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THE CONTRIBUTION OF INTANGIBLE ASSETS TO THE GROWTH OF THE RUSSIAN ECONOMY

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This paper studies the change in the contribution of intangible assets to economic growth in Russia after applying the Corrado, Hulten and Sichel (2005) approach to estimate an extended list of intangible assets. As a result, intangible assets contribution increased from 0.05 p.p to 0.15 p.p of 3.28 percent of growth in Russia in the period 2004–2014. These estimates show that the inclusion of the expanded list of intangible assets increases growth and redistributes production growth between capital accumulation and the growth of multifactor productivity towards capital accumulation, and between the accumulation of tangible capital and intangible capital towards intangible capital. The results differ from European countries, where intangible assets formed 9 percent of growth in 2004–2014. Comparing the structure of intangible assets in Russia and in Europe and the US, we conclude that in Russia, the highest contribution to the growth of intangible assets is due to intellectual property, while in developed countries, the contributions are distributed more evenly across different types of intangible assets under consideration.

JEL Codes: O470, O570, E220

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1. Introduction

According to existing estimates in developed countries, intangible assets account for about a quarter of economic growth.[1] In 2005, Corrado, Hulten and Sichel (CHS) made an extended classification of intangibles (not only R&D and ICT), using the economic view of investments to formalize arguments for capitalizing a wide range of intangible assets in companies and national accounts (Corrado *et al.*, 2005, 2009).

In this paper, we apply the CHS approach to measure intangible assets in Russia. The application of this approach to Russia leads to changes in the understanding of the sources of growth.

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[1]In European countries *(France, UK, Germany, Italy, Spain, Austria, the Netherlands, Finland)* the contribution of intangible assets to the labor productivity growth in the business sector *(the types of economic activities of the NACE code from A to K plus sector O), excluding healthcare, education, real estate and private households)* for the period 1995–2009 was about 25 percent (an average of 0.47 p.p, with an average level of productivity growth of 2.05 percentage points (based on Corrado *et al.*, 2014)).

We use Russia KLEMS to produce harmonized time series of intangible investment for Russia in 2004–2014 and national statistical forms to construct new intangibles.

The sources of growth are compared with and without intangible assets. We use new estimates to address the following issues: the amount of growth without accounting for the inclusion of intangible assets; the contribution of intangible capital to growth; how the inclusion of intangible assets affects the distribution of growth between capital accumulation and growth of multifactor productivity; and the increase in growth after 2004 with the inclusion of intangible assets.

As a result, the contribution of intangible assets to the Russian economy in the period 2004-2014 increased from 0.05 p.p to 0.15 p.p per annum in 3.28 percent of growth.

These estimates show that the inclusion of an expanded list of intangible assets increases growth indicators and redistributes production growth between capital accumulation and the growth of multifactor productivity towards capital accumulation, and between the accumulation of tangible capital and intangible capital towards intangible capital.

Comparing the structure of intangible assets in Russia with their structure in Europe and the US, we can conclude that in Russia the highest contributions are from the intangible assets associated with non-scientific developments (for example, the adoption of production technology), firm specific human capital and structural resources, while in developed countries, R&D is more significant.

Considering the results and limitations of both approaches, we contribute to the assessment of their accuracy, and indicate areas of future research to improve the estimation of intangibles in Russia.

The paper is structured as follows: Section 2 contains the model and calculation methodology. In Section 3 we detail the data used to account for intangible assets in growth. Section 4 discusses empirical results and constraints.

2. Model and Methodology

Suppose aggregate real output is related to the inputs of labor and capital via an aggregate production function, with provision for changes in the productivity of the inputs (Jorgenson *et al.*, 1987). When a change in efficiency has a Hicks-neutral form, the production function can be expressed as:

$$Q_t = A_t F(K_t, L_t), \tag{1}$$

where Q_t is the real output, K_t and L_t are capital and labor, and A_t is an index of the level of TFP. In econometric studies of growth, the production function is given a specific parametric form, and the parameters of $F()$ are then estimated using a variety of techniques.

In the index-number (nonparametric) approach of Solow (1956) and Jorgenson and Griliches (1967), the growth rate of output is equal to the shared-weight growth rates of labor and capital:

$$\Delta LnQ = v^K \Delta LnK + v^L \Delta LnL + \Delta LnA, \tag{2}$$

where the ΔLn terms are growth rates, and the v terms are averaged factor shares.

The present study uses the concept of capital as a factor of production. The flow of capital services is estimated based on the theory of user costs, developed by Jorgenson (1963).

The measurement of capital as a factor of production is based on the assumption that the flow of capital services of each type $k(K_{kj})$ is proportional to the average value of capital stocks of this type at the end of the current (τ) and previous years ($S_{kj,\tau}$ and $S_{kj,\tau-1}$) in this industry j. The growth rate of capital services $\Delta \ln K_j$ is calculated as the average growth rate of capital stocks of each type:

$$\Delta \ln K_j = \sum_{k}^{N_K} v_{k,j}^{K} \Delta Ln S_{k,j}, \tag{3}$$

where N_k is the number of asset types, whereas

$$\tilde{v}_{kj}^{K} = 0.5\,(v_{kj,t}^{K} + v_{kj,t-1}^{K}) \tag{4}$$

the period average shares of each type in the value of capital compensation

$$v_{kj}^{K} = \frac{p_k^K * S_{kj}}{\sum_{k=1}^{N_k} p_k^K * S_{kj}}, \tag{5}$$

The rental price of capital $p_{k,t}^{k}$ reflects the price at which the investor is indifferent between buying and renting the capital good via a one-year lease in the rental market. In the absence of taxation the familiar cost-of-capital equation is given by the standard equation for calculating the alternative cost of using capital:

$$p_{k,t}^{k} = p_{k,t-1}^{I} * r_t + \delta_k * p_{k,t}^{I}, \tag{6}$$

where r_t is the nominal rate of return, δ_k is the depreciation rate of asset k (reflecting the asset's loss of market value under normal operating conditions), and $p_{k,t}^{I}$ is the investment price of asset k.

Price indices are key in measuring volume investment, capital services and user costs. Accurate price indices should be constant quality deflators that reflect price changes for a given performance especially for ICT goods.

In particular, those countries that employ hedonic methods to construct ICT deflators tend to register a larger drop in ICT prices than countries that do not (Wyckoff, 1995).

We follow Schreyer's approach (Schreyer 2000) and assume that the ratios between ICT and non-ICT asset prices evolve in a similar manner across countries,

using the US as the benchmark. A comparison of the growth contributions of ICT based on national and harmonized deflators produces a sensitivity analysis with regard to the choice of deflators.[2]

For each individual asset, stocks were estimated on the basis of investment series using the perpetual inventory method (PIM) with a geometric depreciation profile. According to PIM, the capital stock (S) is defined as a weighted sum of past investments with weights given by the relative efficiencies of capital goods at different ages:

$$S_{k,t} = \sum_{\tau=0}^{\infty} \partial_{k,\tau} \cdot I_{k,t-\tau}, \tag{7}$$

where $S_{k,t}$ is the asset stock of type k at the end of the year t, $\partial_{k,\tau}$ is the productivity of an asset of type k and age τ relative to the productivity of a new asset of this type, and $I_{k,t-\tau}$ is an investment in an asset of type k made in the period $t-\tau$.

It is assumed that capital services generated by assets of different ages are equivalent and are perfect substitutes. By analogy with most of the work in this area, a geometric pattern of retirements is assumed. For a given economic depreciation δ_k, which does not change over time, but varies by asset type, we have $\partial_{k,\tau} = (1 - \delta_k)^{\tau}$, so:

$$S_{k,t} = \sum_{\tau=0}^{\infty} (1-\delta_k)^{\tau} \cdot I_{k,t-\tau} = \sum_{\tau=0}^{t-Tb-1} (1-\delta_k)^{\tau} \cdot I_{k,t-\tau} + (1-\delta_k)^{\tau-Tb} \cdot S_{k,Tb}, \tag{8}$$

where $S_{k,Tb}$ is net capital stock (for asset type k) at the end of the year of the initial valuation Tb.

To evaluate capital services based on the model described above, we need a dynamic series of nominal investments by industry and type of asset, starting from the year following the year of the initial assessment, investment price indices $p^I_{k,t}$, capital stock indicators at the residual value $S_{k,Tb}$ at the end of the year of initial assessment of Tb, the rate of return $I_{k,t-\tau}$, and the economic depreciation rate by assets types δ_k.

In this paper, the first three indicators are obtained from official Russian statistics. The fourth indicator, the risk-free interest rate in the Russia KLEMS-based approach, is calculated, and for the new approach it is considered exogenous and is assumed to be 4 percent per year in accordance with the OECD recommendations for measuring capital in countries where is more reliable estimates are not available.[3]

[2]Traditionally, statisticians identify price changes by comparing the price of the same product across two periods. For ICT products, this has become difficult because their technical characteristics change rapidly. The same computer may not be on the market one year after its appearance, or it may have become obsolete. One way to cope with this situation is based on hedonic methods, where computer characteristics are priced instead of computer "boxes". This helps to make "boxes" comparable and permits price-quantity splits. Price indices based on hedonic functions deviate dramatically from those based on other methods and there is an issue of international comparability.

[3]See (OECD, 2001), p. 133.

Data sources for each indicator are given in the next section.

An important issue is the construction of the initial capital stock at $t = 0$. Our baseline method of constructing the initial capital stock based on Harberger's *et al*. (1978) approach, according to which the economy is in a stable state, and initial stocks can be calculated using the following formula:

$$S_{k,to} = \frac{I_{jt}}{\delta_{jt} + q_j}, \tag{9}$$

where I_{jt} are the investments of the first year at comparable prices, δ_{jt}, is the economic depreciation rate by asset types, and q_j is the annual growth rate of investment, taken as 5 percent.

3. Data

Based on the CHS approach, intangible assets of the market sector were grouped into three categories: computerized information, innovative property, economic competencies.[4] Table 1 outlines what type of asset is included in each broad group. Appendix 1 contains detailed information about these assets.

Column 2 signals about inclusion of assets in SNA.

Each asset listed in Table 1 is associated with a data source on intangible expenses, this information is presented in Column 3.

In order to applying growth accounting, it is important to decide which part of the intangible expenses is an investment, i.e. fits the definition of investment as "any use of resources that reduces current consumption in order to increase it in the future". Column 4 contains capitalization ratios, which shows which part of the intangible expenditure data series is an investment. For example, scientific R&D is assumed to be a long-term investment. In relation to advertising and marketing research, it is assumed that only 60 percent of the total costs had an effect lasting more than a year (Landes and Rosenfield, 1994). The valuation is discounted by 20 percent or more, when the service life of an intangible asset is at least three years, or part of the costs can be spent on routine tasks or represent current consumption.

3.1. *Nominal Investments*

For basic intangible assets (Investments in computerized information, including software and computerized databases; Mineral Resource Exploration and Assessment Results; Entertainment and artistic originals), Russia KLEMS is the only source of data series.

[4]According to the CHS approach, the market sector in EUKLEMS is NACE sectors A through K (excluding real estate) plus sectors O and P. We exclude sector P (private households) and work with NACE sectors A through K (excluding real estate) plus sector O.

TABLE 1
INTANGIBLE ASSETS AND COMMENTARY ON DATA SOURCES

Asset Type	Included in SNA	Data Source	Capitalization Factor
1	2	3	4
Computerized information			
Software	Yes	gross fixed capital formation (GFCF) based *(Indicator i_soft Russia KLEMS)*	100%
Databases	Yes	GFCF based *(Indicator i_soft Russia KLEMS)*	100%
Innovative property			
Mineral resource exploration and assessment results	Yes	GFCF based *(Indicator i_soft Russia KLEMS)*	100%
Entertainment and artistic originals	Yes	GFCF based *(Indicator i_soft Russia KLEMS)*	100%
R&D results	Since 2008, but missing from published data	Cost based indicator *(Internal R&D costs of enterprises from statistical questionnaire №F2-science "Information on the implementation of research and development")*	100%
New product development	No	Calculation according to the formula 10, a salary-based indicator *(Wages of highly qualified specialists in the industry 65 OKVED (Financial intermediation))*	8%
New architectural and engineering designs	No	Based on a statistical questionnaire of large and medium-sized enterprises *(Release of own production goods and services (without VAT and excise taxes) code 74.20.1. Form № P−1 "Information on the production and release of goods and services")*	100%
Economic competencies			
Brand equity			
Advertising expenditures	No	Based on statistical questionnaire of large and medium-sized enterprises *(Release of own production goods and services (without VAT and excise taxes) code 74.4. Form № P−1 "Information on the production and release of goods and services")*	40%

(Continues)

TABLE 1 (CONTINUED)

Asset Type	Included in SNA	Data Source	Capitalization Factor
1	2	3	4
Market research	No	Based on a statistical questionnaire of large and medium-sized enterprises *(Release of own production goods and services (without VAT and excise taxes) code 74.13.1. Form № P−1 "Information on the production and release of goods and services")*	40%
Firm-specific capital			
Human capital	No	Calculation according to the formula 11, a salary-based indicator *(Investments in employee training)*	100%
Organizational capital			
Purchased	No	Based on a statistical questionnaire of large and medium-sized enterprises *(Release of own production goods and services (without VAT and excise taxes) code 74.14. Form № P-1 "Information on the production and release of goods and services")*	80%
Own-account	No	Calculation according to the formula 12, a salary-based indicator *(Wages in executive occupation)*	20%

Source: Based on official statistics from Rosstat (2004, 2009, 2011) and Russia KLEMS, 2017.

Let us look at the Russia KLEMS methodology for capital data collection, explaining why we consider these types of assets to be covered by this source and the limitations.

First, due to limited data, we analyze only aggregated data on the listed types of assets. At this stage, it is impossible for us to determine separately, for example, the contribution of computerized information or mineral resource exploration to economic growth.

To form a series of nominal investments, the starting point is a series of gross fixed capital formation (GFCF) in the SNA.[5] The SNA provides GFCF only for the general economy and common assets.[6] For this study, we are interested in using the breakdown of GFCF by asset types used by Russia KLEMS.

The investment series are constructed by breaking down GFCF data by asset type using shares calculated on the basis of a survey of fixed assets (federal annual statistical monitoring № 11) "Report on Stock and Flows of Fixed Assets and Other Non-Financial Assets" (F-11). This is an important tool for collecting data on fixed assets in CIS countries. F-11 is considered to be consistent with the 1993 SNA.

Standardized statistical questionnaires are sent to all large and medium-sized enterprises (commercial organizations, and non-financial corporations). Enterprises submit their responses to the Federal statistical agency during the first few months of the year (in Russia the deadline is February 25). The balances are first compiled at the level of individual enterprises and then aggregated to obtain balances for industries and the total economy. In principle, the method of balances works as follows: the balance in gross values starts with the gross value of the stock at the beginning of the year, revalued at the beginning of the year prices (January 1), to which the value of "inflows" of assets during the year is added, and from which the value of the "outflows" is subtracted, to obtain the gross stock at the end of the year.

A major advantage of the Balance of Fixed Assets (BFA) is that while the traditional Perpetual Inventory Method estimates the value of retired assets on the basis of their estimated service lives, the methodology of F-11 uses actual statistics on retired and scrapped fixed assets as reported by enterprises.

The BFA is contained in a table, which shows the value, composition and change[7] in the value of fixed assets for the economy as a whole, by industry and by form of ownership. It is compiled annually by the Federal statistical agency at current prices.

F-11 has existed in its current form since 1993, which allows us to analyze data over an extended time period.[8]

[5]About 10 percent of GFCF is not covered in a full cycle. This is because household investments are not taken into account when investing in fixed assets. In Russia KLEMS, an appropriate adjustment is made for the data used from new acquisitions of the Citizens' Property Balance, which covers households.

[6]GFCF time series can be obtained at Rosstat (2004, tab. 1.1.7; 2009, tab. 2.1.7; 2011, tab. 2.1.7).

[7]The BFA shows the stock of fixed assets at the beginning of the year, the acquisitions during the year (separately identifying new assets), withdrawals (separately identifying liquidated assets) and the value of the stock of fixed assets at the end of the year.

[8]However, there are also earlier analogues of F-11, which also make a retrospective analysis possible.

TABLE 2
Classification of Intangible Assets in F-11

Period	1995–2000	2001–2010	2011	2012–2014
Classification	–	Intangible fixed assets (mineral resource exploration and assessment results; computer software; entertainment and artistic originals; high technology industrial technologies. Since 2010, also other intellectual property)	Objects related to intellectual property and IP products	Objects related to intellectual property and IP products: Research and development, mineral resource exploration and assessment results, software, database, entertainment and artistic originals

Source: Based on Rosstat documents enacted F-11.

In Russia KLEMS, capital assets are divided into 8 types: residential structures, buildings and constructions, transport facilities, power machinery and material working machinery, computing equipment, information machinery, data-processing machinery except computing equipment, other assets, and non-material assets. In general, the classification of fixed assets in the SNA and Russia KLEMS can be compared (see Appendix 2). The last type of capital—non-material (intangible) assets—are of interest here.

Table 2 presents how the classification of intangible assets in F-11 changed during the reporting period (with the exception of ICT capital).

Intangible assets have been included in fixed assets since 2001. Prior to this, they belonged to the category "other non-financial assets" and were not included in the composition of GFCF, i.e. the intangible component of fixed assets was identical to ICT capital. The next significant change in the classification of intangible assets occurred in 2011 after the assignment of intellectual property to fixed assets, and since 2012, this included R&D. This is due to the harmonization of Russian statistics with the 2008 SNA.

Since Russia KLEMS data are directly related to F-11 in terms of capital shares, the component of intangible assets began to increase in volume and become indicative only in 2001. F-11 currently takes into account intangible assets such as investments in computerized information, including software and computerized databases; mineral resource exploration and assessment results; entertainment and artistic originals. R&D is just beginning to be counted.

We assume, that other possible inaccuracies in the valuation of intangible assets may be due to incorrect shares of assets, and the classification of fixed assets. Nor does F-11 take into account the data of small and medium-sized businesses. Updates and changes in statistical questionnaire are made almost annually, which may negatively affect the completeness of the information provided by organizations.

Other limitations of the data source are that F-11 does not include intellectual property without legal or other protection, unfinished software or the value of non-produced assets related to fixed assets—contracts, leases, licenses and the value of goodwill and business relationships (trademarks and other marketing assets).

In accordance with the guidelines,[9] filling out F-11 must follow the principles of accounting for fixed assets. In practice accountants have difficulty recognizing intangible assets for accounting in accordance with PBU 14/2007.[10]

In PBU 14/2007 and the Russian Tax Code, Art. 257. intangible assets include non-material assets that can bring future economic benefits (income) to the organization, be used in the production of goods (work, services) or for the organization's management needs for more than 12 months and be documented (patents, certificates and other title documents). Paragraph 3 of PBU 14/2007 determines that in order to accept an object for accounting as an intangible asset, seven established conditions must be met. This requires a one-time compliance. If an asset does not meet at least one criterion, it cannot be recognized as intangible.

In comparison, GAAP US national accounting standards allow an intangible asset to exist for less than 12 months. If an entity has the intention to sell an asset after use, then it can be classified as intangible. In Russian reporting, such assets are recommended to be taken into account separately so that they can be easily distinguished.

In PBU 14/2007, a prerequisite is the separability of an asset from other property; this is not considered by GAAP as an obstacle to their recognition as intangible; paragraph B37 SFAS № 142 allows the existence of intangible assets that cannot be separated from other property (e.g. the production process available at an enterprise or, the qualifications of employees).

Another issue in accounting for intangible assets is that the international standard IAS 38 is significantly different from PBU 14/2007. This leads to the recognition of intangible assets in one account and not in another, which distorts the financial statements and causes accounting difficulties.

As a result, according to a Deloitte study, 78 percent of the companies surveyed reported that the share of intangible assets in total assets was less than 1 percent.[11]

3.1.1. R&D Results

Although R&D results are recommended for capitalization by the 2008 SNA, not all countries, including Russia, include it in survey forms. Therefore, our reference source of data on this asset is the cost-based indicator Internal R&D costs in Russia according to the form of federal statistical observation № F2-science "Information on the implementation of research and development." Legal entities (except small businesses) which carry out R&D are examined. Internal current costs include labor costs; pension contributions; health insurance; social insurance; expenses for the purchase or manufacture of special equipment (including due to

[9]Rosstat order of November 27, 2015 № 563 "On approval of instructions for filling out the forms of federal state statistical monitoring № 11"Information on the availability and movement of fixed assets (funds) and other non-financial assets" and № 11 (brief) "Information on the availability and movement of fixed assets (funds) of non-profit organizations."

[10]At present, the Accounting Regulation "Accounting for Intangible Assets" (PBU 14/2007) is in force.

[11]The specifics of the company, an inside look, according to a survey of representatives of large business in Russia, November 2016, organized by Deloitte.

the cost of the work performed); other material costs (the cost of raw materials, materials, components, semi-finished products, fuel, energy, industrial works and services, etc.), and other current costs.

Standardized statistical questionnaires are sent to all large and medium-sized enterprises carrying out R&D in the reporting year. Enterprises submit their responses to the Federal statistical agency during the first few months of the year.

The criterion for distinguishing R&D from related activities is the presence of a significant element of novelty.

Data on the costs of R&D carried out in the reporting year are taken into account, regardless of the source of funds, including the R&D costs carried out by the organization for its own needs at its own expense, and, including initiative projects. In this case, the amount of depreciation deductions for the full restoration of fixed assets is excluded from the composition of costs.

As alternative data sources for this type of asset, we can distinguish:

- an indicator of the costs of research, development and technological work, calculated on the basis of the structure of investments in non-financial assets and investments in fixed assets collected by Rosstat in the collection Investments in Russia. Investments in non-financial assets, in addition to investments in fixed assets, include investments in non-produced non-financial assets[12]. The source for the formation of this indicator is Form № P-2 "Information on investments in non-financial assets" and, Form № P-2 (invest) "Information on investment activities." This information is provided by all legal entities—commercial and non-profit (including religious) organizations of all forms of ownership (except for small businesses)—which carry out all types of economic activity.

- an indicator of the volume of innovative goods, works, and services in the Russia according to the form of federal statistical observation № 4 (innovation) "Information on the innovative activities of the organization" (annual).[13]

[12]Investments in non-produced non-financial assets are—expenses incurred by legal entities for the acquisition of land, natural resources, contracts, leases, licenses (including rights to use natural objects), goodwill and business relations (marketing assets). The costs of acquiring land and natural resources are based on documents issued by state bodies for land resources and land management in accordance with bills paid or accepted for payment.

[13]The form for federal statistical observation № 4-innovation "Information on the organization's innovative activity" is provided by legal entities, except small businesses, engaged in economic activity in accordance with the All-Russian Classifier of Economic Activities (OKVED2 OK 029-2014 (NACE Rev. 2)) in the field of cultivation annual crops (code 01.1); the cultivation of perennial crops (code 01.2); growing seedlings (code 01.3); animal husbandry (code 01.4), mixed farming (code 01.5), activities in subsidiary in the field of crop production and post-harvest processing of agricultural products (code 01.6); mining (Section B); manufacturing (Section C); provision of electric energy, gas and steam; air conditioning (Section D) (excluding electricity trade (code 35.14); trade in gaseous fuels supplied through distribution networks (code 35.23), trade in steam and hot water (thermal energy) (35.30.6)); water supply; wastewater disposal, waste management, pollution management activities (Section E); roofing works (43.91); other specialized construction activities not included in other groups (code 43.99); publishing activities (code 58); telecommunications activities (code 61); computer software development, consulting services in this area and other related services (code 62); activities in the field of information technology (code 63); activities in the field of law and accounting (code 69); activities of head offices; management consulting (code 70); activities in the field of architecture and engineering design; technical testing, research and analysis (code 71); R&D (code 72); advertising and market research activities (code 73); other professional scientific and technical activities (code 74).

For aggregate analysis (without disaggregation by sector), we preferred the indicator "Internal R&D costs" due to the breadth of organizations (large and medium-sized enterprises and government institutions), and to avoid double counting.

3.1.2. New Financial Product Development

To estimate the costs of new financial projects, we worked with statistics on employment and remuneration (Collection "Labor and Employment in Russia," Bulletin of Labor Force Survey). These expenses were calculated using the definition of 8 percent of the remuneration of highly qualified specialists in the JA industry. To do this, we took data on the average annual number of employees in the JA industry, based on data on managers, it was suggested that about 7 percent of the average annual number of employees are highly qualified specialists. Based on the average monthly nominal accrued salary of JA industry employees, the necessary values were calculated using the following formula:

$$\text{NFP} = (W * S * 0.07 * 12)/1,000,000 \tag{10}$$

where *NFP* are new financial projects in million rubles, W are average monthly nominal accrued wages of JA industry workers in rubles, S is the average annual number of employees in the JA industry.

3.1.3. New Architectural and Engineering Designs

To evaluate the costs of new engineering projects, we relied on the performance indicators for the relevant OKVED industry (KDEK 1.1.). This was based on the indicator of the release of goods and services (without VAT and excise taxes) of the form for federal statistical monitoring № P-1 "Information on the production and release of goods and services" for organizations not related to small businesses and with more than 15 employees. To identify the costs of new architectural and engineering designs the release of organizations corresponding to code 74.20.1 was used.

3.1.4. Brand Equity

To evaluate brand equity, we also relied on the performance indicators for the relevant OKVED industry (KDEK 1.1.). This was based on the indicator of the release of goods and services (without VAT and excise taxes) of the form for federal statistical monitoring № P-1 "Information on the production and release of goods and services" for organizations not related to small businesses and with more than 15 employees. Code 74.4 was used to account for advertising costs; code 74.13.1 was used to account for the costs of marketing research.

There are also specialized industry studies by the Commission of Experts of the Association of Communication Agencies of Russia, which estimate the total volume of advertising by means of distribution minus VAT, and studies of the Russian Association of Marketing Services to assess the size of the marketing services segment, but for the purposes of our paper we use official statistics.

3.1.5. Firm-provided Training

To assess investments in human capital, we worked with statistics on employment and remuneration (Collection "Labor and Employment in Russia," Bulletin of Labor Force Survey). These investments were estimated on the basis of data on the cost of vocational training as a percentage of the average monthly labor costs, the average monthly nominal accrued wages of employees and the employees aged 15–72 years using the following formula:

$$\mathrm{HC} = (C * W * 12 * S_{15-72})/1,000,000 \tag{11}$$

where HC is the investment in human capital in million rubles, C is the cost of vocational training as s percentage of the average monthly labor costs, W are the average monthly nominal accrued wages of workers, in rubles, S_{15-72} is the number of employees aged 15–72 years in Russia.

3.1.6. Purchased Part of Organizational Capital

To evaluate the purchased component of organizational capital, we relied on the performance indicators for the relevant OKVED industry (KDEK 1.1.). This was based on the indicator of the release of goods and services (without VAT and excise taxes) of the form for federal statistical monitoring № P-1 "Information on the production and release of goods and services" for organizations not related to small businesses and with more than 15 employees. Code 74.14 was used to account for the acquired component of organizational capital, which includes the revenues of the management consulting industry.

3.1.7. Own-account Organizational Capital

To assess the own-account component of organizational capital, we used statistics on employment and remuneration (Collection "Labor and Employment in Russia," Bulletin of Labor Force Survey). The own-account component of organizational capital is the sum of the organization's expenses for managerial salaries. To calculate this indicator, we used data on the number of heads of government and management bodies at all levels, and the average accrued wages of employees of organizations by occupation (using management data) in the following formula:

$$\mathrm{MW} = (M * C * 12)/1,000,000 \tag{12}$$

where MW are the wages of managerial staff, in million rubles, M is the number of heads of government and management bodies at all levels, W is average gross salary of employees of organizations for occupations, in rubles.

Further, the capitalization levels of these investments proposed by the CHS were used.

3.2. *Capital Stock*

We use the Perpetual Inventory Method (PIM) to transform data on yearly investment flows into capital stocks. For capital type k the real capital stock in year t is calculated as follows:

$$K_{k,t} = (1 - \delta_k) * K_{k,t-\tau} + I_{k,t}, \tag{13}$$

where $I_{k,t}$, is the annual real investment, δ_k, is the economic depreciation rate by asset types k.

3.3. *Price Deflators*

Price indices are key in measuring volume investment, capital services and user costs. Accurate price indices should be constant quality deflators that reflect price changes for a given performance of ICT investment goods.

Wyckoff (1995) was one of the first to point out that the large differences that could be observed between computer price indices in OECD countries were much more likely to be a reflection of differences in statistical methodology than true differences in price changes. In particular, those countries that employ hedonic methods to construct ICT deflators tend to register a larger drop in ICT prices than countries that do not. Schreyer (2000) used a set of "harmonized" deflators to control for some of the differences in methodology. We follow this approach and assume that the ratios between ICT and non-ICT asset prices evolve in a similar manner across countries, using the US as the benchmark.

First, the percentage point difference between the price index for IT equipment (Information processing equipment) ($\Delta \ln p_t^{\mathrm{IT,US}}$) and the price index for non-ICT equipment (Industrial equipment) was calculated for the US ($\Delta \ln p_t^{\mathrm{N,US}}$). To eliminate short-term fluctuations, the resulting series was regressed against a polynomial trend. Call values from this regression $\lambda_t^{\mathrm{IT}} = f(\Delta \ln p_t^{\mathrm{IT,US}} - \Delta \ln p_t^{\mathrm{N,US}})$. To construct the set of harmonized price indices, we applied these factors to non-ICT price indices (Non-residential structures) of Russia: $\Delta \ln p_t^{\mathrm{IT,RU}} = \Delta \ln p_t^{\mathrm{N,RU}} + \lambda_t^{\mathrm{IT}}$.

Another way of constructing a "harmonized" deflator uses an exchange rate adjustment Schreyer (2002). This is a plausible approach if the ICT product is internationally traded and/or imported into the country under consideration. For Russia, this is especially important, since the import dependence of the ICT equipment market is about 98 percent. It is also instructive to replace national price indices by those used in the US, as comparisons and discussions about measurement issues frequently focus on the comparison with the US.

According to this approach, the adjusted price change in a country is given by:

$$\Delta \ln p^{\mathrm{IT,RU}} = \Delta \ln p^{\mathrm{IT,US}} + \Delta \ln(e^{\mathrm{RU/US}}),$$

where $e^{\mathrm{RU/US}}$ is the bilateral exchange rate between Russia and the US.

The calculation of the harmonized price indices is given in Appendix 3.

We conducted sensitivity analysis of the results depending on price deflators in Appendix 4.

3.4. *The Nominal Rate of Return*

The nominal rate of return in the Russia KLEMS-based approach is calculated, and for the new approach it is considered exogenous and is assumed to be 4 percent per annum in accordance with the OECD recommendations for measuring capital in countries for which there are no more reliable estimates.[14]

3.5. *Depreciation Rate*

The rates of economic depreciation for assets symmetrical to the CHS approach are taken from the work of Corrado *et al*. (2014) and are differentiated by types of intangible assets according to Table 3.

4. The Discussion of the Results with an Expanded List of Intangible Assets

Table 4 presents a comparison of the decomposition of economic growth in Russia and a number of European countries for the period 2004–2014, calculated on the basis of Russia KLEMS and EU KLEMS (release 2019) data series.

We can see the contribution of labor to the growth of value added, the contribution of tangible assets, and the contribution of TFP with SNA intangibles and with extended list of intangibles corresponding to the CHS approach. SNA intangible assets form 8 percent of the average annual growth in the European

TABLE 3
Depreciation Rate for Intangible Assets

Asset Type	Depreciation Rate
Computerized information	
Software	0.315
Databases	0.315
Innovative property	
Mineral resource exploration and assessment results	0.315
Entertainment and artistic originals	0.315
R&D results	0.150
New product development	0.200
New architectural and engineering designs	0.200
Economic competencies	
Brand equity	
Advertising expenditures	0.550
Market research	0.550
Firm-specific capital	
Human capital	0.400
Organizational capital	0.400

Source: Corrado *et al*. (2014).

[14]See OECD (2001), p. 133.

TABLE 4
DECOMPOSITION OF VALUE-ADDED GROWTH RATES, 2004–2014, P.P

	Gross Value Added, Volume Indices	Contribution of Labor (p.p.)	Contribution of Intangible Assets to Value Added Growth (p.p.)	Contribution of Tangible Assets Value Added Growth (p.p.)	Contribution of TFP to Value Added Growth (p.p.)
	1 = 2+3 + 4 + 5	2	3	4	5
With SNA intangibles					
United Kingdom	1.37	0.4	0.1	0.6	0.4
The Netherlands	0.43	0.4	0.1	0.35	0.5
Austria	0.05	0.3	0.14	0.4	0.6
Germany	0.54	0.3	0.1	0.2	0.14
Russia	0.35	0.38	0.05	0.80	2.05
With extended list of intangibles					
United Kingdom	1.5	0.4	0.15	0.5	0.45
The Netherlands	1.4	0.4	0.15	0.35	0.5
Austria	1.5	0.3	0.2	0.4	0.6
Germany	1.4	0.3	0.1	0.2	0.8
Russia	3.3	0.4	0.15	0.8	2.0

Notes: With SNA intangibles here means assets corresponding to the SNA. With extended list of intangibles here means assets corresponding to the CHS approach.
Source: Author's calculation based on Russia KLEMS and EU KLEMS (release 2019).

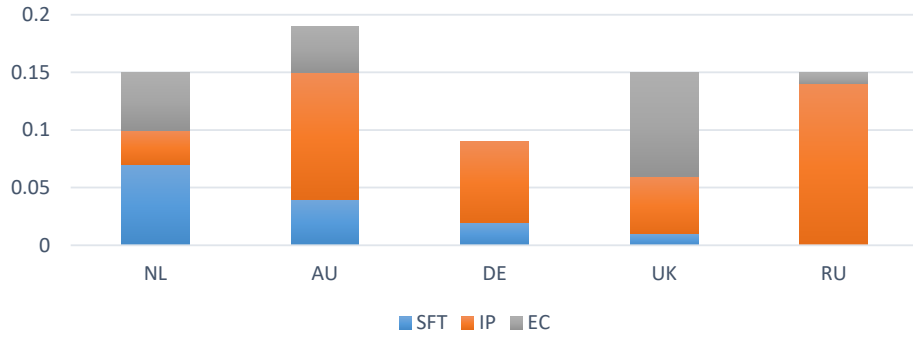

Figure 1. Contributions of Intangible Assets to the Value Added, 2004–2014, p.p.

Notes: SFT is Computerized information investment; IP is Innovative property; EC is Economic competencies.

Source: Author's calculation based on Russia KLEMS and EU KLEMS (release 2019) [Colour figure can be viewed at wileyonlinelibrary.com]

countries under consideration. The Austria is the leader, here the contribution of intangible assets amounted to 0.14 p.p. with an average annual growth of 1.5 percent (9 percent growth).

For Russia, the contribution of intangible compared to other countries and relative to other factors looks less significant and amounts to 0.05 p.p. with an average annual growth of 3.28 percent (1.5 percent).

Tangible assets are the main driver of value added growth.

After transition to CHS approach, intangible assets form about 9 percent of the average annual growth in the European countries under consideration. For Russia new intangibles added a more significant contribution to growth, it increased from 0.05 p.p. to 0.15 p.p. of 3.3 percent (from 1.5 percent to 4.5 percent).

If we look at the role of intangibles by type (Figure 1), we find that, in Austria, and the Netherlands, the various assets have roughly even contributions. In the UK the main role is played by Economic competencies. In Russia, we can see mostly the contribution from Innovative property. The results indicate the high role of R&D in the development of the Russian economy, therefore, the data on Russian intangible assets need to be clarified.[15]

Russian statistics clearly show a lack of the detailed information consistent with the Russian SNA. These limitations include a lack of data on GFCF at a detailed industry level and the need for additional adjustments for data collected from more limited samples.

Another group of restrictions is associated with the ambiguity of the choice of one or another set of parameters as applied to the Russian economy. These include the lack of statistically agreed investment price indices for certain types of

[15]In particular, work in progress to create software is not reflected in the official data source. The costs of creating software at an enterprise, accumulated on account 08 "Investments in non-current assets," are not included in fixed assets accounted in form № 11 until they are completed (debited from account 08 in debit of accounts 04 "Intangible assets"). These expenses do not relate to work in progress for equipment, to equipment intended for installation, or to facilities not completed.

capital. The approach used in this work is based on an extremely approximate correspondence of the technological structure of investment and fixed capital investments by types based on the Russian classification of assets.

It is also essential to use the rate of economic depreciation used in the CHS approach. In further calculations of the system of accounts of economic growth, it would be advisable to use different versions of such estimates to analyze the sensitivity of the final results.

5. Conclusion

This paper estimates the contribution of intangible assets to the growth of the Russian economy based on Russia KLEMS and the approach proposed by CHS.

Different estimates were obtained as a result of applying different approaches. The role of capital in accelerating productivity growth is greater, given the greater number of intangible assets. The results presented in Table 4 show that intangible assets are important not only for accounting for national income and welfare, but also for accounting growth. Our estimates, imply that the traditional practice of eliminating intangible assets leads to a seriously distorted picture of growth.

For a better understanding of these processes, further study of the issue is necessary, taking into account the limitations of existing approaches and indicators.

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Supporting Information

Additional supporting information may be found in the online version of this article at the publisher's web site:

APPENDIX 1: Information About Intangible Assets

TABLE 2.1: Comparison of Classifications of Fixed Assets in the SNA and Russia KLEMS

APPENDIX 3: The Calculation of the Harmonized Price Index for ICT Components

FIGURE (a): Difference Between the Price Index for ICT Equipment (Information Processing Equipment Based on Hedonic Methods) ($\Delta \ln pt^{IT,US}$) and the Price Index for Non-ICT Equipment (Industrial Equipment) in the US. *Source*: Author's calculation

FIGURE (b): Difference Between the Price Index for ICT Equipment (Information Processing Equipment Based on Hedonic Methods) ($\Delta \ln pt^{IT,US}$) and the Price Index for Non-ICT Equipment (Industrial Equipment) in Russia. *Source*: Author's calculation

FIGURE (c): Price Index for ICT Equipment: US (Based on Hedonic Methods) vs Russia (official), 2012 = 100. *Source*: Author's calculation

FIGURE (d): Polynomial Trend $\Delta \ln p_t^{IT,US} - \Delta \ln p_t^{N,US.}$ *Source*: Author's calculation

FIGURE (i): Difference Between the Price Index for IT Equipment (Harmonized) and Non-ICT Equipment in Russia. *Source*: Author's calculation

FIGURE (g): US Price Index Plus Exchange Rate Changes and Russian ICT Equipment Deflator. *Source*: Author's calculation

APPENDIX 4: Sensitivity Analysis of the Contribution of Extended List of Intangible Assets to Economic Growth Depending on the ICT Price Deflator

TABLE 4.2: Decomposition of Growth Rates and Share of Intangible Assets by Types for the Period 2004–2014, p.p. *Source*: Author's calculations