



UNSW Business School

Centre for Applied Economic Research

Productive Screen Time

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The Research Project

The project is a joint research collaboration between The Productivity Institute (based at the University of Manchester), King's College London (KCL) and UNSW. KCL Theme Leaders are Prof. Rebecca Riley (KCL and ESCoE) and Prof. Mary O'Mahony (KCL and ESCoE).

The project's research team:

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The Plan

1. Motivation
2. Theoretical Framework
3. Data Collection
4. Results:
 - i. Digital leisure services – production engagement
 - ii. Value of digital leisure services (NPC) per person
 - iii. Aggregate value of digital leisure services
 - iv. Extended Measure of Activity – quarterly changes
 - v. Extended Measure of Activity (annual)
5. Extended Measure of Activity – real growth rates
6. Conclusions

Motivation

- Official statistics fail to capture recent developments in economic activities due to the digital economy.

- We focus on a production activity that has not yet been captured in the national accounts:

the production process whereby households use their time, along with capital services (hardware, software, AI features) to produce digital leisure services (i.e., own account entertainment or communication services).

- The exclusion of this production activity from official statistics could potentially lead to an understatement of economic activity.

Motivation - clarification

- By convention, the production of own-account leisure services by households is excluded from GDP calculations.
- We are not suggesting expanding current SNA boundaries but rather aim to construct experimental extended measures of activities (EMA) within a framework of satellite accounts while SNA accounting principles are being observed.

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Theoretical Framework (building on Schreyer (2022))

The household's production function is given by:

$$q_L = F(K_L, t_L, \eta_L)$$

Where,

q_L = quantity of digital leisure services that the household produces to itself

K_L = quantity of capital services used to produce digital leisure services by the household (e.g., IT equipment)

t_L = time allocated to produce digital leisure services by the household

η_L = households' network size

$F(K_L, t_L, \eta_L)$ is a continuous, non-negative production function that is nondecreasing in its elements and linear homogenous in K_L and t_L .

Theoretical Framework - continued

Assuming the household has already made a utility-maximising decision on the quantity q_L that it wants to consume given its monetary and time constraints, the conditional cost function is then defined as:

$$c(q_L, u_L, w_L, \eta_L) = \min_{K_L, t_L} [u_L K_L + w_L t_L : F(K_L, t_L, \eta_L) \geq q_L]$$

Where,

u_L = price (user cost) of capital services (exogenously given)

w_L = shadow price of the household's time t_L devoted to leisure production (equilibrium imputed price of time spent on producing digital leisure services)

Theoretical Framework - continued

Using linear homogeneity of F , the minimum cost for achieving q_L can be expressed in terms of the unit cost function $c^L(u_L, w_L, \eta_L)$:

$$c(q_L, u_L, w_L, \eta_L) = q_L c^L(u_L, w_L, \eta_L) = u_L K_L + w_L t_L$$

Where,

$p_L \equiv c^L(u_L, w_L, \eta_L)$, i.e., the unit cost function equals the household's output shadow price for the own-produced digital leisure services and the total value of digital leisure services equals the sum of costs.

Theoretical Framework - continued

- The main obstacle in constructing the satellite account is the lack of observable prices and quantities.
- Utilizing the assumption of constant returns to scale, the nominal value $q_L p_L$ can be written as follows:

$$c(q_L, u_L, w_L, \eta_L) - c(0, u_L, w_L, \eta_L) = q_L c^L(u_L, w_L, \eta_L) = q_L p_L$$

- That is, households' nominal value of digital leisure services equals the difference between the cost of own account production compared to zero production.
- We coin this difference as ***Non-Production Compensation (NPC)*** and we estimate it through online surveys by eliciting the compensation that is required by households to forego engaging in a digital leisure activity for a given period of time.

Theoretical Framework – Extended Measure of Activity

Let $p \equiv [p_1, \dots, p_N]$ and $q \equiv [q_1, \dots, q_N]$ be the prices and quantities of final goods and services included in the conventional measure of GDP, then

Nominal GDP	Nominal Extended Measure of Activity (EMA)
$Y = \sum_{i=1}^N p_i q_i \equiv p \cdot q$	$\tilde{Y} = p \cdot q + \sum_{j=1}^A p_{L_j} q_{L_j}$

Where,

A = number of types of digital leisure services produced in the economy

$p_{L_j} q_{L_j}$ = nominal value of digital leisure service j (aggregated across households)

Theoretical Framework – Extended Measure of Activity

The difference between conventional GDP and EMA is then assessed by:

Percentage difference between *levels* of nominal EMA and GDP

$$\frac{\tilde{Y} - Y}{Y}$$

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Data Collection

- We conducted a multi-wave online survey on a representative sample of the UK population to construct a dataset of households' valuations (NPCs) for four selected digital leisure activities:
 - Instant messaging
 - Video calling
 - Emailing
 - Social networking
- We collected data on:
 - NPCs (elicited as the compensation that is required to forego engaging in a given digital leisure activity for a given period of time).
 - The different types of digital products that were used in the production process.
 - The time spent on producing these digital leisure services.
 - The network size of households in producing these digital leisure services.

Data Collection - continued

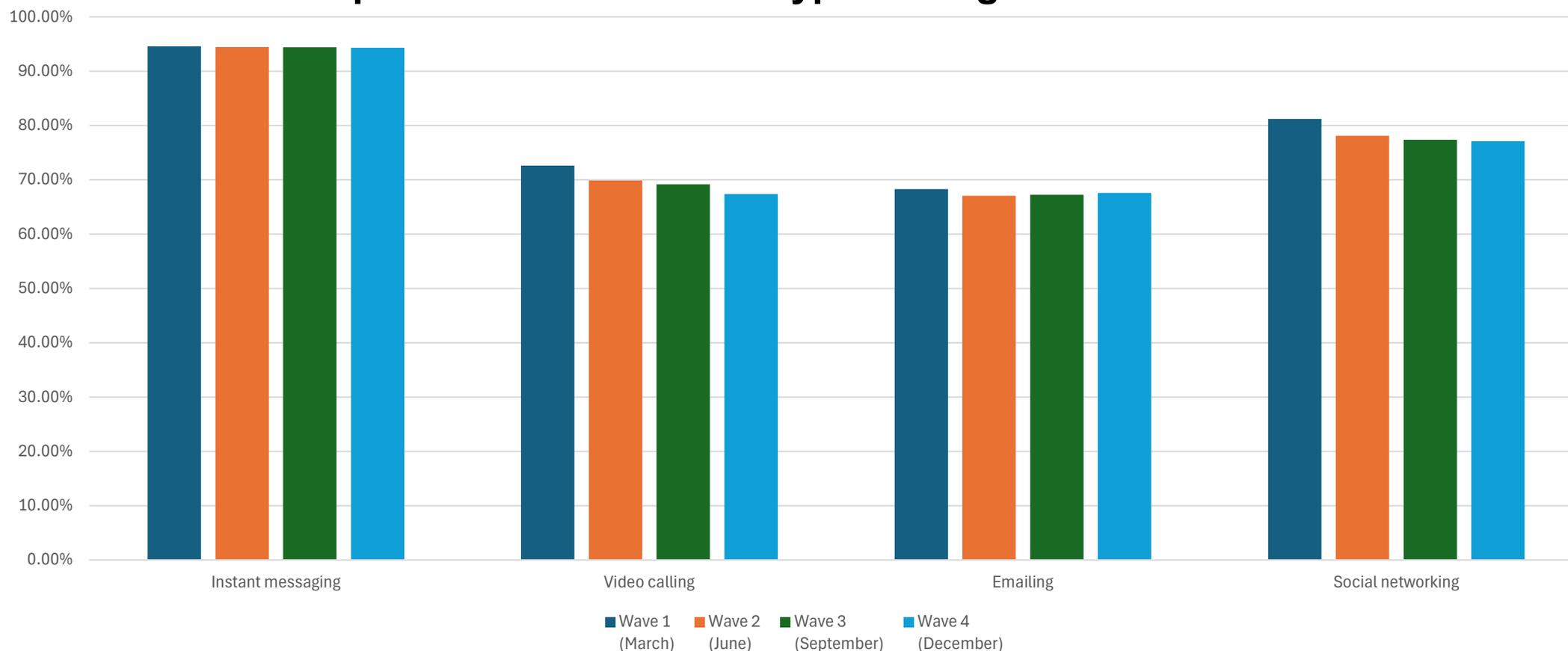
- The online survey was carried out every quarter (March, June, September and December) during 2024.
- The online survey was managed and implemented by YouGov (data service provider, UK branch).
- We used a split panel sample design to enable both cross-section and panel analyses, to facilitate an all-rounded examination of changes across users and time.
- Raw data sets are still in the process of being constructed and cleaned, hence, presented results are preliminary.

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Digital leisure services – production engagement

Percentage of sample participants engaging in the production of the four types of digital leisure services

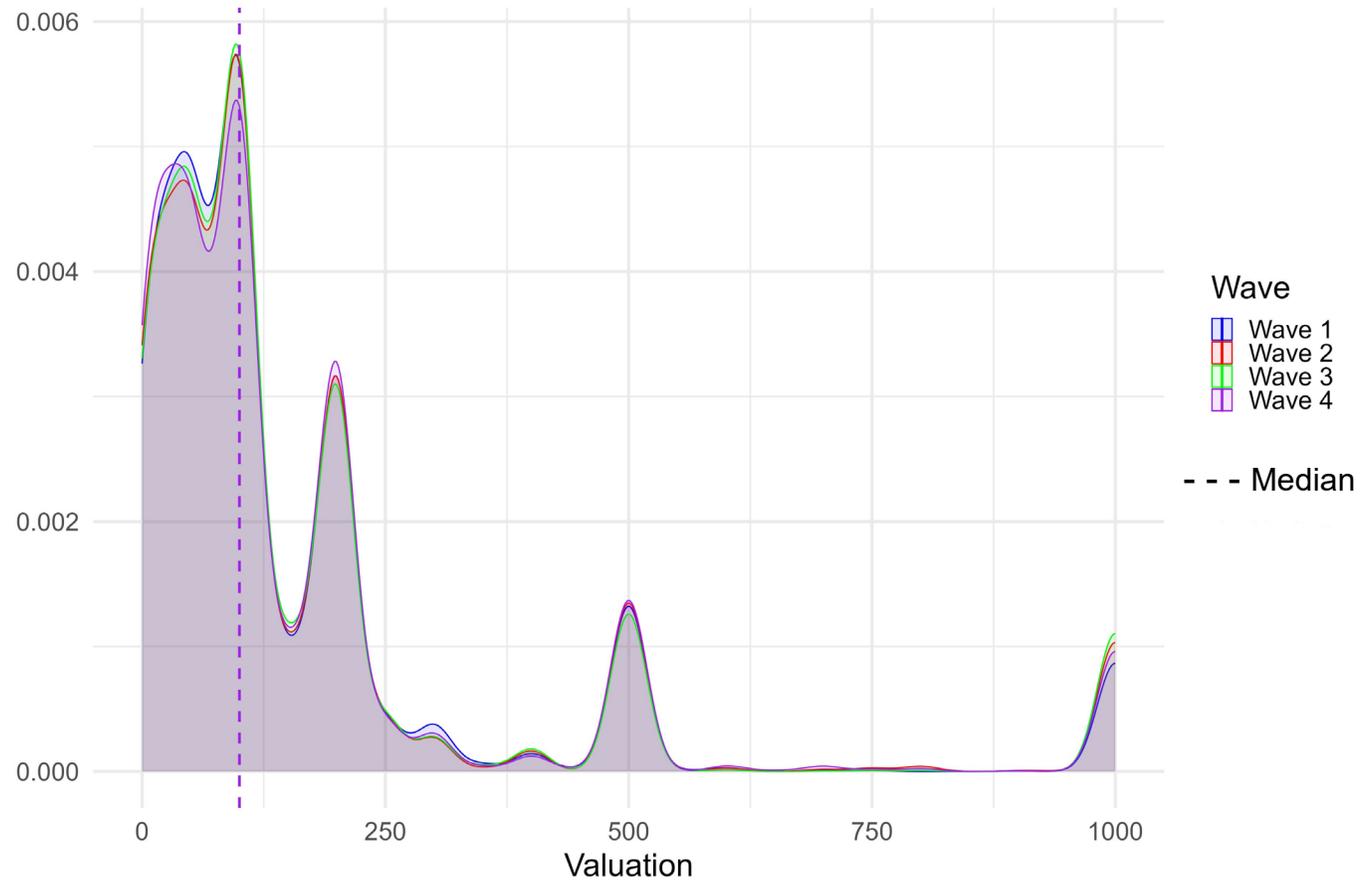


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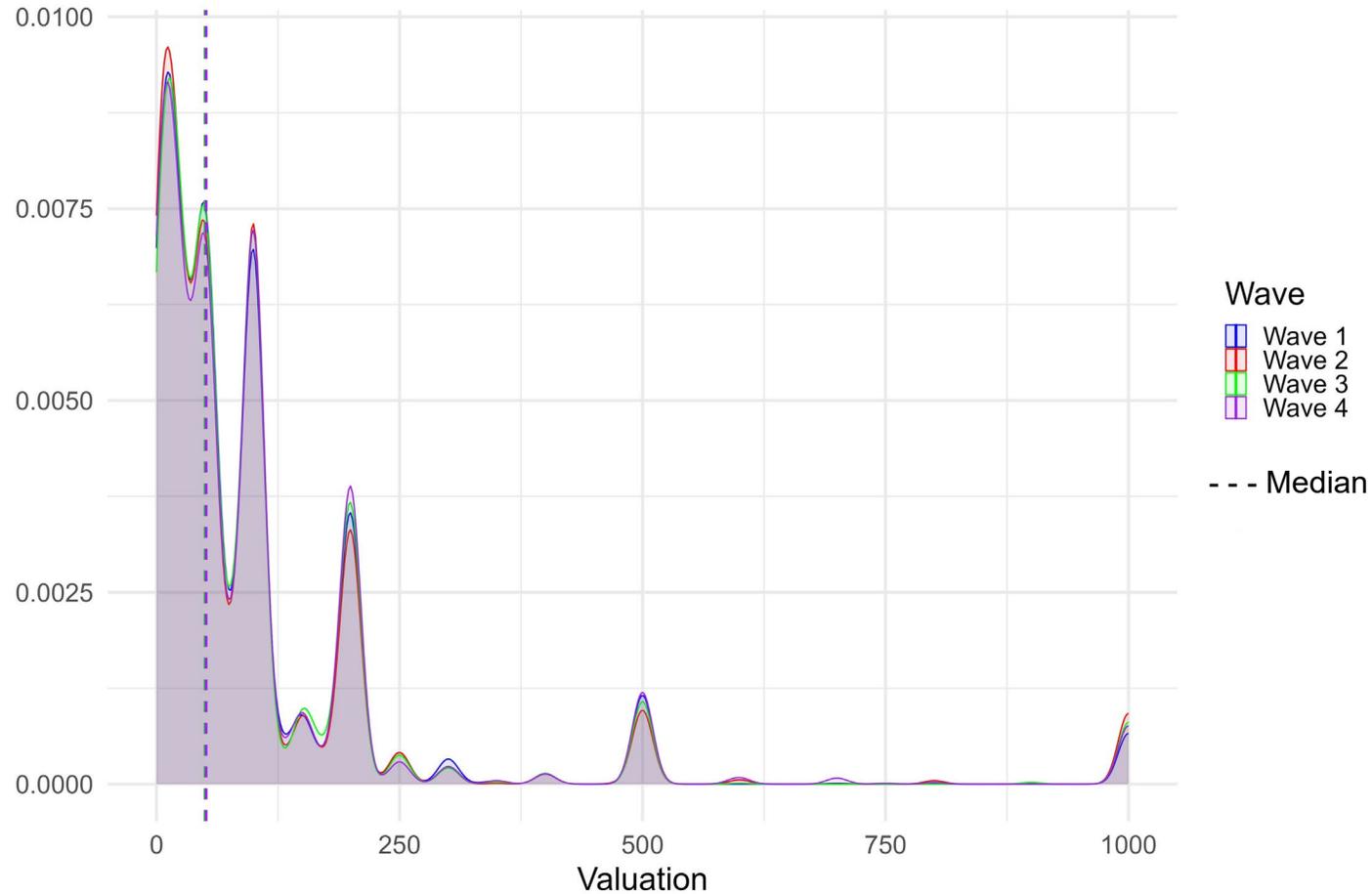
Value of digital leisure services (NPC) per person (£/month)

Kernel Density Estimates for **Instant Messaging** Across Waves



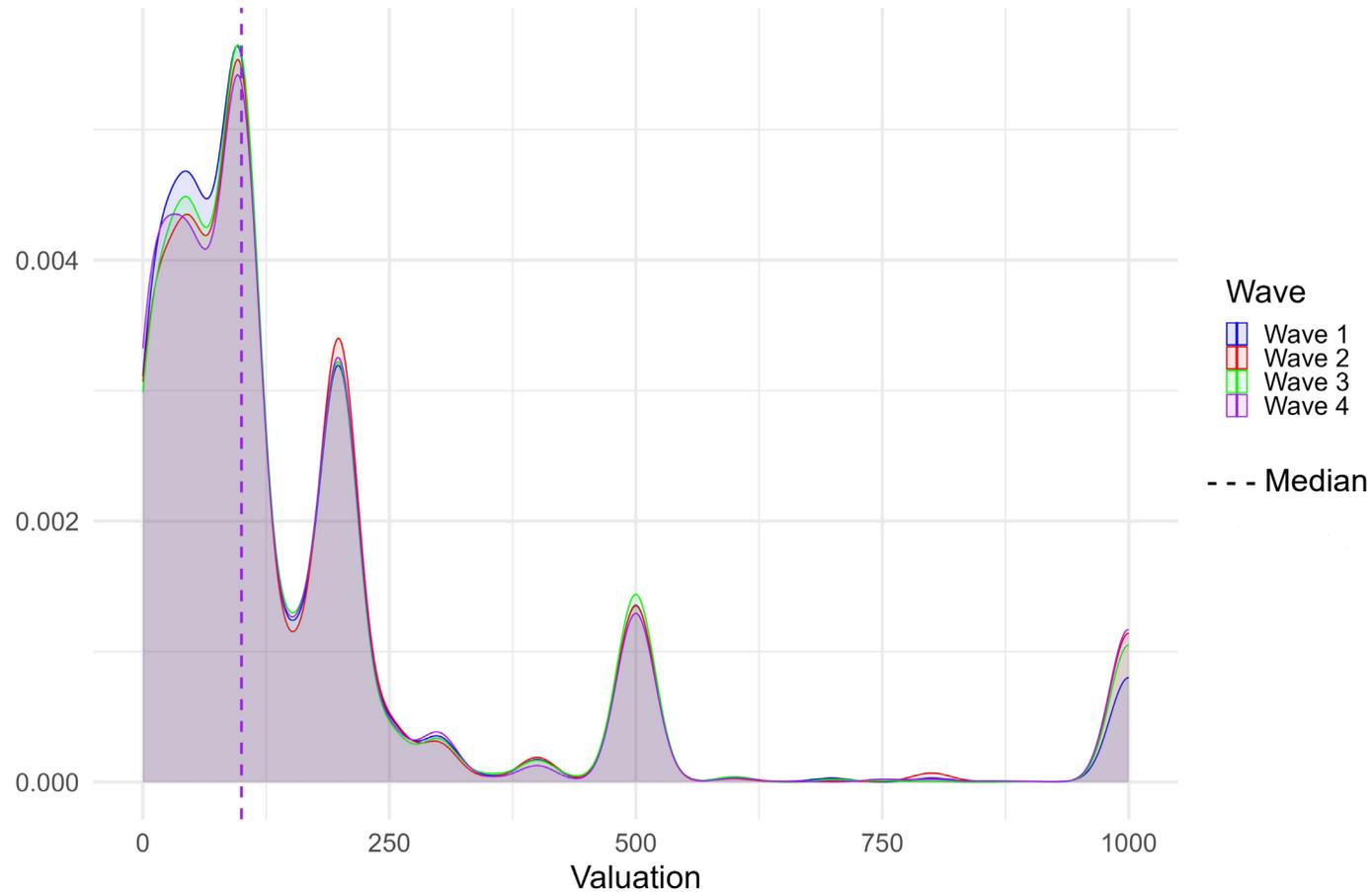
Value of digital leisure services (NPC) per person (£/month)

Kernel Density Estimates for **Emailing** Across Waves



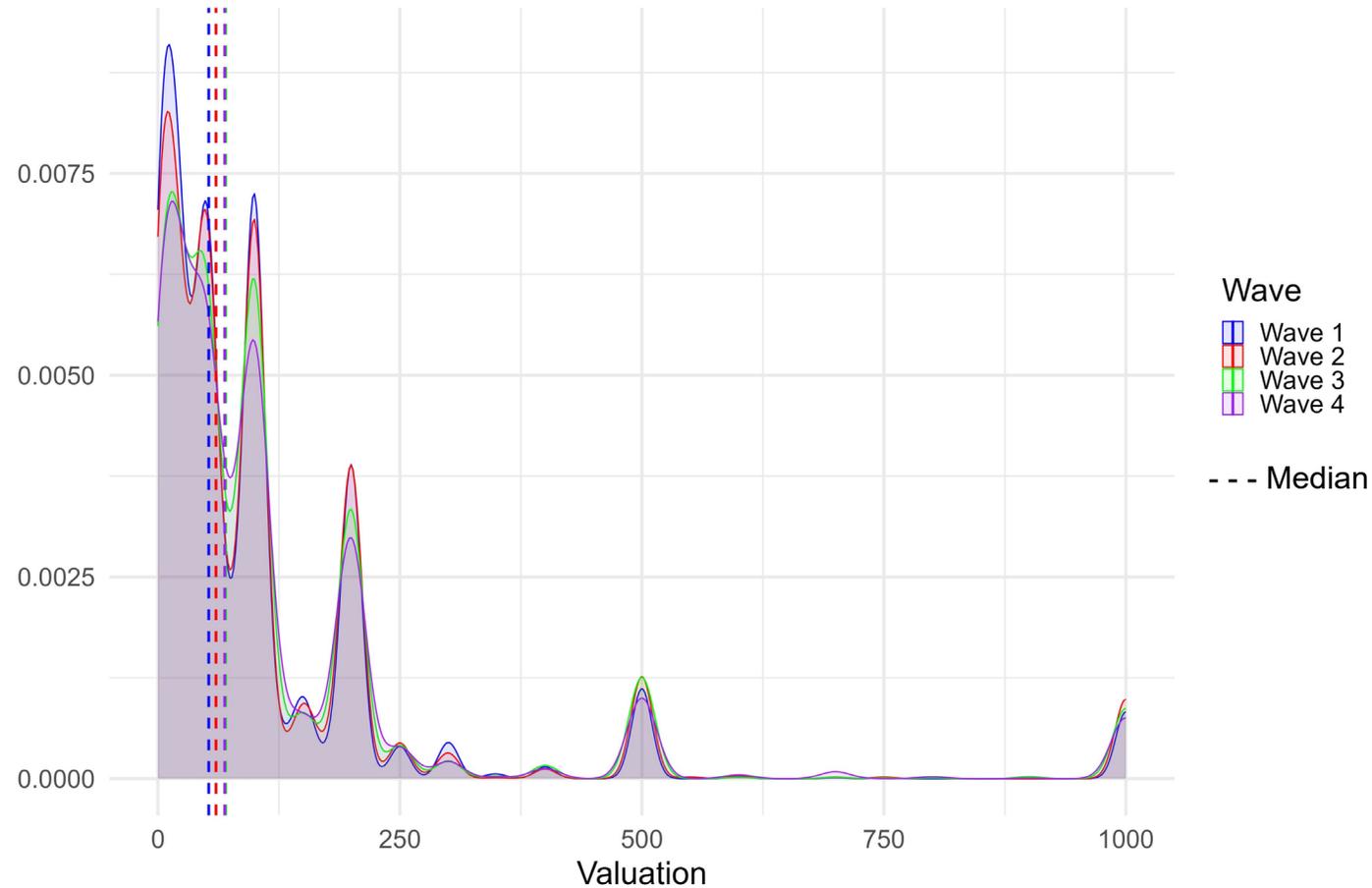
Value of digital leisure services (NPC) per person (£/month)

Kernel Density Estimates for **Social Networking** Across Waves



Value of digital leisure services (NPC) per person (£/month)

Kernel Density Estimates for **Video Calling** Across Waves



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Aggregate value of digital leisure services (£ million/Quarter)

	Wave 1 (March)	Wave 2 (June)	Wave 3 (September)	Wave 4 (December)
Instant messaging	19,365	19,343	19,337	19,312
Video calling	7,808	8,583	9,914	9,521
Emailing	6,994	6,866	6,884	7,057
Social networking	16,629	15,996	15,845	15,788
Total	50,796	50,788	51,980	51,678

Extended Measure of Activity – quarterly changes (£ million)

	Q1 (March)	Q2 (June)	Q3 (September)	Q4 (December)
Nominal GDP	629,502	636,299	645,265	653,849
Nominal EMA (GDP plus the four digital leisure services)	680,298	687,087	697,245	705,527
Percentage difference between <i>levels</i> of nominal EMA and GDP	8.07%	7.98%	8.06%	7.90%

Extended Measure of Activity (£ million/Year)

	2024
Nominal GDP	2,564,915
Nominal EMA (GDP plus the four digital leisure services)	2,770,158
Percentage difference between <i>levels</i> of nominal EMA and GDP	8.00%

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Extended Measure of Activity – real growth rates

- So far focused on changes in levels of *nominal* EMA and GDP.
- It is possible to define a unit cost index (price index) of own-produced digital leisure services between two periods (0 and 1) as:

$$P_L (u_L^1, w_L^1, \eta_L^1, u_L^0, w_L^0, \eta_L^0) = \frac{c^L(u_L^1, w_L^1, \eta_L^1)}{c^L(u_L^0, w_L^0, \eta_L^0)}$$

- Assuming the unit cost function in both periods takes a translog form, then the unit cost index can be represented as a Törnqvist index.

Extended Measure of Activity – real growth rates

- This allows us to construct an EMA Törnqvist price index, which in turn can be used to calculate real EMA estimates and their growth rates.
- We are currently working on these computations with the aim to construct similar tables in real values and provide percentage point difference between real EMA and GDP growth rates.

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Conclusions

- Practical methods for estimating the production of digital leisure services by households and their plausible inclusion in national statistics were presented.
- These methods are consistent with the national accounts' framework and allow the derivation of consistent nominal values, unit cost, and volume indexes for own account household production.
- Preliminary results suggest that the nominal value of digital leisure services corresponds to 8% of the UK nominal GDP.
- A positive effect is also expected with respect to real values and their growth rates (i.e., the growth rate of real EMA is expected to be higher than that of real GDP).

Conclusions

- While the effect on produced output is expected to be positive, the effect on measures of productivity (labour productivity and TFP) is not straight forward.
- Once real EMA estimates and their growth rates are calculated, we will also construct EMA based estimates of labour productivity and TFP to examine the effect of digital leisure services on productivity growth.