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**Globalisation, Intellectual Property Products and Measurement of GDP: Issues and
Proposals
CSSP Informal Reflection Group**



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Globalisation, Intellectual Property Products and Measurement of GDP: Issues and Proposals

CSSP Informal Reflection Group

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Note by the Secretariat

Following the discussion on the impact of globalisation on the measurement of GDP at its meeting in June 2017, the CSSP concluded that further reflection on the topic was necessary, with a particular emphasis on the user perspective. The CSSP agreed that a small informal reflection group be set up to review the question from the perspectives of both policy and analytical users and producers and to formulate a series of recommendations, for consideration by the broader national accounts community. The note at hand puts forward conclusions and recommendations by the Group. An Annex recapitulates the issues.

CSSP delegates are asked to:

- REVIEW and COMMENT ON the conclusions and recommendations in the Group's report;
- RECOMMEND next steps, including transmission of the report to other relevant international bodies.

Globalisation, Intellectual Property Products and Measurement of GDP: Conclusions and Recommendations by CSSP's Informal Reflection Group

1. GDP continues to be a useful aggregate but may require a more differentiated reading.

GDP remains key for production and productivity analysis. But there is a tension between the reality of modern production where labour, physical and intangible capital that are used to produce output can be located in different parts of the world, and our ability to measure domestic production in an economically meaningful way when the location of moveable assets, such as intangible capital, can be readily shifted from one country to another.

Nominal GDP maintains its interpretation as the income generated in a particular territory through the use of the factors of production, including intellectual property. Measures of the drivers of real GDP and of domestic productivity require a more cautious interpretation than in the past when MNEs use intangible assets. For instance, intellectual property assets may be accounted for in one country but provide capital services across affiliates abroad. This complicates the measurement and interpretation of the volumes of factor inputs, and by extension, of productivity (see also point 3 below).

2. Even a differentiated interpretation of GDP does not dispense with the thorny question in which country a particular activity and the incomes derived from it should be recorded in the first place.

This question arises in particular in conjunction with the management of intellectual property products (such as the sale of licences) or with factoryless management of physical production elsewhere.

Clear guidelines concerning statistical residency and economic ownership of assets are critical as intuitively appealing options such as proportional allocation, allocating all value-added entirely to the headquarters, or to the original producers of the asset, create other problems (Annex A), including the disconnect (although not insurmountable) that taxes on income may be paid in one country but the actual income generated is shown in another in the national accounts. That said, of the various options the idea of allocating the activities of Special Purpose Entities to the country of their headquarters has some traction, although, even if fully implemented, it would not resolve all issues (for example the tax issue) and further guidance may be needed in identifying and determining SPEs, and indeed the 'headquarters' if such a recommendation was adopted. Incidentally, this is a question that also arises in a national context, for instance when R&D investment has to be allocated to sub-national entities.

Also of note in this context is the need to ensure that any guidelines and recommendations can be implemented in way that does not generate global accounting inconsistencies through asymmetric treatment by different NSOs or other inconsistencies in the well-established implementation of the SNA framework.

Recommendation 1: *A reflection on how to determine statistical residency of units should be undertaken, reviewing whether current criteria are still up to the task. Concerning more specifically production arising from moveable assets, such as intellectual property but also some tangible assets, clearer and more prescriptive criteria and practical*

guidance should be elaborated to determine in which country (or indeed countries for partitioned assets) an activity should qualify as production, who the economic owners of assets are, and when the activities should be instead recorded as accounting vehicles that do not enter the measurement of GDP. This entails working out an implementable definition of economic ownership with lists of criteria to establish the presence of production, such as managerial and strategic decision-making, financial planning etc.

3. Theoretically, from a production-perspective, the productivity of MNEs can only be properly measured at the level of the MNE, i.e. across national borders.

One approach towards conceptualising production within an MNE is to assert that the production function of an MNE is naturally defined over its entire operations, wherever these take place. Put differently, the only meaningful way of formulating the production process and of capturing in particular the role of movable and intangible assets is by considering an integrated production function that stretches across borders. While this does not help in the quest for a ‘good’ measure of domestic productivity, it points to the usefulness of constructing international ‘MNE’ accounts.

***Recommendation 2:** Develop MNE accounts to track outputs and inputs – including Intellectual Property inputs – consistently and so draw a picture of MNEs’ production processes in nominal and real terms. MNE accounts would complement conventional national accounts and, with breakdowns by the country of their affiliates, provide insights on the potential impact of relocations.*

4. The most promising avenues to deal with the impact of globalisation on the measurement of GDP and national accounts, and indeed other macro-economic frameworks such as the balance of payments, require some form of exchange of information and data between countries.

Just as it has become difficult to conceptualise domestic production in a globalised world, it has become difficult to carry out statistical operations on a purely domestic basis. A first step is ensuring coherence and consistency of treatment of similar transactions across countries along with an exchange of information between NSOs to develop a common understanding of ownership and structures of MNEs. In a second step, exchange and comparison of selected statistical data on MNEs may be envisaged to paint a full picture of the geography of production. It is important to ensure that the implementation of current and possible future guidelines (e.g. regarding Special Purpose Entities) does not result in accounting asymmetries.

Also, national accountants and international tax policy makers should engage in discussion on how far the tax base and GDP can meaningfully divert and how international information exchange in the context of the OECD’s Base Erosion and Profit Shifting (BEPS) project and information exchange between NSOs can complement each other.

Naturally, any progress in international harmonisation of taxation itself (as under the BEPS Initiative) will also help the statistical case as there will be reduced incentives to shift assets for fiscal reasons in the first place.

5. Valuation of intellectual property assets remains a major challenge.

With the rising importance of intellectual property assets as a source of value creation, their measurement in countries' balance sheets and as an input is important. At the point of production, intellectual property products produced for own use are typically valued as the sum of costs, which is prudent. Subsequent changes in value are in theory captured as holding gains or losses but to what extent these revaluations are captured in practice is not clear. Although of limited consequence for GDP, this may not be the case for multi-factor productivity measurement. In addition, if the assets are subsequently transferred to an affiliate abroad, it is (a) not always clear how this is captured on the balance sheets of the exporting country, and (b) how the asset is subsequently depreciated in the receiving country – i.e. whether the relevant parameters (such as the remaining service life) reflect its age at the point of transfer. Both potential mismeasurements may affect sectors' and countries' level and changes in net worth.

Recommendation 3: *Improve methods to value investment in IP assets, i.e., the output of research and development activity and investigate methods for the treatment of internationally transferred assets (remaining service life, symmetry in treatment, ...).*

6. Communication on what GDP measures and what it doesn't is more important than ever.

It will be important to further enhance transparency about methods used and granularity of information provided for macro-economic aggregates. Key users of GDP such as Central Banks already focus on a wide variety of indicators and typically use many models to minimise the risk of reacting solely to any one indicator, but added break-downs of national accounts aggregates and methodological descriptions in particular for international transactions will add to these efforts.

Similarly, communication on GDP and other indicators may need reinforcing. At one level, this concerns the general concept of GDP as a measure of production and associated incomes but not a measure of welfare. At another level, communication relates to explaining the driving forces behind movements in GDP. One reason why the 'Irish case' did not transform itself into a major political issue lay in the efforts by CSO Ireland to be transparent and pedagogical in its communication.

Recommendation 4: *Develop a common understanding for the most pertinent additional break-downs that should be provided in the national accounts. This would in particular include but not necessarily be limited to:*

- *a standardised break-down of key accounts, including institutional sector accounts and Supply and Use Tables into activities of purely domestic enterprises, affiliates of foreign MNEs, and domestic MNEs. The objective here is to identify the role of MNEs in domestic production, income and in the fiscal space and the possibility to develop aggregates excluding MNEs;*
- *a break-down of gross operating surplus into the value of capital services by type of asset. This is well established in the economics literature and conceptually recognised in the 2008 SNA, but only partially put in place in countries. Growth accounting with a well-developed set of capital services measures will, for instance, allow measuring the share of GDP growth that is due to IP assets,*

which will be even more powerful if coupled with breakdowns by the category of firms described above.

Recommendation 5: *Elaborate communication strategies around GDP and other national accounts aggregates both new (such as those described above) and existing (such as net national income or household disposable income).*

7. Volatility matters from a practical perspective.

Volatility, in and of itself, does not necessarily make GDP wrong, if it reflects volatility of the underlying series and thus one type of economic reality. But volatility in conjunction with large revisions can be a source of concern for users, for instance if monetary policy were to target nominal GDP. Also, GDP has been used as a reference indicator for multiple purposes including of an administrative nature because production processes used to be largely domestically defined and relatively stable. As there is nothing inherent in GDP that qualifies it as the single or best scaling variable and as the national accounts offer a number of meaningful and potentially more stable alternatives, these should be considered. These should include concepts net of depreciation given the growing importance of quickly depreciating assets.

Recommendation 6: *For certain administrative or analytical uses, e.g. tracking debt sustainability, broad stability of a reference measure is a valued characteristic, and it may be appropriate to use or develop alternative aggregates specifically designed for this purpose – for instance, an ‘administrative GDP⁺/GNI⁺/NNI⁺’ (see discussion in Annex). These should be derived from existing national accounts.*

Annex A. Background Paper discussed by Reflection Group

Globalisation, Intellectual Property Products and Measurement of GDP: Issues and Some Proposals

1. **Background**

1. It has long been recognised that globalisation of economic activity affects our capacity to measure GDP, a domestic concept that aims at capturing production by resident units¹. Globalisation has complicated the recording of flows in conjunction with international production arrangements, such as goods that are sent abroad for processing, merchanting (a distribution activity where products are purchased and sold in third countries), factoryless production, leasing arrangements and the treatment of intellectual property products² (IPPs).

2. A widely discussed example is Ireland where trans-border movements of IP assets and the associated output and related income flows gave rise to a staggering 26% rise in real GDP in 2015 and a similar unusual two-digit growth in labour productivity. While Ireland may have brought the issue of measuring output and productivity into sharp focus, it constitutes by no means a unique case. Especially in small open economies, changes in organisational structures through transfers of high value IP assets or through other mechanisms, e.g. by transferring merchanting or contracting responsibilities, can have visible effects on measured GDP, income and productivity. Indeed, the Irish example has raised questions about the very meaning of GDP and its usability as an indicator for business cycle analysis and for designing monetary, fiscal and structural policies.

3. The note at hand sets out the issues mainly from an economic perspective without necessarily working through all the accounting implications and provides a few draft proposals for consideration of the informal reflection group.

2. **Upfront - the role of assets**

4. Assets play a major role in the debate here, for two reasons. One is the recognition of the increasing importance of **intangible assets as sources of competitiveness and economic growth** (Corrado, Hulten and Sichel 2005; OECD 2013; Goodrich, Haskel, Wallis 2012). These include intellectual property assets, organisational capital, marketing capital and more. Thus, defining production or analysing it without accounting for the services from at least some of these assets remains incomplete. The 2008 SNA has gone some way towards recognising intangibles by treating R&D, software, mineral exploration expenditures and the creation of entertainment, literary and artistic originals as investment, giving rise to an important group of Intellectual property (IP) assets.

5. Second is the observation that many assets are geographically mobile and in particular can cross national boundaries rather easily. This is the case for certain physical assets (relocation of factories or leasing arrangements for airplanes are well-established

¹ See in particular UN-ECE (2011), and UN-ECE (2015).

² See OECD (2010).

phenomena), but it is most certainly true for IP assets that can be transferred instantaneously and (nearly) bare of transaction costs. A red thread through the measurement issues associated with globalisation is thus the **question of where assets are located for production** – i.e., where they provide capital services in conjunction with other inputs. As it is typically possible to observe sales or value-added, for instance in the form of profits, we want to match outputs with inputs.

6. There is sometimes a perception that some of the measurement problems associated with globalisation could have been avoided had national accounts not started to treat R&D or software production activity as investment. **But this is a misunderstanding:** value is generated through the use of R&D and other intangible assets whether they are recognised or not as such in the national accounts. And that value is always recorded in the system as value-added, for example in the form of profits³. Recording IP assets (or for that matter other intangibles) enables us to identify their contribution to this value generation when used in production. Thus, recognition of the asset is not the cause of the problem - rather it is part of the solution.

3. **A model of three departments - current treatment in the national accounts**

7. Much of the current debate about the Irish case has been around the question whether the activity of managing an asset constitutes production. When there is a physical presence, when there is employment and when computers, structures and equipment are used in the management of knowledge assets, and when the unit accepts risks and rewards for managing the knowledge asset, the case for concluding that there is no production is difficult⁴, even when these units are subsidiaries of foreign firms and even when the suspected reason for moving the asset management to a different country is tax minimisation.

8. In national accounts terms, the question about production has been couched in terms of whether there is ‘economic ownership’ of the knowledge asset by the unit managing it or whether there is pure ‘legal ownership’⁵. Economic ownership entails in particular accepting the economic and operating risks involved in exploiting the asset in return for receiving the benefits by using it in a productive activity. The economic question is where to draw the line between pure legal ownership and ‘economic ownership’. The current practice is to examine, on a case-by-case basis, whether a particular activity exhibits a sufficient number of the characteristics outlined above to qualify as production from an economic substance point of view.

9. As the identification and location of production with intangibles in general and with IP assets more specifically is at the core of the debate, it is useful to set out a small

³ Indeed the only value that is omitted is the value of the original asset, when produced on own-account, and this is not an issue affected by globalisation.

⁴ For a more detailed discussion see Chapter 4 of UN-ECE (2015) *Guide to Measuring Global Production*.

⁵ The 2008 SNA (3.26) defines economic ownership as follows: “The economic owner of entities such as goods and services, natural resources, financial assets and liabilities is the institutional unit entitled to claim the benefits associated with the use of the entity in question in the course of an economic activity by virtue of accepting the associated risks.” Legal ownership refers to being “entitled in law and sustainable under the law to claim the benefits associated with the entities” (3.21).

model of production where three distinct departments operate to produce a final product such as a mobile phone:

- (i) the ‘California dreams’ research department where R&D takes place and the intellectual property asset is constructed;
- (ii) the ‘Shamrock heights’ licencing department where rights to use the design and technology blueprint of the smartphone are marketed. Alternatively, ‘Shamrock heights’ doesn’t sell licences to produce but organises production elsewhere and sells the phones;
- (iii) the ‘Dragon River’ assembly department where the final product is put together.

10. The three departments could be in the same country or in different countries. Their respective production functions are described and discussed below. As it turns out there are different ways of capturing the production process with implications for the value-added registered with each department, and the respective measures of real GDP and productivity.

11. In judging various accounting treatments, it is helpful to formulate some criteria that each treatment should pass. In particular, measures at the global level should be the same independently of geographical and institutional set-up and measures should also be the same if the flows concerned transactions between unaffiliated entities.

‘California dreams’ – the research department

12. Since the introduction of the 2008 SNA, research efforts measured as R&D expenditure are capitalised and so real R&D investment I_R is produced by a set of labour and capital inputs X_R (ignoring for simplicity intermediate inputs). Nominal value-added generated by ‘California dreams’, VA_R , equals the wages and remuneration of capital used in research $w_R X_R$. Finally, the R&D asset R^t corresponds to cumulated R&D investments, adjusted for depreciation/obsolescence (h):

$$(1a) \quad I_R = f_R(X_R)$$

$$(1b) \quad VA_R = w_R X_R$$

$$(1c) \quad R^t = I_R^t + hI_R^{t-1} + hI_R^{t-2} + \dots$$

‘Shamrock heights’ – the licencing department

13. The licencing department owns the R&D asset, either after a purchase from California dreams or following a transfer that is internal to an MNE. The asset is then used to generate licences or it is being ‘rented’ out for use in production elsewhere. We take it that there is a physical presence, there is employment and equipment is used in the management of knowledge assets, so operations do not qualify as pure legal ownership and it is concluded that there is economic ownership and production. An alternative approach will be presented later where the act of licencing is not (or only partially) considered production but for the moment it shall be taken as such. Call S the number of licences sold, X_S the non-R&D inputs involved in managing the licencing, and A_{S1} the level of multi-factor productivity (MFP), then the production process can be represented as follows:

$$(2) \quad S = f_{S1}(X_S, R)A_{S1}.$$

14. Licences are sold off at the price P_S and value-added of Shamrock Heights (ignoring intermediate inputs) equals the value of licences sold which in turn equals non-R&D factor costs $w_S X_S$ and a compensation for the use of the R&D asset, $u_R R$, that is part of Shamrock Heights profits. It may well be that $u_R R$ accounts for a significant part of value-added if few other inputs are needed for IP management:

$$(3) \quad VA_{S1} = P_S S = w_S X_S + u_R R.$$

15. One notes that VA_{S1} is part of the GDP of the territory where ‘Shamrock Heights’ resides. If S rises or falls quickly, real GDP and labour productivity will rise or fall equally fast. However, nothing can be said about the direction of change of MFP when both the quantity of capital services from the R&D asset and the number of licences rise or fall, as the denominator $f_{S1}(X_S, R)$ depends positively on R and the numerator rises with S :

$$(4) \quad MFP_{S1} = A_{S1} = S / f_{S1}(X_S, R).$$

16. If ‘Shamrock Heights’ is a truly national enterprise, the returns from licence sales $u_R R$ belong to no-one else. If the licencing department actually belongs to an MNE with headquarters in California (or elsewhere), the claim to the returns on the IP asset resides with the headquarters. In particular, when profits are repatriated⁶, disposable income of ‘Shamrock Heights’ (DI_S) will reflect such an outflow:

$$(5) \quad DI_S = P_S S - u_R R = w_S X_S$$

17. In return, California dreams’ disposable income will have gone up:

$$(6) \quad DI_R = w_R X_R + u_R R.$$

18. At the level of entire economies, the last two equations reflect the movement of Gross National Income in California and Shamrock respectively. It is thus evident that here GNI statistics allocate returns to assets to the location of the ultimate owner. However it is important to recognise that this simple case not always holds in practice. For example, a holding company of headquarters may be located in a different location to any of the three departments described above - a location where the tax advantages are significant, and profits are merely parked until it is advantageous to repatriate them to shareholders. Under these circumstances measures of GNI are not necessarily without their own problems.

‘Dragon Valley’ - the assembly department

19. The assembly department purchases a licence to put together the final product. The payment for the licence (assuming it is paid annually, and so is not treated as investment) is payment for an intermediate input. Real value added in the Dragon Valley $h_{Q1}(Q, S)$ is a function of the number of final products Q assembled and licences S purchased (the former increasing, the latter reducing real value added) and production technology $j_{Q1}(X_Q)A_{Q1}$ that reflects the use of non-R&D inputs X_Q and productivity A_{Q1} :

$$(7a) \quad h_{Q1}(Q, S) = j_{Q1}(X_Q)A_{Q1}$$

$$(7b) \quad VA_{Q1} = P_Q Q - P_S S = w_Q X_Q$$

⁶ Even when earnings are not repatriated but retained, the SNA treats them as an outflow that is subsequently re-invested. We abstract here from further complications such as taking into account depreciation that may affect repatriated flows.

$$(7c) \quad DI_{Q1} = w_Q X_Q$$

20. Nominal value-added in Dragon Valley VA_{Q1} only reflects wages, salaries and return to non-R&D capital $w_Q X_Q$; returns to the R&D assets $u_R R$ are nowhere in sight here which seems plausible for an assembly plant. Also, MFP growth in Dragon Valley is unlikely to be affected by changes in S as gross output Q will move in proportion to S .

21. The current treatment in the national accounts also lives up to the requirements stated upfront. No different treatment is needed when the departments are truly independent or fully integrated. Value-added for each department remains the same. While the distribution of disposable income across countries will be different when the departments all belong to the same MNE – world income and world GDP are unaffected by the institutional setting and equal to the sum of all primary factor incomes:

$$(8) \quad \text{World GDP} = VA_R + VA_{S1} + VA_{Q1} = w_R X_R + w_S X_S + u_R R + w_Q X_Q.$$

4. **Challenges to the current treatment**

22. Why is this treatment challenged? The intuitive answer is: when the Shamrock and California department are part of the same company, it doesn't feel right to record all the profits from licencing in Shamrock Heights given that the asset has been created in California. And suspicion of an inaccurate geographical recording of output, value added and related income rises even further when Shamrock is a tax-friendly location and there are reasons to believe that transactions are at least partially motivated by tax optimisation rather than real economic processes. This intuition is reinforced by large variations in measured GDP such as those in Ireland which appears to be at variance with an 'economic' notion of production.

23. The more technical answer is that some or all of the transactions that are registered in Shamrock country may not actually constitute output. Or they constitute output but the true location of the production process is elsewhere. Consequently, the value-added of an MNE should be allocated where 'production takes place' or on the basis of the 'true location of economic activity'; and it should be recalled that this is also the underlying philosophy that governs the SNA.

24. At the heart of the conceptual question is thus: what constitutes production and where does it happen or: how can we identify the location of the set of inputs that are transformed into outputs? The conceptual question is followed by a practical one – suppose we agree on what constitutes production, how good are we at identifying and measuring it in the presence of patchy information on MNEs and practices such as transfer pricing? The present note will not venture at the practical questions but provide some alternative views on production in the case at hand. The discussion remains within the scope of the example of sales of licences but reference will be made to related phenomena such as factoryless production or the organisation of sending goods abroad for processing as appropriate.

5. **Possible alternative views of locating production**

Sales of licences is retailing

25. Another way of looking at the way that IPPs generate value-added, is by viewing the original knowledge asset merely as a stock of future licenses that are waiting to be sold; in other words they are similar to inventories, with the only difference being that the

original production of this stock is recorded as investment and not as changes in inventories⁷. The production activity on Shamrock Heights would be considered as being merely redistributive, and so similar to a retailer: parts of the R&D asset are sold off every time a licence is produced. The volume output of the distribution department, $g_{s2}(S, R)$, then depends positively on the number of licences sold and negatively on the slices of R taken from the inventory. Inputs correspond only to non-R&D labour and capital services. Nominal value added is the difference between the value of licences sold and the value of R&D inventory used – Shamrock heights is now a ‘margin industry’, akin to a retailer or wholesaler that trades in parts of assets:

$$(9a) \quad g_{s2}(S, R) = f_{s2}(X_S)$$

$$(9b) \quad VA_{S2} = P_S S - u_R R = w_S X_S$$

26. A slightly different way of motivating the above is considering the sunk cost typically involved in creating an R&D asset: these sunk costs need to be recuperated with the sale of licences, and may or may not be combined with extra profits that exploit the temporary monopoly that is often created by IPPs. In this case, the trade margin ($P_S S - u_R R$) will also include the recovered sunk costs and a monopoly mark-up.

27. Dragon Valley still makes a payment to Shamrock, $P_S S$. Part of it is payment for a retail service ($P_S S - u_R R$) but now the question arises whether the remaining value of the transaction, equal to $u_R R$, constitutes the purchase of an asset (i.e., is to be considered as investment) or whether it constitutes payment for an R&D capital service (i.e., is to be considered as an intermediate input). Neither treatment will affect Shamrock Heights’ GDP if this is where the asset resides as the payment (an export from Shamrock to Dragon Valley) is directly offset by the run-down of Shamrock’s R&D stocks (a negative investment). But Dragon Valley’s production function, nominal value-added and income will look differently if the IPP purchase constitutes investment⁸ rather than the purchase of intermediate input as in the standard case.

28. If Dragon Valley’s IPP purchase is recorded as a payment for a service, world GDP is less than under the standard treatment, as the creation of licences now no more constitutes production. In this case, world GDP and world income are reduced to:

$$(10) \quad \text{World GDP} = w_R X_R + w_S X_S + w_Q X_Q.$$

29. Note that such a reduction of world GDP would also have to apply if Shamrock, California and Dragon were in the same location: only the equivalent of trade margins (plus assembly services and ongoing research activity) would contribute to value-added at the time of sales of the final output as the production of the original (or the ‘stock’ of licenses and their contribution to GDP) may have occurred in an earlier period.

30. This has some intuitive appeal and indeed such a treatment did form part of the reflections of the Canberra II group. However it was recognised that in practice it raised significant problems, firstly because it presupposes perfect valuation of the original: California Dream’s research output would have to reflect the net present value of future

⁷ While additions to inventories in the SNA are part of capital formation, they are not part of fixed capital formation, so a full treatment as inventories would be at odds with the notion that California Dreams produces a fixed R&D asset.

⁸ The SNA (10.100) provides a discussion of when a treatment as investment is appropriate as opposed to a treatment as purchase of a service but the distinction is difficult in practice, to say the least.

sales which is exceedingly difficult to establish, even from a theoretical standpoint. Secondly, it would imply that the creation of the R&D asset was recorded as investment in California without ever generating any capital services (as the flows are all recorded as sales of existing ‘parts’).

31. If, on the other hand, the IPP payment by Dragon Valley is considered investment expenditure, world GDP remains unchanged in comparison with the standard treatment. The R&D asset is used in production, generating capital services in Dragon Valley that would be reflected in profits π as compensation for these services. The implication is that returns to IP assets are now part of Dragon Valley’s GDP. This may or may not be a plausible outcome.

$$(11) \quad VA_{Q2} = P_Q Q - (P_S S - u_R R) = w_Q X_Q + \pi$$

32. Finally, a treatment of Shamrock’s operations as distribution activity is arguably far removed from its actual activity, especially if Shamrock qualifies as a factoryless producer that manages the operation and so is not just providing a distribution service where products are simply ‘channelled through’: value is added by IPPs, management and other services that are provided and will normally exceed the trade margins in compensation of distribution activities such as minimal processing and packaging. A similar point applies if Shamrock’s operations consist in sending goods abroad for processing.

33. Overall, thus the treatment of R&D stocks as inventories could go some way towards dealing with the sales of licences in Shamrock Heights but is unlikely to be applicable to the broader spectrum of global production arrangements.

Production can only be defined meaningfully for an entire MNE

34. Another approach towards conceptualising global production within an MNE challenges the departmental approach in Section 1.2 *as a whole*. The argument being that the production function of an MNE is naturally defined over its entire operations, wherever these take place. Put differently, the only meaningful way of formulating the production process of Q is by reasoning in terms of an integrated production function:

$$(11a) \quad Q = g_Q(X_R, X_S, X_Q, R)A_Q \text{ and in nominal terms,}$$

$$(11b) \quad P_Q Q = w_R X_R + w_S X_S + u_R R + w_{Q1} X_Q.$$

35. (11a,b) assume that all three departments are subsidiaries of an MNE but it is straight forward to modify this in a case where only California and Shamrock are affiliated. From the perspective of production and productivity analysis, (11a) is rather attractive: after all, there is a reason why enterprises operate internationally and optimal use of geographical structures is part of their production function and likely a source of efficiency change A_Q . It is also plausible that the R&D asset (R) affects the entire production process in a way that is hard to allocate to individual departments or locations.

36. But whose GDP are we talking about? How should it be split between locations? Some options are discussed in the section below. And should it be split in the first place? A distribution of nominal value-added may be useful in gauging the respective sizes of the three economies but does not really solve the issue of *domestic* productivity and production analysis, absent domestic production functions. Indeed, there can be no analysis of domestic production or productivity if the main hypothesis holds, namely that the production function of MNEs necessarily spreads across geographical boundaries. It is worth emphasising that the argument here is about analysing *production*, not income.

Income, in particular national income remains a well-defined concept but it answers a different question from GDP.

37. One conclusion here is that it is worth constructing MNE accounts to reflect their vertically integrated production processes. This would make the issue where IP assets are located and where value-added should be allocated redundant. But obviously it wouldn't resolve the question about domestic production.

Production functions are similar across affiliates, with a shared input

38. Guvenen et al (2017) look at the case of an MNE that differs from the one above. While our own exposition has considered an MNE with three departments, each fulfilling a different function, Guvenen and co-authors consider the case where departments or affiliates of an MNE each produce the same final product but in a different part of the world. The R&D asset is shared as it defines production equally in all locations. Under such a set-up production is well defined conceptually – a similar production function for each affiliate but returns to the R&D asset need to be divided up between locations.

39. The authors apply *formulary apportionment*. “Under this method, the total worldwide earnings of an MNE are attributed to locations based on apportionment factors that aim to capture the true location of economic activity. As apportionment factors, we use, in each geographical location, a combination of (i) labour compensation and (ii) sales to unaffiliated parties, as they are likely to be good proxies for the actual economic activity taking place in each location.” (Guvenen et al 2017).

40. Implicit in their use of the formulary apportionment is the assumption that the services provided by the R&D asset are proportional to non-R&D inputs (or sales). While this seems a reasonable assumption in the case described by the authors, where affiliates produce the same output, it is much harder to justify when a more complex situation applies where affiliates' tasks are different and globalised production is organised in vertically integrated value chains, as is increasingly the case. Applying formulary apportionment in such a case may be a pragmatic way to proceed but lacks a clear theoretical foundation and may create different problems. In the California-Shamrock-Dragon case, and assuming that all three departments were part of a single MNE, formulary apportionment would imply that California commands a larger share in total value added - but so would Dragon Valley. Indeed if for the sake of argument we assumed that the value of the IPP were distributed in proportion to labour input, then the allocation method would likely generate significant value-added in Dragon Valley where production is expected to be labour intensive – such a solution would be incongruous and take us no closer to an outcome that better reflects economic reality – a point also made by Moulton and Van den Ven (2018).

Production of IP services is always with the headquarters

41. Another approach is to entirely *ascribe returns to IPP to the location of headquarters*. Moulton and Van de Ven (2018) reason in this sense: “From a conceptual point of view this treatment is justified as the ultimate parent is indeed the true economic owner of the IPPs and the profits generated worldwide, and also because it is practically impossible to find a good rationale for allocating these assets and profits to certain parts of the worldwide production process”.

42. Translated into our departmental model, this means that for purposes of national accounting, Shamrock's value-added, and indeed the entire process of producing licences would be transported to California Dreams provided this is where headquarters are located. There is no challenging of the existence of production of licences *as such* (as in the treatment of IPP sales as distribution activity), only where it takes place – California rather than Shamrock. After reallocating the production of licences to California, the distribution of value-added would thus resemble the distribution of disposable income. If, however, headquarters were in Shamrock, the initial standard picture would prevail. As acknowledged by Moulton and Van de Ven (2018), the approach stops short, however, of providing plausible outcomes when headquarters (and only headquarters) are located in yet another country.

43. Lequiller (2017) in his discussion of the Irish case, considers as valid options both a formulary apportionment method and a re-allocation of the returns to IPP assets. However, he emphasises labour and non-R&D inputs as the basis for formulary apportionment rather than sales as in Guvenen et al (2017) and he favours allocation of the returns to IPP assets to where they were created rather than where headquarters are located as in Moulton and Van de Ven (2018). His version of the formulary apportionment brings with it the same problems described earlier and allocating all IPP returns to the location where the asset was created has its own problems.

Issues: Are there other alternative, economically pertinent criteria to establishing what constitutes production and where it takes place?

Is there an 'impossibility theorem' about constructing a conceptually water-tight measure of GDP when significant parts of production occur in global value chains?

6. Usefulness of GDP as an indicator - undermined?

44. One consequence of global production arrangements is the ease with which assets and associated revenues can be transferred between balance sheets and income statements, thus causing jumps in GDP, wealth and capital stock. Related is a weakened link between outputs and labour and other, less movable, capital inputs. Part of the uneasiness with large jumps in GDP is that such volatility may reduce the usefulness of key indicators. Such indicators include but are not limited to:

45. **Business cycle analysis.** One question is the possible deterioration of the usefulness of GDP for business cycle analysis. A routine indicator of the business cycle is the economy's output gap, or actual GDP compared to potential GDP that also serves as a measure for inflationary pressures and a yardstick to measure the sustainability of fiscal deficits. Suppose actual GDP growth expands or contracts quickly as a consequence of newly appearing or disappearing knowledge assets that boost or contract production. In theory, the output gap should be little affected as potential output should also expand or contract with the emergence or disappearance of knowledge assets. In practice, this will be much more difficult, however, because estimates of long-term productivity and capital will be harder to establish.

46. **Public deficit and debt ratios.** Another key use of nominal GDP figures is as denominators in deficit and debt ratios. A sudden surge in nominal GDP immediately reduces the deficit and debt ratios, thus signalling a strong improvement in a country's fiscal position and capacity to sustain debt. The converse holds with a sudden decline in

nominal GDP when production is transferred out of a country. While unusual, the change in the fiscal sustainability as signalled by the deficit and debt ratios is a reality, at least in the short term. However, the indicators' capacity to reflect the longer-term sustainability fiscal positions via income from production is reduced when it is apparent that the indicators exhibit significant swings over time. Having said that, there are other indicators of the sustainability of fiscal positions (for instance the output gap helps identifying structural deficits) that may be less affected by volatile GDP series.

47. More generally, GDP is frequently used as a **normalising denominator** in economic and social indicators and increased volatility of GDP may reduce the meaningfulness of such ratios for structural analysis.

48. **Evolution of the tax base.** While GDP is not necessarily the best indicator for judging the evolution of a country's tax base it is often used as such. Reflecting the activities related to the management of knowledge assets as production will preserve a link between GDP and the tax base because revenues from selling knowledge services are part of the tax base ('following the money'). That said, there are many other activities not recorded as production that are also part of the tax base, so the link to GDP may be weak in the first place. One alternative would be to consider the use of Gross National Income (GNI) as the denominator for the tax base but this too comes with complications as it would exclude repatriated profits of resident foreign affiliates that do pay taxes on their activities and include returned profits generated by domestically owned foreign affiliates abroad that may not contribute to the tax base.

49. **Nominal GDP growth and monetary policy.** Central banks pay attention to the evolution of nominal GDP. The use of a nominal GDP target (rather than inflation) has been discussed repeatedly, the idea being that nominal GDP growth reflects both real economic activity and inflation. Large short-term variations in nominal GDP in conjunction with asset management activities would likely reduce the usefulness of nominal GDP growth as a variable upon which to base decisions about monetary tightening or loosening as these typically have longer-term consequences and are effective with a lag.

50. **Labour productivity.** Large jumps in measured labour productivity may jeopardise its use as an approximation to gauging the pace of technical change, innovation or the overall efficiency of economies. However, a better measure of efficiency change is multi-factor productivity that takes account of all inputs, including knowledge assets. This more complete picture of productivity change may turn out to be quite different from labour productivity growth. Another, related reason for tracking real GDP growth is the expectation that job creation is closely linked to GDP growth. Management of intellectual property assets as described above tends to be an activity with high labour productivity and its emergence will thus mean that GDP growth is a less reliable predictor of changes in employment especially when new production activities (that have been qualified as such) occur in lumps and when they are sizeable compared to the entire economy.

Issue:

To what extent do discrete jumps in measured production (especially for smaller countries) reduce the usefulness of GDP?

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