, 40.0% for productive capital stock, but, on the other hand, only 4.5% growth in domestic consumption of goods and services.

Such figures pose an obvious problem from the Irish point of view. By ricochet, they also pose a problem for the credibility of growth figures for other countries. But, first of all, how can this phenomenon be analysed? The emergence of globalised production processes is creating a new geography of production. Research and development (R&D), design, manufacturing, assembly, marketing and invoicing no longer necessarily take place in the same centres. In this new organisation, Ireland offers the characteristic of being what can be called an "intangible centre" for many companies in the high-tech, digital, pharmaceutical or other fields. The multinationals based in Ireland concentrate the revenue from their intangible assets (data, ownership rights) there along with related services (marketing, invoicing, etc.), which is the result of a combination of several factors: the existence of a favourable tax regime, competitive costs, combined with Eurozone membership and the legal protection that goes with it.

What does GDP record in such a situation? Conceptually, national accounting records exchanges corresponding to changes of ownership. It is to this notion of ownership that reference is made to locate an activity. If a multinational in country A has a mobile phone made under licence by a factory in country B at a low cost, then sells it in a third country C, the national accounts of country A will count as an import flow the remuneration it pays to country B for the production of this phone as well as the value of the inputs incorporated into it, and as an export the revenue from its sale in country C. The difference between the exports and the imports will mainly correspond to the remuneration of the intangible assets located in country A, and it will be counted in the GDP of country A, even if the phone in question never crosses the border as it is delivered directly from B to C: this result is explained by the fact that it is country A that is the formal owner of the device until it is sold, its "production" corresponding to what the final consumer is willing to pay for all the intangible capital incorporated into the product.

Let's then suppose that the multinational decides to move the unit that owns this intangible capital from country A to a country A' and that this country A' is Ireland: the gross domestic product and Irish exports will record a sudden increase, which will echo an equally sudden increase in the intangible capital recognised there. Statistical secrecy means that the Irish Central Statistical Office (CSO) cannot disclose which multinational firm or firms are behind this leap in its growth, but we know that it is this type of mechanism that is at work.

This atypical development obviously prompted a lot of reactions. A commission has been set up in Ireland, chaired by the governor of the central bank, to make sure firstly that the CSO complied with international standards in calculating the GDP, and to propose solutions for the indicator's loss of relevance [ESRG, 2016]. From the standpoint of the application of the rules, the debate is focusing in particular on the implementation of the criterion of ownership, about which accounting rules leave some room for interpretation: should we content ourselves with a legal definition, as the CSO did, or use a notion of economic ownership, as promoted by the international handbooks of national accounting, which would in theory be more satisfactory, but also more difficult to define and apply ?

As for the solutions, the avenue taken by Ireland has been to propose an alternative indicator to GDP. The national accountants have already long considered a better measure of Ireland's

living standard is its gross national income (GNI) rather than its GDP. The GNI corrects the GDP by integrating the inflow of remuneration of capital held abroad by Irish residents and by excluding the flows out of Ireland to foreign shareholders of the multinational firms based there, thereby taking account of the fact that it is only a temporary place of transit for these revenue flows. But this correction only takes the edge off the shock of 2014-2015 without correcting it completely (*figure 5*), as a part of the additional income of this period remained immobilised in Ireland. Hence the application of a second correction, the switch to a GNI* also including the depreciation of the additional intangible capital that caused the shock to GDP, but at the price of conventional assumptions on the scale of this depreciation: the evaluation of the depreciation of capital is already difficult for physical capital assets, which explains why output or net income indicators are not highlighted more by national accountants; it is even more arbitrary and fragile in the case of intangible assets.

This having been detailed, what interests us here is the mirror effect of this type of flow of income on the measurement of growth in the large countries subject to tax optimisation. Quantifying the phenomenon is hampered by the lack of statistical information on multinationals that would be both harmonized and shareable between the different countries. Nevertheless, we do have the beginnings of some answers for the country presumed to be the most exposed to this "growth evasion" effect, again the United States, and which tend to put into perspective the idea that it would be enough to explain the slowdown in growth. A calculation proposed by Guvenen et al. [2017] consists of evaluating what the US GDP would be after reincorporating the returns on direct investments abroad resulting from the optimisation by American multinationals of the location of their revenues. They apply the "formulary apportionment" method practised by tax specialists: it breaks down the worldwide profits of American multinationals in each of their countries of operation according to (i) the share that the country concerned represents in the multinational's total wage bill, and (ii) the share that the country represents in

5. Evolutions of Irish GDP and Gross National Income (GNI)
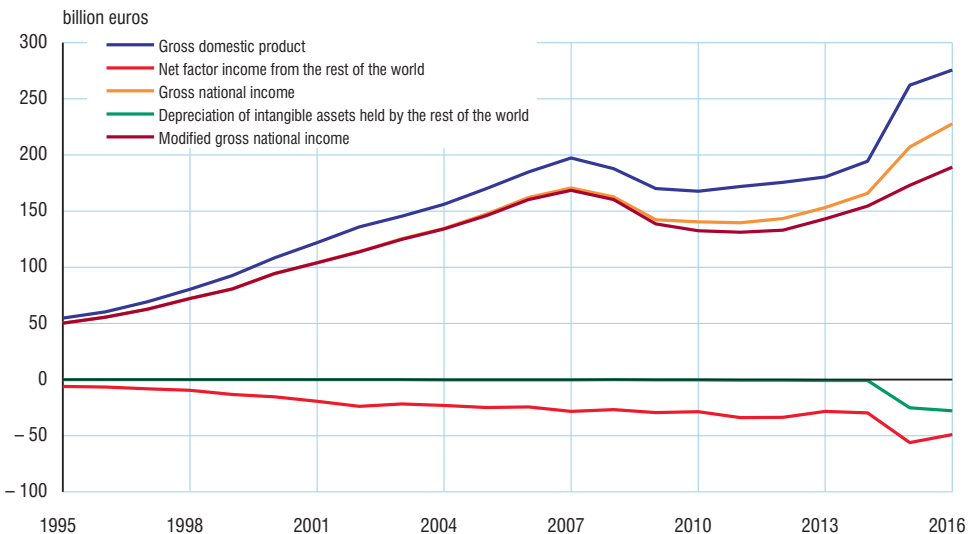
Note: the graph shows GDP, gross national income (GNI) and a modified gross national income (GNI*), on which the Irish statistical institute now communicates. The bottom two curves give the two main components in the gaps between these indicators. The GNI removes from the GDP the property income paid to foreign residents. The GNI* adds a correction taking account of the depreciation of intangible assets located in Ireland. Other deviation factors play a more secondary role and are not shown on the graph.
Source: Central Statistical Office

terms of sales to non-affiliated entities[3] by the multinational. Although the study concludes with a figure of 65% of returns on direct foreign investments being reallocated to American GDP, the final impact on GDP remains limited in scale: over 2004-2014, this adjustment amounts to raising the level of the GDP by $260 billion a year on average, or 1.5% of GDP in 2014. In terms of GDP growth, the correction is also limited. It mitigates the slowdown in productivity growth observed since 2004, but does not call it into question: the annual labour productivity growth figures put out by the Bureau of Labor Statistics would, after imputation, be increased by 0.1% over the period 1994-2004, by 0.25% over the period 2004-2008, and would be unchanged after 2008, which should be compared to an average annual labour productivity growth of 3.0% over the period 1994-2004, and 1.4% over the period 2004-2014. A more isolated experience that is also worth mentioning is the Homeland Investment Act which, in 2005, led to the repatriation to the United States of two thirds of a total mass of funds estimated at $486 billion, weighing 3.7% of the GDP at the time, without any observable impact on either GDP growth or that of the GNI.

The Guvenen et al. study [2017] cannot be reproduced identically for France, in the absence of any survey comparable to the one they used. An indirect piece of evidence, however, can be put forward. Let's suppose in fact that the optimising behaviours of French multinationals have an impact on macroeconomic aggregates and that they are increasingly prevalent due to the growing role of intangible assets. If the corporation tax rate is higher in France, French multinationals could be incentivised to register the legal ownership of their intangible assets in foreign subsidiaries subject to lower tax rates. After having reduced their taxable income in France, the French parent companies would pay themselves back in the form of dividends or reinvested profits. This remuneration of foreign direct investment (FDI) would be counted in the GNI, but not in the GDP, in a reversal of the GDP-GNI gap observed in the Irish case: the GNI would be higher than the GDP and grow faster than it, therefore diverging from the latter. In fact, it turns out that this is not really the case: the gap is certainly in the direction expected, but it is small and has only widened very moderately over time (*figure 6*). It could be objected that reinvested profits from French multinationals' FDIs are recorded from the point of view of the French economy net of the depreciation of the capital. As intangible assets depreciate faster than "conventional" physical capital assets, the apparent stability of the gap between GDP and GNI could result from an increase in the depreciation of the assets owned by the French multinationals' foreign subsidiaries, for example due to an increase in the share of the intangible assets held by these subsidiaries. Nevertheless, the preconception that French growth is systematically penalised by this type of optimisation behaviour is also debatable, as France makes up for its high corporation tax with tax breaks for R&D which can also make it an attractive country for a certain number of intangible investments. Indeed, according to the annual report published in 2016 by the Banque de France on France's balance of payments and international investment position, charges for the use of intellectual property generate a surplus of €2.1 billion[4].

All in all, although globalisation poses some undeniable problems of measurement, their scale is not the same depending on the size of the country. In the case of Ireland, it is clearly all three uses, U1, U2 and U3 that are adversely affected. The GDP is no longer of much use to manage macroeconomic policy, and it provides even less information than before about changes in the Irish population's living standards and even less so on its well-being. At the very most it could continue to help with the management of public finances: the additional production located in Ireland would widen the tax base of the Irish State. But this result is partly an

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3. Non-affiliated entities refers to final consumers or enterprises outside the group. Sales to non-affiliated entities are not considered as their "sale price" can be manipulated by the multinational for the purposes of optimising its tax burden, an issue referred to by the name of "transfer prices".
4. This balance is volatile, but has been in surplus since at least 2013.

6. French GDP and GNI

billion euro
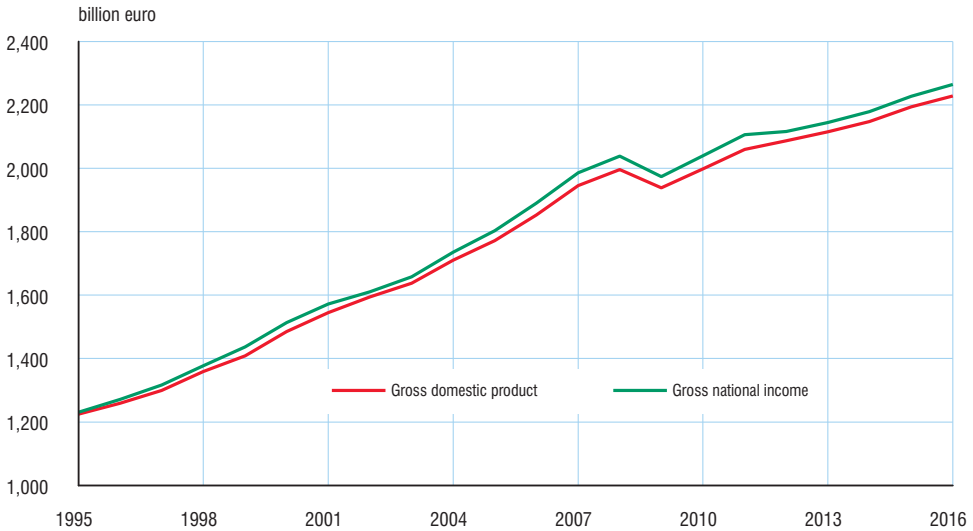
Source: Insee.

illusion: these additional resources only arrive on Irish shores because they are taxed there at a very low rate, so the contribution of taxable resources is therefore not on a par with the 26.3% extra GDP. It could well ebb away as measures are taken by other countries to repatriate the capital of the multinationals concerned, such as the Tax Cuts and Jobs Act passed in December 2017 in the United States.

In large countries, the effect at this stage remains more limited and is not of a nature to challenge any of the uses of GDP, U1, U2 or U3. What represents a very large shock for a small economy such as Ireland will appear much more diluted for a large country. But the phenomenon could in turn end up becoming a measurement challenge there too. According to the United Nations Conference on Trade and Development [UNCTAD, 2018] the stock of non-repatriated profits targeted by the Tax Cuts and Jobs Act amounts to $3,200 billion, seven times more than the funds targeted by the 2005 Homeland Investment Act mentioned above. In addition, the consequences of the Tax Cuts and Jobs Act on the American GDP and GNI could go deeper than a pure repatriation of the profits as the law also introduces tax incentives to relocate headquarters, the business and the ownership of intangible assets in the United States[5]. The Tax Policy Center [Gale et al., 2018] nevertheless estimates that all the tax reforms introduced by the TCJA are only likely to increase the United States' GDP by something of the order of 0.3% to 0.9% in the first three years and that the impact on the GNI would be even less.

That being said, whatever the quantitative size of the problem, the large countries cannot remain indifferent to the way the Irish case affects the credibility of the indicator: the fact that

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5. The Tax Cuts and Jobs Act introduces for example (i) a minimum tax on the "excess" profits recorded in the foreign subsidiaries of American multinationals called the "Global Intangible Low-Taxed Income Tax" (ii) a new tax deduction on income from intangible assets held in the United States, called the "Foreign-Derived Intangible Income Deduction" and (iii) a tax on deductible expenses paid from the United States to foreign subsidiaries called the "Base Erosion and anti-Abuse Tax".

it can change in a small country in a way totally disconnected from what it is supposed to measure - local output - weakens its value for all countries. But one paradoxical advantage of this situation may be to force a re-clarification of what exactly we are seeking to measure and how to qualify it (box 2). What makes the Irish situation absurd in users' eyes is the fact that they are used to seeing GDP as a measure of a "substantial" notion of output: an aggregate combining tonnes of steel, litres of milk and numbers of smartphones, with prices as an aggregation key supposed to represent the relative utilities attributed to these different goods by final users. In fact, what is measured is something that is a little different: it is above all, and more and more, monetary flows, with no measurable physical counterpart. What we call local production in a globalised system is the revenue that different countries draw from their position in the global value chains, a position that multinational firms can alter very quickly, as they decide to take advantage of tax incentives. If it is clearly very difficult to admit that effective production could be restructured as fast as the Irish figures for 2014-2015 suggest, this volatility is much easier to understand if we reason in such terms of income, and all the more so as what we are talking about is income from an intangible item that can be located anywhere. From such a premise, what has to be done is to better isolate the share of these fluctuating incomes that constitutes the core stable resources on which the economy of a country can rely – what the Irish GNI* is attempting to approach – and a set of "floating" incomes, for which the idea of a territorial or national attachment has become much less operational. Various initiatives have been taken at international level to move forward on these subjects, at the OECD and Eurostat. They concern both the conceptual aspects of the problem [OCDE, 2018] and the operational side, with the aim of achieving better pooling of the information held by the different national statistical institutes.

Box 2

What is "local" production?
Conceptual problems, problems of vocabulary

Beyond the palliative solutions that can be implemented, the Irish case illustrates general questions that national accounts have to address. Is it always possible to locate production? Does economic theory provide rules for doing so in a rigorous way?

We can try and answer these questions by coming back to the basic concept of the production function which links output to inputs which are capital K, labour L but also intangible factors of production I. There is no ambiguity about the place of production as long as all these factors of production are located in the same place: production is measured "at the factory gate". But this is no longer the case when several factors involved come from different places. Saying what is produced in the different places requires an additive breakdown of the contributions of each factor. Now, a production function F (K,L,I) can be broken down in this way only if it is itself linear, that is to say in the case of perfect substitutability where the same good can be produced indifferently with only capital, only labour or only

intangible assets. Yet this hypothesis makes no sense and so there is in fact a problem of location of production whenever K, L or I or their different subcomponents are not all in the same place. The "formulary apportionment" type rules used by Guvenen et al. [2017] give at best an idea of how large is the phenomenon of geographical reallocation, but they are conventional rules that cannot be rationalized in relation to the concept of the production function.

What can be founded theoretically is another type of breakdown, the one of the revenue generated by the production itself rather than a breakdown of the production itself. This is what national accounting does when it calculates the sharing of value added which measures what each factor receives in remuneration of its contribution to the value chain. This is a breakdown of the revenue from production, not of the production itself. The difference between the two can be illustrated by the standard example of a constant returns to scale production function with capital and labour as the only inputs, operating on

competitive markets where each factor is remunerated at its marginal productivity: if r stands for the return on capital and w the wage rate, the sum rK+wL of the remunerations of the two factors is equal to the global value of production pY = rK+wL. This breakdown is a breakdown of the revenue generated by the production of Y, not a physical breakdown between a part of product Y specifically produced by K and a part of the same product produced by L.

The same will apply in the presence of the intangible factor I, corresponding for example to patents, which are also remunerated for their contribution to production. This example of patents demonstrates in an even more marked way how the breakdown of the revenue can deviate from the notion of the breakdown of the production. From the standpoint of the national accounts, the patent will be considered as productive only insofar as it is remunerated. If it falls into the public domain and continues to be used for free, it goes on being productive within the meaning of the production function, the technology Y=F(K,L,I) remaining unchanged. What changes is only the fact that this contribution ceases to be remunerated, which will be offset either by a reduction in the price of the product, or an increase in the remunerations of the other factors. All in all, the sharing of value added reflects at best one part of the properties of the function F: it also depends on the relative scarcity of the factors and the organization of the markets. This is exactly the same problem as we encounter with the contribution to production of natural assets: it is ignored as long as they are used for free.

This distinction between production and revenue from production suggests a better way of interpreting the Irish growth figures. They do not indicate that a new "production" has appeared in Ireland. They just reflect the fact that revenues associated with a "floating" factor of production have suddenly landed on Irish shores. It is easier to admit the volatility of the GDP in this "revenue"-based reading than in a reading in terms of production or productivity: it easy to understand that revenues can quickly move from one place to another without there really being any change in the production process.

But this change in vocabulary does not solve all the problems. It just helps to formulate the questions more effectively. Is it normal to break down these revenues solely on the basis of the legal location of the firms? What portion of the revenues actually benefits the resident population? Are the revenues in question durable resources for the Irish economy or are they just passing through? In particular, should they be seen as a genuine contribution to the sustainability of the country's public finances insofar as, as we know, the presence of these revenues in Ireland is due above all to the fact that they are not taxed too heavily there? Is it here that the rules of formulary apportionment can make sense, and in that case how should they be applied? Are the breakdowns according to sales and wages the right way of going about this or should we rather opt for a breakdown according to the location of the shareholders or of the headquarters where decisions are taken ?

Can we measure growth better by widening the scope of GDP?

This question of the "geographical" boundaries of GDP echoes the third of the questions raised in the introduction, that of its "monetary" boundaries. Is the degree to which the new forms of growth tend to cross this boundary the cause of a new and large-scale measurement problem?

The list of potential subjects is well known. Their treatment in the national accounts is presented and argued in detail in Bellego and Mahieu [2016] or Ahmad and Schreyer [2016]. Totally free services are only counted in GDP for the few paid jobs they create and the paid-for goods and services they consume to function, with the providers of such free services treated according to the non-profit institutions serving households (NPISH) model. "Free" services that are actually financed by advertising appear in the national accounts through the advertising that they generate. They are added to nominal GDP. Their effect on real GDP depends upon the

extent to which they are passed on to the price of the final goods. Advertising is not a household final consumption, but an intermediate consumption of the companies that use it. If its price is billed to the consumer in fine, there will a perfect compensation between value and price effects, and the development of free services financed by advertising will therefore be neutral or virtually neutral for the real GDP. At the same time, if recreational services come to be financed in this way rather than by direct payment, there may be a drop in output in real terms. As for the services that put private individuals in touch with each other for a commission, it is only that commission that is recorded in the national accounts. Reselling a good via Price Minister or Leboncoin is neutral for output, as any form of resale of second-hand goods is, since this is just a good that has already been produced changing hands. As for rentals between private individuals via AirBnB or similar services, once again this is neutral, for the same reason as for other forms of rentals between private individuals. The neutrality comes from the fact that the national accounts consider that the housing service is produced whatever happens, and evaluated by imputed rents, whether the dwelling is effectively occupied by its owner, temporarily vacant or rented to passing tourists.

Do these different accounting conventions pose a problem? The question must once again be considered with reference to the three main uses of the national accounts. For two of these three uses, there are very good reasons to remain contained within these limits of the monetary interactions. Concerning use U1, the aim of short-term economic policies is to create paid jobs: this justifies focusing on productions that are themselves remunerated. The reasoning is all the more valid for use U2, the management of public expenditure: the development of free services may be good news for the population's living standards, but it is not this kind of development that will help to finance the future wages of government employees or help to pay off the government debt. These are arguments already used to justify that GDP does not take account of the production of domestic services. This form of output is admittedly interesting to quantify occasionally, although at the cost of numerous assumptions [Poissonnier et Roy, 2013], but systematically adding it to the evaluation of annual or quarterly GDP would not contribute anything to short-term economic management. Adding it is even less justified for the "public finances" use, unless it is assumed that the monetary equivalent of this domestic work could become a taxable resource, which is not the idea.

It is therefore only for use U3, to measure living standards, that the questions actually apply. They can, moreover, be envisaged as a continuation of that of the volume/price decompositions. The arrival of a new good or service that can be substituted for paid-for services is only an extreme version of the arrival of a new product that is cheaper than the ones already in place and, logically, one would expect it to be treated in the same way. The fear is that this will not be the case and that this emergence of free services will lead to falling national accounts indicators, when in fact it is an increase in the standard of living that should be recorded. Typically, if purchases of CDs are falling due to free viewing of videos on YouTube leading to a decline in the nominal revenues of the record industry, and if we apply to this figure a price index that is stable because it is still calculated on paid-for goods only, the message will be one of a fall in volumes. Likewise, if the use of AirBnB is at the expense of conventional hotel services.

Several nuances may temper this fear. One first point is that the arrival of free goods can be partly passed on to the measurement of existing prices. Either it is a good present in the index whose price falls to zero: a fall in the price of 100% weighted by the initial budget coefficient of this good is recorded. Or the free good is totally new: its appearance will not be dealt with by the index, but there is a chance it will lead to a reduction in the prices of the paid-for goods it will be competing with, which will be taken into account in the index. A second element is that considering that free goods and services will lead to reductions in both nominal and real aggregates ignores the general equilibrium effects. The arrival of free goods enables households to redeploy their expenditures to other paid-for goods and services. In the AirBnB example, the

saving that foreign tourists make on their accommodation frees up resources for them to buy other services in France, and the income the person renting the accommodation makes will also be recycled into other spending.

These considerations put into perspective the idea that the national accounts could be sending out messages that completely go against the benefits that are expected of these free services. Yet there remains a risk of under-reporting some phenomena that objective U3 would justify quantifying. Byrne et al. [2016] and Syverson [2017] have examined the extent of this problem, picking up from and completing other studies. The methods of estimation used are varied, but generally only lead to effects that are once again too weak to account for the slow-down in growth, and some of these exploratory attempts raise the question of the limits that should be placed on the national accounts.

For example, it is possible to take up a type of treatment already proposed in the past to allow the financing of free media by advertising to be retraced in household final consumption [Cremeans, 1980; Vanoli, 2002]. This method avoids GDP being affected by the switchover effects between paid-for media and media financed by advertising. It has been implemented by Nakamura and Soloveichik [2015], but it results in only very limited effects: 0.019% of extra annual growth, which reflects the fact this advertising expenditure represents only a very small and relatively stable part of GDP.

A very different approach is that of Goolsbee and Klenow [2006] or Brynjolfsson and Oh [2012] who use a Becker-type assessment of all the time households spend online. By updating the Goolsbee and Klenow figure for 2015, Syverson arrives for the United States at an amount of €900 billion, which is much higher but still too low as it only accounts for one third of the 3,400 billion of "missing output" mentioned in the introduction. Now, this time, the calcula-tion is really too generous. It is an attempt to calculate the total utility to the consumer, or in even more technical terms, the "surplus" he derives from these new services. No-one has ever asked the national accounts to assess in such a way the amount of time households spend in front of the television.

In the same spirit, it is worth mentioning the general conceptual framework proposed by Hulten and Nakamura [2017], who suggest isolating a new form of growth allowed, among other things, by the internet: an "output saving" technical change that allows more well-be-ing to be generated for households with a reduced quantity of market production, in return once again for a bigger contribution of household time (box 3). This framework is legitimate and stimulating, but reasoning in these terms leads to opening up a whole chain of questions that go much further than the initial issue of the slowdown in economic growth. Once the natural boundaries of GDP have been crossed, the question that is posed becomes that of the general measurement of well-being and it would be an oversimplification to reduce it merely to the contribution of digital technology, for there are many other factors that GDP ignores, whether they have a favourable or unfavourable effect on well-being. Here it is necessary to take account of a much older criticism of GDP, the fact that it would have a tendency to overestimate increases in the standard of living, as it fails to take into account factors such as the rise in inequality, environmental damage or the fact that the perception of well-being does not necessarily increase in line with the increase in material resources. These types of phenomena can also be mirrored in the usual perception of prices, with inflation generally being perceived as higher, and even much higher, than the level of inflation measured by the CPI [Accardo et al., 2011]. Reinsdorf and Schreyer [2017] mention that a part of this discrep-ancy could precisely reflect the fact that individuals' subjective evaluations spontaneously include negative externalities associated with digital goods, or the fact that they render fewer services than they claim.

All these questions are central, but it is the entire statistical system that they must mobilise. They spill out of the field that the national accounts can claim to cover, at least in the context of their regular production. The accounts' role is first of all to provide a comprehensive tracking

**Digital economy, market production and domestic output:
an example of formalisation**

The digital economy allows the development of free services that do not fall within the scope of commercial exchanges. Another of its effects is to move certain market production activities to households: for example, it is possible to organise one's holidays oneself directly on the internet without the services of a travel agent. Hulten and Nakamura [2017] propose to formalise this type of emerging phenomena by using the model of consumer behaviour developed by Lancaster in the 1960s and largely taken up afterwards by Becker. This model considers that households are not passive consumers of goods and services provided ready-to-use on the market. Rather they are seen as producers of their own well-being, which they achieve by combining their domestic time with the goods and services they procure on the market. Formally, by adapting the notation used by the authors, the well-being of the representative household is written as $U=F(Y(X,L_m),L_d)$, where Y is market production which combines primary inputs X and market labour L_m, which this household then combines with domestic time L_d to "produce" U according to technology F.

This formalism distinguishes two forms of technical progress. The form that the usual growth analysis is interested in is the fact of managing to produce more Y from the inputs X and market labour L_m. But it is also possible to envisage "output saving" technical progress which can generate more final well-being with less Y. This type of progress may lead to less output in the sense measured by the national accounts, and in spite of the growth of U. The example of the travel agent is a good illustration of this mechanism: the same final result – holidays – is achieved without using the services of such an agent, services that the national accounts would have recorded in output Y. This form of technical progress is also fostered by the development of the sharing economy or direct exchanges between private individuals: websites for selling second-hand goods, car-sharing sites and rental sites enabling more utility with a given market production of goods, thanks to an increase in their rate of use. This growing contribution of households to the final production of well-being would seem to be the opposite of the phenomenon seen in the period when GDP growth was swollen by the transfer to the market of activities that were originally domestic activities [Coyle, 2017].

This framework of analysis is enlightening, but raises problems of quantification which are very difficult to resolve. The U function is not observable, unlike market output Y. In fact, if it is the development of U that interests us or its comparison between countries, it will be necessary to extend the analysis to all the determinants of well-being, which cannot be reduced to just market consumption Y and domestic production time L_d. We are faced with the general problem of aggregate indicators of well-being. A certain number of recent studies have attempted to construct indicators of this type, using various techniques to try and convert into monetary equivalents the dimensions of well-being that are not naturally expressed in these terms, such as health or access to employment [Boarini et al., 2016; Jones and Klenow, 2016]. The quantification of the non-market effects of digital technology could attempt to grasp this notion, but this is research work that goes far beyond the framework of national accounting

of the monetary flows between agents, flows measured within the national borders, but also, more and more, flows that cross those national borders. Better articulating the accounts of different countries and better categorising the revenue flows according to the place of residence of their beneficiaries represents in itself a substantial task. Through the volume/price decompositions, the national accounts also strive to quantify the way these monetary flows contribute to the populations' standards of living. In doing so, they have to borrow elements from the conceptual framework of the theory of well-being. Some of the tools they use are very revealing of those borrowings: hedonic pricing method, constant-utility price indices. These volume/price decompositions are perfectible, and not only in the area of digital technologies which has been emphasised in this report: another traditional subject is for instance that of

the volume/price decompositions applied to public services for which the output remains, most often, valued at its production cost, without taking into account the efficiency gains at work in these sectors. National accounting is finally able to extend this evaluation of living standards to a few forms of consumption that do not involve monetary transactions but for which the imputation of monetary equivalents remains easy enough to be handled in current production: the evaluation of imputed rents is the best example, aiming to render statistically neutral the switch between housing services produced by landlords and those self-produced by owner-occupiers. A few new types of free services could be evaluated, on an exploratory basis, by applying the same type of principles. But it is at this point that national accounting are be more or less forced to stop, at a position of equilibrium between satisfaction of the three classes of uses presented in the introduction. ■

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