Are pandemics and stay-at-home orders economic factors? An analysis of their impact on employment and consumption in the USA

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Abstract

The objective of this paper is to analyse the impact on consumption and employment of state-level stay-at-home orders (SHO) in the USA at the state and county levels. Moreover, it answers the following research question: Can SHO have non-negative effects on consumption (heterogeneity across sectors) and some elements of employment (heterogeneity across wages and sectors)? The data contain proxy variables (high-frequency data on credit and debit card spending and job positions). This research utilises the data on the pandemic and public stay-at-home orders for all US states in 2020, applying the fixed effects (LSDV) difference-in-differences approach to answer the research question and obtain the empirical results. The overall findings indicate that the non-negative outcomes of stay-at-home orders on consumption, and some elements of employment, are possible. In addition, this research justifies the possibility of applying depersonalised high-frequency data for economic analysis. Furthermore, the empirical evidence supports the hypothesis that SHO can be an economic factor influencing both consumption and employment. Thus, certain regions can pursue independent policies to counter the pandemic and similar threats, while not fearing that such orders will necessarily affect the unemployment rate and citizens' consumption (hence, fulfilling the precautions and measures that are suggested in the present paper).

Keywords

pandemics, personal consumption, employment, USA

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Introduction

It might seem intuitive that stay-at-home orders (SHO) should decrease consumption and employment. At the same time, this intuition does not hint at whether the decrease

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in consumption or employment in the offline world can increase these parameters in the online world, nor to what extent. Can the online world diminish the negative impact of SHO to some level of insignificance, or even present positive signs? Which employees are the most vulnerable regarding SHO, in terms of wages and the employment sector? What economic branch can enjoy the most positive consumption effect of the SHO policy? To the best of our knowledge, these questions have never been investigated in the scientific literature. This research aims to answer these questions in order to achieve its primary objective (i.e. to analyse the impact of SHO on employment and consumption in the USA in 2020).

At the same time, it is unclear whether stay-at-home orders are economic factors (and what consequences one might expect). The current knowledge gap is the motivation for this research. The main research question pertains to the effect of SHO on private consumption and employment in the USA. This paper hypothesises that stay-at-home orders could have a non-negative impact on total consumption and employment for some of its main components. The study aims to analyse consumption and employment in the USA at the county and state levels, to confirm the central hypothesis, and answer the main research question.

Moreover, the recent recession shows that everything is changing rapidly in the modern world. The situation can change dramatically from a typical crisis to the necessity of lockdown measures in a mere few weeks (if not days). The old ways to gather decision-making data for implementing economic policy required one to work with macroeconomic data (Galbraith, 1998; Harrod and Hicks, 1939; Hicks, 1959; Kuznets, 1941; Lutz and Samuelson, 1961; Shell and Mishan, 1969). The low frequency of these data (semi-annual or annual) complicates the rapid decision-making process in times of acute crises (e.g. pandemics).

There are significant gaps in the current state of knowledge of most studies. The few studies that have aimed to implement high-frequency data analysis never considered SHO as an economic factor. In addition, those studies never joined different high-frequency datasets with datasets representing a substantial part of transactions on the macroeconomic level in other dimensions. For example, GDP is an aggregate measure of different economic spheres. At the same time, it has low frequency and significant limitations in the application at the subnational levels (i.e. smaller territory units). The high-frequency multidimensional indicators that are transferrable from international to subnational levels (down to the sizes of municipalities) could fill this gap, creating a basis for solid crisis management decisions.

Thus, the coronavirus pandemic is the newest form of recession. Economic regulators often apply the dynamic stochastic general equilibrium (DSGE) models to combat crises and overcome risks for the entire economy (Caraiani, 2018; Chacón, 2016; Jia, 2020; Slobodyan and Wouters, 2012). These models have become increasingly more effective. Hence, the chances of a repetition of something similar to the Great Depression have declined significantly with the development of modern tools for economic analysis (Babecký and Campos, 2011; Babecky and Havranek, 2014). However, economic mechanisms never faced pandemics (Harapan et al., 2020; Dingel and Neiman, 2020; Pullano et al., 2020). On the other hand, the welfare benefit of the macroeconomic volatility is not immense. There is a high cost of fluctuations for long-term economic growth; therefore, governments should concentrate on long-term stable growth by minimising fluctuations (Lucas, 1976; Lucas and Sargent, 1981; Banaszyk et al., 2021).

At the same time, the volatilities of consumption and employment are interconnected. For example, people who lose their jobs during times of crisis can suffer a significant

decrease in the application of their human capital and, in expecting it to last, throughout their career. Kahn (2010), for instance, finds a significant negative and stable effect of graduating from educational institutions during economic recessions. Thus, people will consume less if they do not disclose their professional skills and talents to the maximum level. Incomes will be lower in number. Therefore, consumption will be lower; in turn, this will affect business revenues and thus employment. Suppose that DSGE designers consider the pandemic and potential governmental restrictions to be economic factors. What is the significance of the effect? What is the size of the possible impact on the economy (and the direction thereof)? To the best of our knowledge, this question has never been answered in the scientific literature to date.

There is another negative shock which is associated with a recession: it changes personal preferences and the ways people work and consume. For example, there is a high probability that Americans who grew up in times of economic crises will value redistribution more than people who grew up in stable times (Giuliano and Spilimbergo, 2014). A recession also decreases the level of trust between individuals in the society (Ananyev and Guriev, 2019), which can lead to difficulties in finding jobs (i.e. employers will trust potential new employees less) and consequently consumption (the fewer people there are who work, the less they will earn and, therefore, the less they will consume).

The final part of this introduction discusses the structure of the paper. The next part explains the theoretical framework and hypothesis development by exploring the current economic concept, and developing the idea of the study. The next chapter is on the methodology. The first part of that chapter explores the data sources and explains the final merged dataset. It introduces the concept of analysis, based on high-frequency data, and analyses the primary empirical approach. The following chapter is about results and discussion. The first section discloses the empirical identification strategy in terms of the actual data. It then goes on to reveal the overall scheme of the influence of the SHO policies on consumption and employment. After that, it discloses the heterogeneity across sectors and wages by means of regression analysis. Finally, it discusses the economic transmission mechanism results. This section utilises a significant number of sources for discussion. The final component is the conclusion that summarises the paper.

1. Theoretical framework

The first papers on data-driven decision-making in macroeconomic policy were published in 1941 (Kuznets, 1941; Smith, 1942). The US government has conducted regular polls to identify behavioural patterns in households and businesss. At the same time, researchers apply macroeconomic data as the classical data sources (such as GNP, GDP, exchange rates, deflators, population, and many others) (Kitrar and Lipkind, 2021). These are potent tools for understanding critical processes among national economies (Krugman and Wells, 2018). At the same time, these indicators do not allow one to descend to the regional or local level. The number of observations and variables at the regional and local level is minimal, making almost any research biased. Therefore, researchers are obliged to return to macroeconomic indicators.

Moreover, macroeconomic data have a low frequency. Official agencies publish these data once a year, or two, three, or four times a year (Feenstra et al., 2021; International Monetary Fund, 2022; World Bank, 2022). Rare indicators are published more often. Even the most frequent variables often cannot replace significant indicators. For example, the industrial production index has a monthly or quarterly frequency. Researchers often estimate it as a proxy vari-

able for the level of GRP or GDP (published annually and quarterly). Simultaneously, production is becoming a minor and limited meaningful element of GDP for developed economies. Consequently, this variable becomes a less effective tool for describing the progression of GDP and GNP. The Consumer Expenditure Survey (CEX) has the best data on household consumption expenditure in the US, and it is published semi-annually (Panel on Redesigning the BLS Consumer Expenditure Surveys et al., 2013). Thus, macroeconomic data have low frequency and few observations at the regional level. Consequently, the implications of such indicators impose significant restrictions on the quantitative analysis of microeconomic or regional policies, especially in the context of instability; for example, a pandemic (Chetty et al., 2020).

Consumption is an integral part of the economy. An essential component of consumption in determining household expenditures is private consumption expenditure (Carrier and Heyman, 1997; Firat and Dholakia, 2003; Keynes, 1936). It is also possible to decide on the range of firms that operate in a particular region (Ershova, 2017). Other participants in economic relations are the regional and federal authorities, as well as their operations (Ross and Campbell, 2008; Stiglitz, 2005), the processes of financial and banking establishments (Léon and Zins, 2020; Shemetev, 2012; Sun et al., 2013), financial markets (Fama et al., 2017; Murphy, 1999), and households. Thus, it is clear that households are an essential component of the national and regional economic systems. By 'household', we mean a group of people who live together and share their income and expenses.

Households determine their activities based on their funds (Williamson, 2018). Families may obtain remuneration through regular work activities and the use of capital that they own (M. Doepke et al., 1999; Doepke and Zilibotti, 2019). They may sometimes receive some endowments and gifts (for example, inheritance, lottery winnings, and the discovery of valuables).

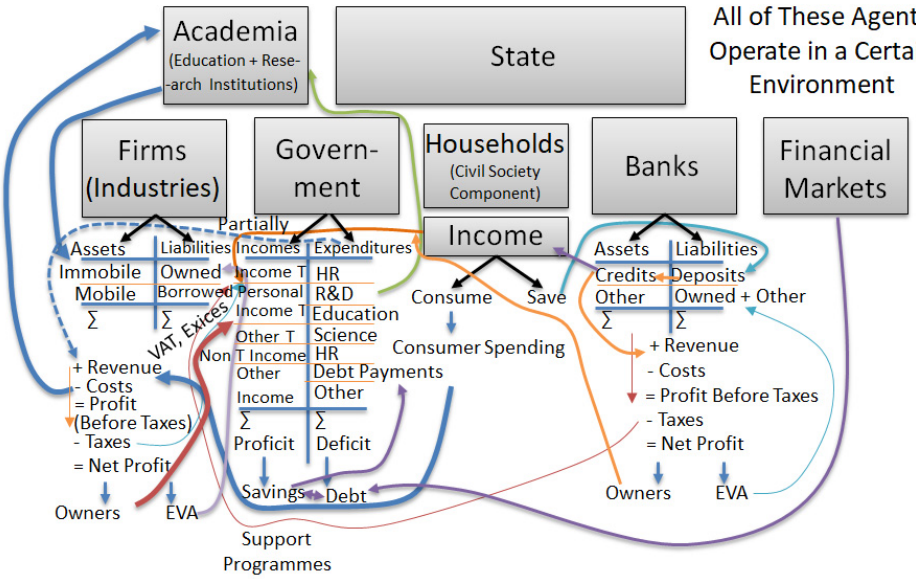
Households can either save or spend funds (Perloff, 2014). When families choose to keep their money, people choose between just two approaches: keeping their income(s) in cash or depositing everything into their bank accounts. If some households prefer to spend money, their spending becomes an indicator of their consumer spending. The aforementioned study implies that consumer spending would be the entire sum(s) paid for individual usage or satisfaction which maximises their utility. Consumer spending persists at regional (Carruth and Henley, 1993) and national (Huntington, 1993; Levitt, 1983a, 1983b) levels. The present study recommends consumer spending as a proxy for estimating the well-being of the market ecosystem in a specific region or country.

Moreover, the following scheme explains certain B2B deals. Enterprises resell goods to each other (and partially modify them) in order to ultimately sell them to the final consumer. An enterprise receives goods, works, and services from another enterprise to cover its needs. Subsequently, it resells its goods, works and services to the end consumer, or to another enterprise (which, in turn, can resell these goods, works, and services to the end consumer). The potential opportunity for future reselling is the primary motivation for many enterprises to purchase goods and services. Therefore, consumer spending can represent a specific indicator of the health of a business through sectors of the economy (Douglas and Isherwood, 1996).

At the same time, it is essential to estimate the interrelation of consumption and employment in the general economic transmission mechanism during a pandemic. Growth in consumer spending is a crucial driver of business revenue growth. A company does not need to create and assemble more products if no one buys them. Consumer spending also reflects the ability of households to pur-

chase products from companies. A decline in this indicator correlates with a slowdown in the business activity of enterprises. Revenue is the nominator of ratios for measuring business activity (Altman, 1968; Brealey et al., 2020; Lee and Faff, 2009). The decline in business activity means the enterprise does not need many workers. As a result, unemployment begins to rise. Enterprises do not need to buy many person-hours of labour. Therefore, there is no need to attract an additional workforce. Hence, the unemployment rate is related to the level of personal consumption through transmission mechanisms (Figure 1 and Figure 9). The banking sector will also have to react to such changes.

Figure 1. The theoretical model of the roles of consumption and employment in terms of the quintuple helix



Source: own elaboration based on the quintuple helix concept of Carayannis et al. (2012) and Carayannis and Campbell (2010)

In addition, the government is dependent on consumer spending. The transmission mechanisms determine this dependence (Nissanke and Thorbecke, 2007). The fewer unemployed people there are in the economy, and the more earnings households have, the more income tax there will be (Goerke, 2002). Thus, the higher the revenues collected, the more funds the regional or federal budget will have. This means that an increase in earnings raises consumer spending, but this is partly subjected to per-unit (indirect) taxes. However, taxes will boost government funding for different programmes.

Moreover, consumer spending turns into revenue for some businesses (Berk and DeMarzo, 2019; Damodaran, 2014). People stimulate business revenues (and thus profit before taxes) when they increase their consumer spending. In turn, they increase the amount of taxes which companies pay to the government from their incomes. This is an essential source of the national, regional, and local budgets. A decline in consumer spending decreases business revenues and corporate income tax amounts; therefore, governments and firms will have less funds with which to pay salaries.

Consumer spending is thus crucial to the national economy (Shemetev and Pelucha, 2021). Consumer expenditures spur business profit in various areas of the economy, and consumer spending increase the tax revenues of the regional and federal governments. A government can fund academies [research and education institutions] more from higher tax incomes. Firms' incentives to support the academy depend on the potential sales from such interaction. Thus, in many cases, the importance of consumer spending that is attributable to a specific industry and company determines the financing of the academy. Each participant in the named scheme (Figure 1) can hire a member of his or her household. Members of households can work in academies, government, firms, financial markets, banks, and they may also be self-employed. Higher family income leads to higher potential for spending.

2. Methodology

2.1. Sample and data collection sources

This research draws upon several databases, such as Google Databases (Google, 2020c, 2020a, 2020b), US Bureau of Economic Analysis data (US Bureau of Economic Analysis, 2020a), the WHO Database on COVID Disease (World Health Organization, 2020), The Opportunity Insights Project by Harvard University (The Opportunity Insights, 2020), US Regional Economic Accounts (US Bureau of Economic Analysis, 2020b), Our World in Data (Our World in Data, 2020), the FRED database on PCE (Federal Reserve Bank of St. Louis, 2020), Paychex (Paychex, 2020), Earnin (Earnin, 2020), Intuit (Intuit, 2020), Kronos (Kronos, 2020), Worldometer (Worldometer, 2020) and other datasets affiliated with Johns Hopkins University (Johns Hopkins University, 2020), Bill and Melinda Gates Foundation projects (Bill and Melinda Gates Foundation, 2020), and Affinity Solutions (Affinity Solutions, 2020).

2.2. Data description

There is no unified database for this research. As such, this study combines data from credit card processors, financial service companies, and payroll firms on employment and consumer spending. Analysts would benefit from working with original raw data, but such information is unavailable for privacy reasons; hence the merging of several depersonalised datasets in this research.

The resulting dataset has 15,708 observations with 109 variables (at state level). Several (2224) observations are missing for the indicators of the COVID-19 statistics. Thus, 13,484 observations [15,708 – 2,224] describe the situation concerning consumption within the treatment period. We suggest omitting the observations with the missing values. Only 154 missing values expressed a period with at least one person in a state suffering from COVID-19. The pre-pandemic periods differ from those during the pandemic.

This research applies the R programming language for merging the datasets and statistical analysis. The main variables describe employment, the coronavirus disease, and spending (frequency: average-daily); the additional variables describe the anti-pandemic measures taken by the US government. The period of analysis began on 21 January 2020 and ended on 29 November 2020. The data for five days are missing (23–28 November 2020). The overall number of observations is 308 per US state (or 13,484 for the entire dataset [51 * 308 – 2224]). The additional dataset contains 3143 observations (111 variables) per period for all US counties.

Unfortunately, there are some additional missing values for employment (21 January 2020 – 30 September 2020), and the data on unemployment are heterogeneous (wage and sectors); thus, the resulting dataset on employment contains 12,954 observations [254 * 51] with some missing values. The unavailable data for the COVID-19 statistics decrease the number of observations further: 12,954 – 2,224 = 10,730 observations.

2.3. Discussion on the potential applicability of the high-frequency data

Consumer spending has a relatively low frequency. This research utilises consumer spending (payment by plastic cards) as a reliable proxy variable for the actual value of consumer spending. The potential crisis management strategies can apply similar proxies to estimate a situation with a high frequency (within one to three weeks after the shock).

2.4. The empirical approach

The database contains panel data. The following model assesses the effect of stay-at-home orders (1):

$$\mathbf{Y_{it} = \mu1*If\ After\ Treatment_{it}*If\ Treated_i + \mu2*If\ After\ Treatment_{it} + s_i*\ U.S.\ State\ D_i + \mu3*\ COVID\ Death\ Rate_{it} + \mu4*\ If\ Treated_i\ *COVID\ Death\ Rate_{it} + \xi_{it}}$$

Notes: Y_{it} is either consumer spending per capita or employment rate;
i is a specific state (or county); t is a specific time (day);
If After Treatment$_{it}$ – dummy variable (1 if a period is after the treatment; 0 otherwise);
If Treated$_i$ – dummy variable (1 if a state has ever been SHO-treated; 0 otherwise);
COVID Death Rate$_{it}$ = COVID-19 death rate per 100 000$_{it}$/New COVID-19 cases per 100 000$_{it}$;
US State Di – state fixed effects in the LSDV-approach;
ξ_{it} – residual term.

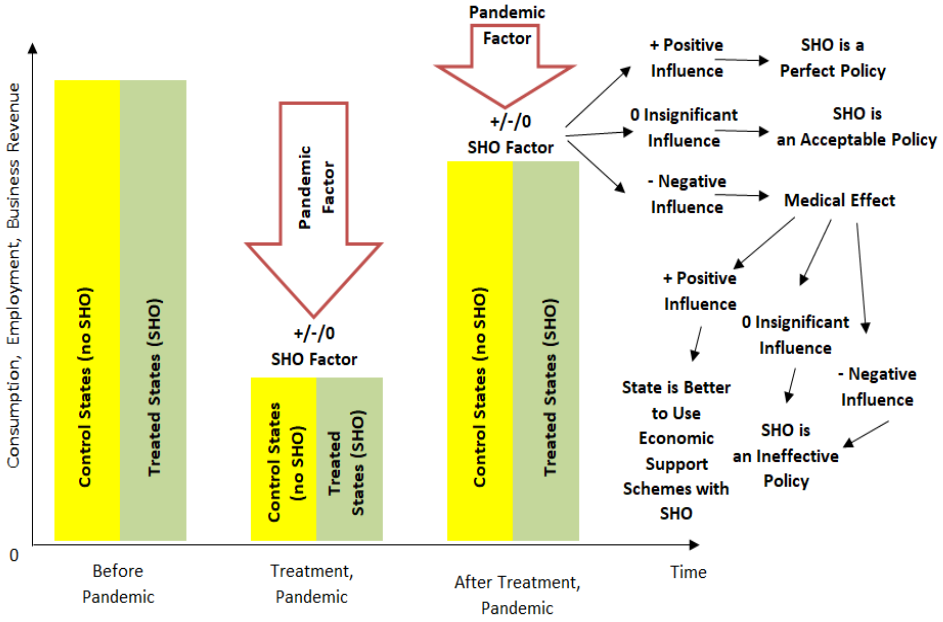
The principal methodology is the fixed-effects DiD (difference-in-difference) approach (Card and Krueger, 1994; Leite, 2017; Yee, 2015). The core assumptions are: relatively low heteroscedasticity among the states; random treatment (proof of which comes in the fact that, in comparing the search for COVID-19 on Google across different states and treatments, no distinct geospatial pattern was found).

3. Results and Discussion

3.1. Assessment of the identification strategy in the framework of the potential outcomes

The methodology section explains the core approach. The results of this study suggest that SHO-treated and control states revealed different patterns. Moreover, the treatment start, end, and duration periods are comparable. The treatment period was from mid- to late spring until the beginning of summer. This allows for the implementation of the DiD identification strategy (Figure 2).

Figure 2. The potential impacts of the SHO treatment on the dependent variable



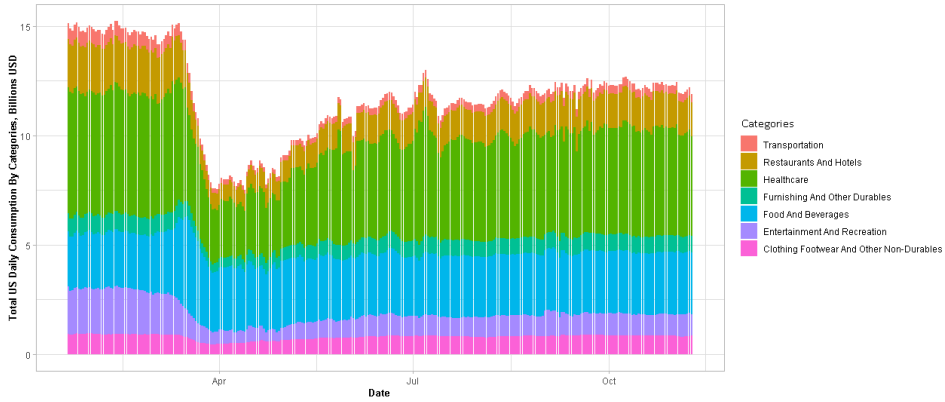
Source: own elaboration based on the visualisation of the potential outcomes

Figure 2 shows that the pandemic decreased the level of consumption in both the treated and control groups of states. The statistical identification strategy (DiD) should reveal the differences between the treated and control groups (the green and yellow columns in Figure 2, respectively). There is no necessity in the propensity score matching technique or regression discontinuity design, because of the almost perfect actual matching of the treatment period among the different US states in reality. In addition, the following sections mention our previous research, which proves the randomness of treatment based on people's fear of the pandemic by way of Internet searches in different US states (Shemetev and Pelucha, 2021). The right-hand part of Figure 2 represents the set of potential outcomes.

3.2. Assessment of the SHO treatment and consumer spending

The first step is the graphical representation of the overall pattern (Figure 3). Some normalisation of consumption is visible in this chart.

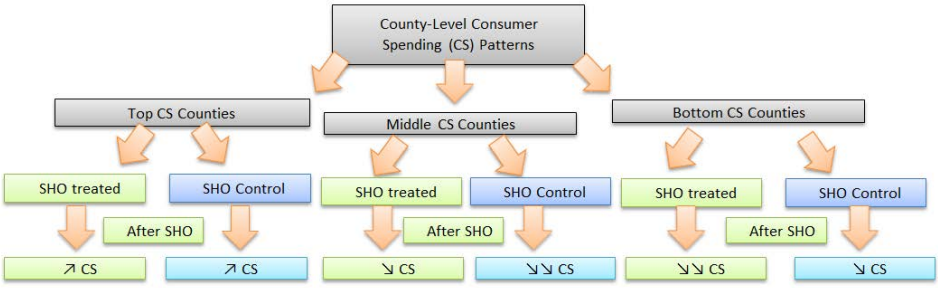
Figure 3. The US daily total consumer spending pattern, USD per capita (PC) (21 January – 11 November 2020)



Source: own elaboration based on the merged dataset reproduced in levels

Figure 3 reveals the overall effect of the pandemic on consumption in levels. Panic buying of food caused a rapid jump in overall consumption. The continued pandemic corresponded with a decline in consumer spending in both SHO-treated and control groups of states, which resulted in a plateau (the general level of this plateau is below the original pre-pandemic consumption pattern). Figure 4 represents the differences between the treated and control groups of states.

Figure 4. Measurement model for consumption in the counties in the SHO-treated and control groups



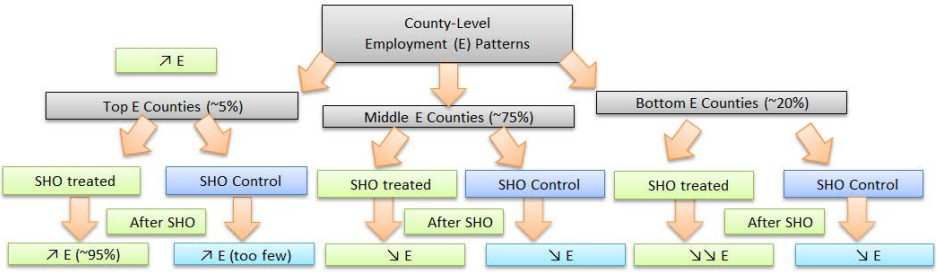
Source: own elaboration based on the visualisation of the data patterns

Further regression analysis reveals the consumer spending patterns (Figure 4) more clearly. Figure 4 represents the heterogeneity of the overall consumption pattern in terms of an increase or decrease, separating all of the US territory units by way of the overall per capita consumption levels.

3.3. SHO treatment and employment

This research estimates employment through trends rather than levels. Suppose that the employment rate had been 100% in January 2020 (before the pandemic); it would, therefore, be possible to evaluate the effect of the pandemic on unemployment.

Figure 5. Measurement model for employment (E) in the counties by way of SHO treatment



Source: own elaboration based on the visualisation of the data patterns

The value of Pearson's correlation coefficient is 0.54 (p-value 0.000), which reveals a significant correlation between the employment rate and personal consumer spending. An enquiry into whether or not this correlation is spurious is beyond the scope of this research. However, this could become a topic for future studies in this field.

This study creates a category (see Figure 5) for the states that increased employment after treatment. Their pattern diverts away from the typical US pattern; further study should clarify this issue.

3.4. SHO treatment and consumer spending with heterogeneity across sectors

The USA has many economic sectors, and different pandemic stages have affected some sectors differently, suggesting via this research that a negative effect on total consumer spending was generated. Meanwhile, there is no satisfactory evidence to blame SHO for worsening the situation even more.

Figure 6. SHO treatment and consumer spending with heterogeneity across sectors, fixed effects DID

	Dependent variable:			
	Total_CS	Healthcare	Food&Bever.	Hotels&Rest
	(1)	(2)	(3)	(4)
if_after_treatment_period	0.090***	0.112***	-0.105***	0.131***
	(0.004)	(0.009)	(0.005)	(0.006)
IfAfterTreatmentPeriodXIfTreated	0.018***	0.059***	0.006	-0.006
	(0.004)	(0.010)	(0.005)	(0.006)
COVID_DeathRate	-0.450***	-0.423	-0.535***	-1.478***
	(0.111)	(0.294)	(0.158)	(0.184)
COVIDDeathRateXIfTreated	-0.262**	-1.102***	-0.174	-0.097
	(0.114)	(0.301)	(0.162)	(0.189)
Observations	13,484	13,484	13,484	13,484
R2	0.381	0.196	0.158	0.311
Adjusted R2	0.378	0.193	0.155	0.308
F Statistic (df = 4; 13429)	2,063.289***	820.480***	630.403***	1,516.885***
Note:				*p<0.1; **p<0.05; ***p<0.01

Source: own elaboration in the programming language R

Additional notes: "Healthcare" is personal consumer spending on medicine (healthcare); "HotelsandRest" is expenditure on accommodation and food services; "Total_CS" is overall spending; and "FoodandBever" is expenditure on nutrition and beverages. This research suggests that the SHO treatment produced a non-negative effect on total consumption and some of its main components.

Interpretation of the DiD regression on trends has inherent complications. The primary approach here is imagining cents per USD, if the level of the specific component was around 100 USD per capita per day. For example, the total consumer spending in the US was actually around 100 USD per day. Thus, the treatment effect is +1.8 USD per capita per day for treated and non-treated states. The same interpretation would be fair for healthcare. For example, if the consumption level is around 100 USD, then the treatment would be about 6 USD. The actual level was approximately 17 USD per capita per day for this parameter. Thus, the treatment effect would be 17 * 6 / 100 = 1.02. Regressions on trends can be beneficial in terms of data privacy. Thus, pure additional mechanical calculations add a significant share to data privacy and, thus, reduce the transaction costs of obtaining and sharing such data.

3.5. SHO treatment and employment with heterogeneity across wages and sectors

The main income classification principle for the US job market in this research is that some people receive high wages, while the salaries of others can be relatively low. Low-wage employees earn below $27,000 per annum, high-wage employees receive above $60,000 per annum, and other employees constitute the middle class ($27,000 - $60,000).

Figure 7. Employment and SHO treatment with heterogeneity across wages, FE DID

	Dependent variable:			
	Total Employment (1)	Low-Wages Employment (2)	Middle-Wages Employment (3)	High-Wages Employment (4)
if_after_treatment_period	0.033***	0.060***	0.023***	0.023***
	(0.003)	(0.004)	(0.003)	(0.002)
IfAfterTreatmentPeriodXIfTreated	0.004	-0.052***	0.019***	0.031***
	(0.003)	(0.005)	(0.003)	(0.002)
COVID_DeathRate	-1.037***	-2.061***	-0.713***	-0.497***
	(0.085)	(0.132)	(0.085)	(0.081)
COVIDDeathRateXIfTreated	-0.062	0.369***	-0.387***	0.016
	(0.087)	(0.136)	(0.087)	(0.082)
Observations	10,730	10,730	10,730	9,909
R2	0.346	0.274	0.352	0.434
Adjusted R2	0.342	0.271	0.349	0.432
F Statistic	1,410.192*** (df = 4; 10675)	1,008.314*** (df = 4; 10675)	1,448.696*** (df = 4; 10675)	1,893.026*** (df = 4; 9858)
Note:				*p<0.1; **p<0.05; ***p<0.01

Source: own elaboration in the programming language R

SHO had a dual effect on US employment in 2020. On the one hand, they significantly and negatively affected low-wage employees; on the other, they positively favoured medium- and high-wage employees. Suppose that low-wage employees have a lower likelihood of finding work in states with SHO; they will then have to consume even less in these states. Therefore, the Engel curve theory has an effect in this case.

The medium-wage employees enjoyed an additional +1.9% employment level for the

states that implemented the SHO treatment (compared to the territories that did not enforce this treatment). The same parameter for the high-wage employees is +3.1%. This study assumes that more high-skilled and fewer low-skilled workers are required during the lockdown period. For example, the opportunity to sell online requires high-skilled employees (ideally, good web developers and Internet marketing specialists) to obtain a competitive advantage. At the same time, other factors (such as the better position of stores) influence success in offline trade, providing opportunities to save money on the cost of the labour force by employing lower-skilled workers (for example, salespeople in stores as opposed to expensive IT specialists). Thus, low-wage employees proved to be the most vulnerable (when ordered to stay at home). It makes sense to subsidise these workers when issuing orders to remain at home, in order to help them support their consumer spending. Another potential solution would be to provide these workers with tax deductions and bonuses at the state level, federal level, and individual county level.

This study analysed the impact of stay-at-home orders, while considering heterogeneity in the employment sector.

Figure 8. SHO treatment and employment with heterogeneity among s-sectors, fixed effects DID

	Dependent variable:			
	NAICS supersector 40 trade, transp. and utilities	NAICS supersector 60 prof.& business services	NAICS supersector 65 education&health services	NAICS supersector 70 leisure and hospitality
	(1)	(2)	(3)	(4)
if_after_treatment_period	-0.003	0.039***	0.054***	0.113***
	(0.003)	(0.003)	(0.004)	(0.007)
IfAfterTreatmentPeriodXIfTreated	0.039***	-0.017***	-0.014***	-0.033***
	(0.003)	(0.003)	(0.004)	(0.007)
COVID_DeathRate	-0.971***	-1.128***	-1.503***	-2.368***
	(0.092)	(0.095)	(0.125)	(0.202)
COVIDDeathRateXIfTreated	-0.029	0.379***	0.398***	-0.058
	(0.094)	(0.097)	(0.127)	(0.207)
Observations	10,525	10,730	10,321	10,526
R2	0.341	0.170	0.297	0.343
Adjusted R2	0.338	0.166	0.294	0.340
F Statistic	1,355.622*** (df = 4; 10471)	547.827*** (df = 4; 10675)	1,085.013*** (df = 4; 10268)	1,367.153*** (df = 4; 10472)
Note:				*p<0.1; **p<0.05; ***p<0.01

Source: own elaboration in the programming language R

The trade, transportation, and utility sectors increased the level of employment in the treated states. This sector benefitted from an additional +3.9% for the territories that implemented stay-at-home orders compared to those that did not implement such strict lockdown measures. People tend to buy more online and consume more utilities while spending more time at home (as in, being unable to leave their homes to engage in other activities). Our previous research confirms these results (Shemetev and Pelucha, 2021), and concluded that the pattern of fear did not correlate with the treatment pattern; thus, the treatment was random and the DiD methodology conditions are fulfilled. Therefore, our research concludes that online trade (and, partially, consumption) is the main factor in boosting employment in some sectors. The engagement in other sectors fell significant-

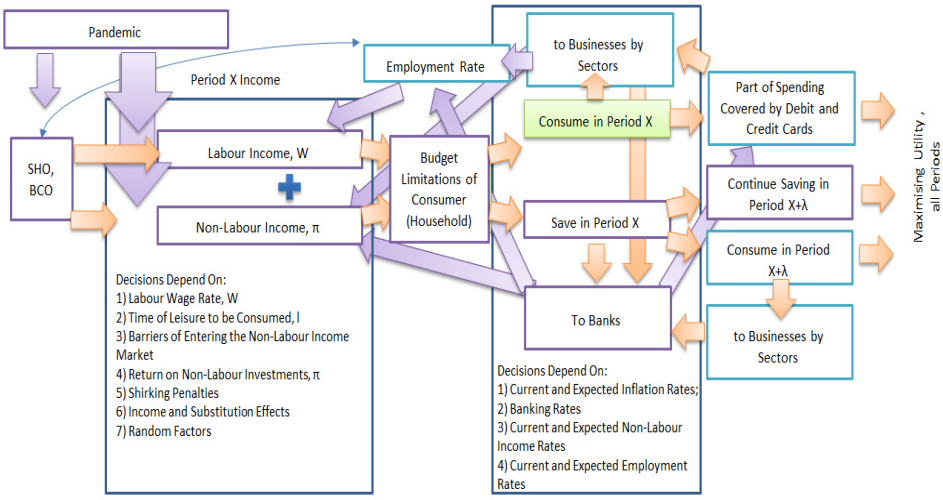
ly in the treated states. For example, stay-at-home orders decreased the number of people employed by 1.7% in the professional and business services, by 1.4% for education and health services, and by 3.3% for leisure and hospitality for the treated states compared to the territories that did not adopt such strict lockdown policies.

3.6. Discussion in the framework of the economic transmission mechanisms

A decrease in income should decrease the consumer spending of households (Engel's curve) (Jackson, 1984; Lewbel and Pendakur, 2008; Li, 2019; Seale et al., 2012; Trigg, 2004), which comes from the logic of economic theory (Krugman and Wells, 2018; Perloff, 2014; Phelps, 1990; Williamson, 2018). Households can receive either labour income (W) or other income (π) (Doepke et al., 1999). Labour income is rooted in participation in the labour force (Perloff, 2014; Williamson, 2018). A higher unemployment rate decreases the possibilities for earning money for an average household, thereby decreasing consumer spending (Doepke and Zilibotti, 2019; Ganong and Noel, 2016). Families in need can increase the frequency of withdrawals of funds from commercial banks, thus increasing the risks for banks (potential insufficiency of liquid funds] and these families (high probability of living in times with high levels of instability in the banking sector). At the same time, the current state of knowledge omits stay-at-home orders (lockdown policies) during the pandemic as an economic factor.

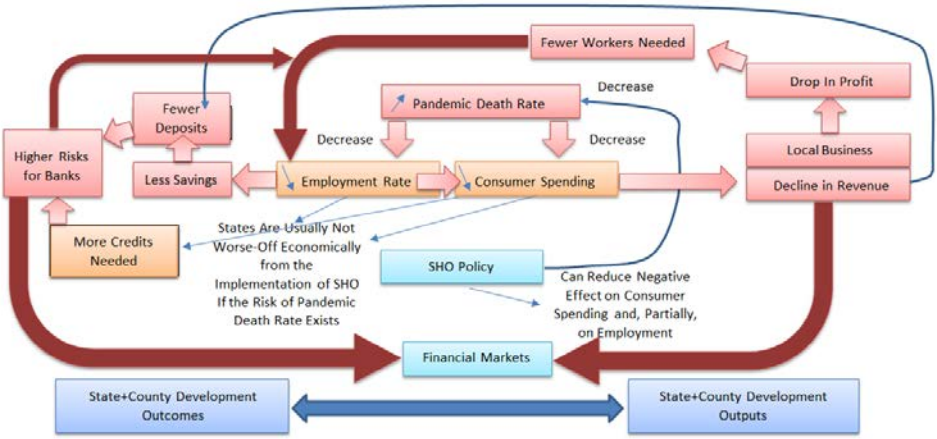
This study cannot neglect the hypothesis that SHO are a factor which influences the economic transmission mechanisms, partially through personal consumer spending. Some economic categories (such as footwear, clothing, furnishing, and durable household equipment) are more vulnerable. IT technologies may stimulate consumer spending during periods of SHO.

Figure 9. The proposed macroeconomic model for estimating the role of consumer spending, employment, and SHO



Source: own elaboration based on the Ri of consumer decisions

Figure 10. The proposed economic chain mechanism of the SHO treatment



Source: own elaboration based on merging the economic logic of the consumer decisions and the data patterns from the pandemic in the USA in 2020

This research applies the DID approach to estimate the pure treatment effect. Results suggest that the SHO treatment produced a statistically significant positive impact on total consumer spending and some of its components. We hope that these results may be of interest to researchers and public policymakers when there is a need to implement the SHO treatment during a pandemic. This research assumed that the SHO treatment could produce non-negative effects on total consumer spending and its main components. Nevertheless, it did affect employment for low-wage employees and some sectors of the economy. This research confirms this part of our hypothesis.

Conclusions

The logic of economic theory suggests that SHO should produce a negative effect on both consumption and employment. However, stay-at-home orders positively affected general consumer spending and healthcare, and caused a non-negative impact on expenditures on food and beverages, and certain other sectors of the economy. The pandemic affected these sectors, but the stay-at-home orders did not produce a statistically significant additional decline. Thus, pandemics and SHO are factors in consumer spending.

In addition, SHO had an insignificant effect on total employment. However, SHO did have a significant adverse impact on work for low-wage employees. The states that implemented the SHO policy faced a decrease in employment by 5% (on average). Low-wage employees are the most vulnerable part of the employment pattern.

Moreover, the trade, transportation, and utility sector is the only sector that had a greater number of employees in the treated states. The level of engagement in other sectors fell significantly in the treated states (professional business services, education, health services, leisure, and hospitality). Therefore, pandemics and SHO are factors in employment.

The theoretical contribution of this study is, firstly, the confirmation of the possibility of implementing high-frequency microdata to analyse macroeconomic indicators through proxy variables. The second theoretical result confirms that pandemics and stay-at-home orders can be economic factors which can affect both consumption and employment at national and other levels

(it is not a given that this effect should be negative). It is a contribution to the current body of knowledge.

Thus, analysts should include this factor in crisis management models during pandemics when implementing their models, including DSGE. In addition, the measures to support the most vulnerable participants of economic interactions can be more precise when considering the heterogeneity across sectors of consumption and employment. An additional source of heterogeneity is wages. This research also investigates this heterogeneity.

The coronavirus pandemic has been one of the biggest tragedies the world has seen in recent decades (Harapan et al., 2020). Governments had to choose between freedom of movement and the high risks of a pandemic, or restrictions on activity and threats to businesses and employment (Dingel and Neiman, 2020; Pullano et al., 2020). This paper analyses the state-level stay-at-home-orders (SHO) in terms of employment and consumption in the different states of the USA. The takeaways are: 1) the higher the level of consumption, the better it is for each particular business, and 2) the higher the level of employment, the easier it is for people to consume, thus providing companies with revenues.

A limitation of this research is that it analyses the first wave of the pandemic in a developed and federative country, namely, the USA. This research does not reveal how different the results would be for other types of territory organisation; this could be the topic of future research in this area. At the same time, similar studies could improve our understanding of the economic effects of the counter-pandemic measures in future scenarios. The effect provided in this research is not, for instance, due to the transmission mechanisms. Future research could focus on other counter-pandemic actions, and their effects on the economy.

The additional managerial implications can improve the potential crisis management plans of corporations in times of future pandemic crises. This research provides the first clues to what would make industries more or less vulnerable during pandemics, and what would be the potential side effects (in terms of trends and money). At the same time, the estimation of this effect is fair and reasonable for the COVID-19 pandemics in the USA in 2020 (the so-called first wave), but it could be different in other situations.

Further, it would be better to have at least some understanding of the size and influence of the effect, rather than no understanding at all. This research can provide, at least, the initial overview of the potential outcomes of consumer spending (equal to company income from consumers) and employment, with heterogeneity across wages and sectors.

The additional practical significance of the results of this study is that it provides confirmation that certain regions can pursue independent policies, with which to counter the pandemic and similar threats by means of SHO orders. There is, to date, insufficient proof that such a policy can significantly severely impact total consumer spending and employment (in addition to the pandemic impact factor).

Further research will include providing similar analysis worldwide, to create a potential economic mechanism that could counter a potential future pandemic, based on high-frequency microeconomic data, that are significant at the macroeconomic level. It will complete the economic model based on similar indicators at all economic levels (national, regional, and local). Then, the DSGE and other economic regulative models will become significantly better tools, with which to prevent the negative consequences of heavy shocks (such as pandemics). It will surely improve the lives of ordinary people, because the quality of consumption and employment of every person on the planet depends upon a stable and solid economy, that is capable of easily withstanding potential shocks.

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References

Affinity Solutions (2020), Data for good, retrieved from: https://www.affinity.solutions/dataforgood (accessed 16 April 2022).

Altman, E. I. (1968), Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy, The Journal of Finance, 23(4), 589-609. https://doi.org/10.2307/2978933

Ananyev, M., Guriev, S. (2019), Effect of Income on Trust: Evidence from the 2009 Economic Crisis in Russia, The Economic Journal, 129(619), 1082–1118. https://doi.org/10.1111/ECOJ.12612

Babecký, J., Campos, N. F. (2011), Does reform work? An econometric survey of the reform-growth puzzle, Journal of Comparative Economics, 39(1), 140-158. https://doi.org/10.1016/j.jce.2010.11.001

Babecky, J., Havranek, T. (2014), Structural reforms and growth in transition, Economics of Transition, 22(1), 13-42. https://doi.org/10.1111/ecot.12029

Banaszyk, P., Deszczyński, P., Gorynia, M., Malaga, K. (2021), The Covid-19 pandemic as a potential change agent for selected economic concepts, Entrepreneurial Business and Economics Review, 9(4), 35-50. https://doi.org/10.15678/EBER.2021.090403

Berk, J. B., DeMarzo, P. M. (2019), Corporate Finance, New York: Pearson.

Bill and Melinda Gates Foundation (2020), Nonprofit Fighting Poverty, Disease, and Inequity around the World, retrieved from: https://www.gatesfoundation.org/ (accessed 23 August 2022).

Galbraith, J.K. (1998), The Affluent Society. New York: Mariner Books. https://doi.org/10.2307/1925471

Brealey, R., Myers, S., Allen, F. (2020), Principles of Corporate Finance. New York: McGraw-Hill Education.

Caraiani, P. (2018), Introduction to Quantitative Macroeconomics with Julia: State-Of-The-Art Dynamic Stochastic General Equilibrium Models. New York: Academic Press, Inc.

Carayannis, E. G., Barth, T. D., Campbell, D. F. (2012), The Quintuple Helix innovation model: global warming as a challenge and driver for innovation, Journal of Innovation and Entrepreneurship, 1(2), 1-12. https://doi.org/10.1186/2192-5372-1-2

Carayannis, E. G., Campbell, D. F. J. (2010), Triple Helix, Quadruple Helix and Quintuple Helix and How Do Knowledge, Innovation and the Environment Relate to Each Other?, International Journal of Social Ecology and Sustainable Development, 1(1), 41-69. https://doi.org/10.4018/jsesd.2010010105

Card, D., Krueger, A. B. (1994), Minimum wages and employment: A case study of the fast-food industry in New Jersey and Pennsylvania, American Economic Review, 84(4), 772-793. https://doi.org/10.2307/2118030

Carrier, J. G., Heyman, J. M. (1997), Consumption and Political Economy, The Journal of the Royal Anthropological Institute, 3(2), 355-373. https://doi.org/10.2307/3035024

Carruth, A., Henley, A. (1993), Housing Assets and Consumer Spending: A Regional Analysis, Regional Studies, 27(7), 611-621. https://doi.org/10.1080/00343409312331347805

Chacón, J. L. T. (2016), Introduction to Dynamic Macroeconomic General Equilibrium Models. New York: Vernon Press.

Chetty, R., Friedman, J. N., Hendren, N., Stephner, M. (2020), How Did COVID-19 and Stabilization Policies Affect Spending and Employment? A New Real-Time Economic Tracker Based on Private Sector Data, National Bureau of Economic Research (unpublished working paper).

Damodaran, A. (2014), Applied Corporate Finance. New York: John Wiley & Sons,

Dingel, J. I., Neiman, B. (2020), How many jobs can be done at home?, Journal of Public Economics, 189, 1-8. https://doi.org/10.1016/j.jpubeco.2020.104235

Doepke, M., Lehnert, A., Sellgren, A. (1999), Macroeconomics, Chicago: University of Chicago.

Doepke, M., Zilibotti, F. (2019), Love, Money, and Parenting: How Economics Explains the Way We Raise Our Kids, Princeton: Princeton University Press.

Douglas, M., Isherwood, B. (1996), The World of Goods: Towards an Anthropology of Consumption, New York: Routledge.

Earnin (2020), Employment data, retrieved from: https://www.earnin.com/ (accessed 16 April 2022).

Ershova, N. (2017), Investment climate in Russia and challenges for foreign business: The case of Japanese companies, Journal of Eurasian Studies, 8, 151-160. https://doi.org/10.1016/j.euras.2017.03.001

Fama, E. F., Cochrane, J. H., Moskowit, T. J. (2017), The Fama Portfolio: Selected Papers of Eugene F. Fama. Chicago: University of Chicago Press.

Federal Reserve Bank of St. Louis (2020), Personal Consumption Expenditures by State, retrieved from: https://fred.stlouisfed.org/release?rid=391 (accessed 16 April 2022).

Feenstra, R., Inklaar, R., Timmer, M. (2021), Penn World Table version 10.0, retrieved from: https://www.rug.nl/ggdc/productivity/pwt/?lang=en (accessed 16 April 2022).

Firat, A. F., Dholakia, N. (2003), Consuming people: From Political Economy to Theaters of Consumption, New York: Routledge. https://doi.org/10.4324/9780203449813_chapter_9

Ganong, P., Noel, P. (2016), How Does Unemployment Affect Consumer Spending?, retrieved from: https://scholar.harvard.edu/files/ganong/files/ganong_jmp_unemployment_spending.pdf (accessed 16 April 2022).

Giuliano, P., Spilimbergo, A. (2014), Growing up in a Recession, The Review of Economic Studies, 81(2), 787–817. https://doi.org/10.1093/RESTUD/RDT040

Goerke, L. (2002), Taxes and Unemployment: Collective Bargaining and Efficiency Wage Models, New York: Springer.

Google (2020a), COVID-19 Community Mobility Reports, retrieved from: https://www.google.com/covid19/mobility/data_documentation.html?hl=en (accessed 16 April 2022).

Google (2020b), Google Cloud databases, retrieved from: https://cloud.google.com/products/databases (accessed 16 April 2022).

Google (2020c), Open source databases, retrieved from: https://cloud.google.com/solutions/open-source-databases (accessed 16 April 2022).

Harapan, H., Itoh, N., Yufika, A., Winardi, W., Keam, S., Te, H., Megawati, D., Hayati, Z., Wagner, A. L., Mudatsir, M. (2020), Coronavirus disease 2019 (COVID-19), A literature review, Journal of Infection and Public Health, 13, 667-673. https://doi.org/10.1016/j.jiph.2020.03.019

Harrod, R. F., Hicks, J. R. (1939), Value and Capital, The Economic Journal, 49(194), 294-300. https://doi.org/10.2307/2225091

Hicks, J. R. (1959), A "value and capital" growth model, Review of Economic Studies, 6(3), 159-173. https://doi.org/10.2307/2295744

Huntington, S. P.(1993), The Clash of Civilisations?, Foreign Affairs, 72(3), 22-49. https://doi.org/10.2307/20045621

International Monetary Fund (2022), IMF Data, retrieved from: https://www.imf.org/en/Data (accessed 16 April 2022).

Intuit (2020), Employment data, retrieved from: https://www.intuit.com/ (accessed 16 April 2022).

Jackson, L. F. (1984), Hierarchic Demand and the Engel Curve for Variety, The Review of Economics and Statistics, 66(1), 8-15. https://doi.org/10.2307/1924690

Jia, D. L. (2020), Dynamic Macroeconomic Models in Emerging Market Economies: DSGE Modelling with Financial and Housing Sectors, New York: Palgrave MacMillan.

Johns Hopkins University (2020), Johns Hopkins University: Official Web Page, retrieved from: https://www.jhu.edu/ (accessed 16 April 2022).

Kahn, L. B. (2010), The long-term labor market consequences of graduating from college in a bad economy, Labour Economics, 17(2), 303–316. https://doi.org/10.1016/J.LABECO.2009.09.002

Keynes, J. M. (1936), The General Theory of Employment, Interest and Money: in: Political Science Quarterly. Project Gutenberg of Australia eBook. https://doi.org/10.2307/2143949

Kitrar, L., Lipkind, T. (2021), The relationship of economic sentiment and GDP growth in Russia in light of the Covid-19 crisis, Entrepreneurial Business and Economics Review, 9(1), 7-29. https://doi.org/10.15678/EBER.2021.090101

Kronos (2020), Employment, retrieved from: https://www.kronos.com/ (accessed 16 April 2022).

Krugman, P., Wells, R. (2018), Macroeconomics (5th edition), Worth Publishers Macmillan Learning, retrieved from: www.macmillanlearning.com (accessed 16 April 2022).

Kuznets, S. (1941), The Structure of the American Economy, 1919–1929, The Journal of Economic History, 246. https://doi.org/10.1017/s0022050700053158

Lee, D. D., Faff, R. W. (2009), Corporate Sustainability Performance and Idiosyncratic Risk: A Global Perspective, Financial Review, 44(2), 213–237. https://doi.org/10.1111/j.1540-6288.2009.00216.x

Leite, W. (2017), Propensity Score Matching, in: Practical Propensity Score Methods Using R, London: SAGE. https://doi.org/10.4135/9781071802854.n5

Léon, F., Zins, A. (2020), Regional foreign banks and financial inclusion: Evidence from Africa, Economic Modelling, 18(3), 1-49. https://doi.org/10.1016/j.econmod.2019.03.012

Levitt, T. (1983a), After the sale is over, Harvard Business Review (e-copy).

Levitt, T. (1983b), The globalization of the markets, Harvard Business Review, 25(3), 17-19.

Lewbel, A., Pendakur, K. (2008), Estimation of collective household models with Engel curves, Journal of Econometrics, 147(2), 350-358. https://doi.org/10.1016/j.jeconom.2008.09.012

Li, N. (2019), An Engel Curve for Variety, The Review of Economics and Statistics, 11, 1-44. https://doi.org/10.1162/rest_a_00879

Lucas, R. E. J. (1976), Econometric policy evaluation: A critique. Carnegie-Rochester Conference Series on Public Policy, 1, 19-46. https://doi.org/10.1016/s0167-2231(76),0003-6

Lucas, R. E. J., Sargent, T. (1981), Rational Expectations and Econometric Practice, Vol. 1. Minneapolis: University Of Minnesota Press.

Lutz, F. A., Samuelson, P. A. (1961), The Evaluation of 'Social Income': Capital Formation and Wealth, The Theory of Capital. https://doi.org/10.1007/978-1-349-08452-4_3

Murphy, J. J. (1999), Technical Analysis of the Financial Markets: A Comprehensive Guide to Trading Methods and Applications, New York: New York Institute of Finance.

Nissanke, M., Thorbecke, E. (2007), The Impact of Globalization on the World's Poor: Transmission Mechanisms, New York: Palgrave MacMillan.

Our World in Data (2020), Our World in Data, retrieved from: https://ourworldindata.org/ (accessed 16 April 2022).

Panel on Redesigning the BLS Consumer Expenditure Surveys, Committee on National Statistics, Division of Behavioral and Social Sciences and Education, National Research Council, Dillman, D. A., and House, C. C. (2013), Measuring What We Spend: Toward a New Consumer Expenditure Survey. Washington: National Academies Press.

Paychex. (2020), Employment data, retrieved from: https://www.paychex.com/ (accessed 16 April 2022).

Perloff, J. (2014), Microeconomics. LA: University of California.

Phelps, E. S. (1990), Seven Schools of Macroeconomic Thought: The Arne Ryde Lectures, New York: Clarendon Press.

Pullano, G., Valdano, E., Scarpa, N., Rubrichi, S., Colizza, V. (2020), Evaluating the effect of demographic factors, socioeconomic factors, and risk aversion on mobility during the COVID-19 epidemic in France under lockdown: a population-based study, The Lancet Digital Health, 2(12), 638–649. https://doi.org/10.1016/S2589-7500(20),0243-0

Ross, C., Campbell, A. (2008), Federalism and local politics in Russia, New York: Routledge. https://doi.org/10.4324/9780203891513

Seale, J. L., Bai, J., Wahl, T. I., Lohmar, B. T. (2012), Household Engel curve analysis for food, Beijing, China, China Agricultural Economic Review, 4(4), 427-439. https://doi.org/10.1108/17561371211284795

Shell, K., and Mishan, E. J. (1975), The Costs of Economic Growth, The Journal of Finance, Auckland: Penguin Books. https://doi.org/10.2307/2325366

Shemetev, A. (2012), Complex financial analysis and bankruptcy prognosis and also financial management-marketing manual for self-tuition book (1st edition), retrieved from: https://books.google.cz/books/about/Complex_financial_analysis_and_bankruptc.html?id=iViOsALV23QCandredir_esc=y (accessed 16 April 2022).

Shemetev, A., Pelucha, M. (2021), Did stay-at-home-orders produce a significant effect on consumer spending and employment in the US?, International Days of Science, 37–53, retrieved from: http://idsconference.cz/wp-content/uploads/2021/05/International-Days-of-Science-2021-proceedings.pdf (accessed 16 April 2022).

Slobodyan, S., Wouters, R. (2012), Learning in an estimated medium-scale DSGE model, Journal of Economic Dynamics and Control, 36, 26-46. https://doi.org/10.1016/j.jedc.2011.01.016

Stiglitz, J. E. (2005), The Ethical Economist. Growth may be everything, but it's not the only thing. Review Essay of "The Moral Consequences of Economic Growth by B.M. Friedman", Knopf, 2005, Foreign Affairs, 84(6), 128-134.

Sun, J., Harimaya, K., Yamori, N. (2013), Regional economic development, strategic investors, and efficiency of Chinese city commercial banks, Journal of Banking and Finance, 37, 1602–1611. https://doi.org/10.1016/j.jbankfin.2012.12.013

The Opportunity Insights (2020), The Opportunity Insights Economic Tracker: Supporting the Recovery from COVID-19, retrieved from: https://opportunityinsights.org/ (accessed 16 April 2022).

Trigg, A. B. (2004), Deriving the Engel curve: Pierre Bourdieu and the social critique of Maslow's hierarchy of needs, Review of Social Economy, 62(3), 393-406. https://doi.org/10.1080/0034676042000253987

US Bureau of Economic Analysis (2020a), Consumer Spending, retrieved from: https://www.bea.gov/data/consumer-spending/main (accessed 16 April 2022).

US Bureau of Economic Analysis (2020b), Regional Economic Accounts, retrieved from: https://www.bea.gov/data/economic-accounts/regional (accessed 16 April 2022).

Williamson, J. (2018), Macroeconomics, New York: Pearson.

World Bank (2022), World Bank Open Data, retrieved from: https://data.worldbank.org/ (accessed 16 April 2022).

World Health Organization (2020), WHO Coronavirus Disease (COVID-19), Dashboard. World Health Organization, retrieved from: https://covid19.who.int/ (accessed 16 April 2022).

Worldometer (2020), Coronavirus data, retrieved from: https://www.worldometers.info/coronavirus/ (accessed 16 April 2022).

Yee, T. W. (2015), Erratum: Vector Generalized Linear and Additive Models (With an Implementation in R), New York: Springer. https://doi.org/10.1007/978-1-4939-2818-7

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