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CONTACT-INTENSITY, DISRUPTIONS IN THE CULTURAL SECTOR AND WAGE INEQUALITY: A MODEL OF COVID-19 CRISIS AND ITS IMPACT

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COVID-19 has adverse impacts on contact-intensive sectors, viz., manufacturing, tourism, and the entertainment sector (ES). In a general equilibrium (GE) model with online, entertainment and informal sectors employing skill, unskilled, and capital, we show that COVID-19 could cause polarization pushing contact-intensive entertainment industry on the brink of collapse while the other two survive. Dual roles of factor intensity and contact intensity (CI) contribute to such finite changes, triggering inter-skill wage inequality. This is the first of its kind to offer a theoretical mechanism capturing the contractionary effects on contact-intensive sectors and wage inequality. These results match with the literature emphasizing the hardships faced by the cultural sector.

Keywords: Wage-gap; COVID-19; contact-intensive; cultural sector; general equilibrium; quasi-specific; social-distancing.

JEL Classification: D50, I18, J31, L80, N30, O10

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1. Introduction and Motivation

Life is a shipwreck, but we must not forget to sing in the lifeboats. — Voltaire

Of late, no other issue has gripped the attention of intense research as the precarious effects of COVID-19 crisis. For example, a whole issue and subsequently other issues were devoted to the analysis of impacts of COVID-19 on the Japanese economy, with sectoral as well as diverse labor market repercussions (see Iwamoto *et al.*, 2021). These are empirical studies with rich information. Plethora of studies has explored voluminous data and causal relationships among numerous factors (variables) to offer empirical analysis. Quite obviously, as the pandemic has affected overall socio-economic, and political landscapes, this empiricism is no doubt useful exercise with rich arrays of information. However, Conley and Johnson's (2021) study is a significant eye-opener to highlight the necessity of conducting advanced social science research going beyond the "causal revolution" to comprehend "generalizability" based on the findings, so that it addresses "longstanding questions in the social sciences", and has impacts beyond the Corona crisis phase. In particular, they argue that as exogenous shocks like the pandemic occurs in a system which is *inherently endogenous* with interrelationships among variables, the research design should be such that "to answer major question about how absence from work, social isolation, and other more general phenomena induced by the pandemic affect our social, economic, and political behavior" (*ibid.*, p. 2). Theoretical analysis is extremely relevant as to pin down what to expect and what not to expect from unanticipated shocks/changes, etc. on various economic activities.

In this context, one of the important aspects to look at is the impact of stringent lockdowns, spatial distancing, and rigorous health policy regulation curbing demand for culture and in allied sectors while consumption demand for culture and connectivity matters more than production-centric policy and closure of "crowd-based" events due to COVID-19 was a double blow for creative sectors (Cunningham *et al.*, 2020). Using labor force survey, Fukai *et al.* (2021) find for Japan that the most affected people are in the hotel and restaurant industry and service sectors with heterogeneous impacts, and with strict measures employment probability drops. Now, for organizing production with different types of workers, apart from *factor-intensity* of production *contact-intensity* (CI) of sectors matters with heterogeneous impacts. Some sectors are relatively more contact-intensive than the others, such as the entertainment sector (ES), opera, tourism, etc. Usually, CI is less in less labor-intensive and remotely performable activities. Virtual trade thanks to digitization has flourished where CI is much less for organizing production remotely. Performing arts or ES has high CI, while manufacturing has much less CI, and online sector has least CI. Bartik *et al.* (2021) offered survey evidence of such adverse impacts on small business in the US, and their resilience. Hou *et al.* (2021) showed empirically how even within a county the mobility is hampered by heterogeneities across age and race with health challenges. Sheridan *et al.* (2021) found loss in economic activities in case of Scandinavia due to cut down in spending. Chen *et al.* (2021) found that a direct exposure-led increase in subjective uncertainty greatly reduces economic activities. Understanding this would offer critical insights for formulating recovery policy (such as policy acceleration and policy movement) and planning strategy as has been discussed for case studies in the context of Australia,

South Korea, Japan and China (Cunningham *et al.*, 2020; Hardin, 2021; Lee *et al.*, 2021). Carmona and León (2022) showed in an augmented Solow model that in the steady state after COVID-19, the economy contracts with fall in per capita output.

Based on this background, we focus on the cultural sector facing "shutdown" threat. We ask a specific theoretical question as to — how the contact-intensive ES or creative sector is supposed to respond to such a shock in a well-specified general equilibrium (GE) system which explores the outcome with interconnected activities (Jones, 1965; Jones and Scheinkman, 1977).[1] It is not only just causal relation of what caused what, but also to understand "why" or, "why not" or, "how". Unfortunately, underlying mechanisms are so scantly represented in the empirical literature that it is important that we do this exercise. It is not enough to know that a sector will be in trouble during pandemic, but it is important to know how workers there would try to survive, where they would go and how to integrate the sectoral and systemic consequences in an analytical model. This description will abstract from the context-specific factors of a single empirical exercise and try to extract the essence so that the analysis becomes relevant for many such empirical exercises. To capture such mechanism is essential for general replicability of results and its application conducted in different contexts. Also, when unemployment or disguised unemployment is becoming a pervasive and serious consequence of pandemic-led regulations, this kind of research is crucial for understanding deleterious socio-economic impacts in the less developed or the developing economies. As per Conley and Johnson (2021) and Velu and Iyer (2021), in order to tackle the adverse socio-economic consequences of COVID-19, a framework that offers *generalized 'durable knowledge'* is more valuable to impart insights. As in the context of management of climate crisis and policy relevance, this methodological framework can bridge the North-South divide in COVID-19-related research too (see, for example, Blicharska *et al.*, 2017).

This paper fills the gap by providing a general analytical framework of structural changes in arts and culture sector, in an economy with three representative sectors (viz. virtual, entertainment and informal manufacturing) where endogenously employment and output changes due to "social distancing", and shutdown orders in the wake of COVID-19. In sum, cultural economy is an important factor for its contributions to socio-economic progress and development, as well as social capital and hence, collapse of such sector could lead to social exclusion deterrent for inclusive development. That is not sustainable. Our paper contributes by providing a holistic view with general treatment of the sectoral interactions. For forestalling or withstanding shocks or vulnerabilities, governments need strengthened resilience, inclusion, and making policies for social cohesion for the marginalized or the excluded persons. Developing flexible and resilient skill systems and investment in skills in the immediate aftermath of post-Corona to meet the changing needs is important as lockdown or closures could accentuate inequalities. Several government-supported programs that facilitate need-based skills, adoption of digital technologies, employment creation, etc. are necessary.

[1] Jones and Scheinkman (1977) specifically discusses about how such production model could "generalize" in higher dimensions beyond 2×2 model.

Section 2 provides the background of the study and surveys some empirics. Section 3 presents the model, results, and discussions. Section 4 concludes.

2. Background of Contact-Intensity and Empirical Studies

2.1. *Background of contact intensity*

The pandemic has jolted the world economy severely, with disruptions on both the demand and the supply side, affecting overall economic performance. Lockdowns, spatial distancing and adopting health standards are imperative with similar policy regulation in practice. The vulnerability of the sectors depends on whether the sector operates with labor-intensive production process and in close proximity so that spread of the contagion might occur. Therefore, both *factor-intensity* of production and CI of sectors matter. In an important volume McCann and Vorley (2021) explored the impact of COVID-19-related uncertainty and containment strategy on firms' performance, skill development, and shift to online consumption due to social distancing-related behavioral changes and policy regulation. Lockdowns (total and partial) or social distancing with social repercussions across various sectors are discussed. Mathur (2020) is an empirical study to construct "Economic Contact-Intensity (ECI)" index (ranging from 0 to 10) at firm level for India, where sectoral index is a weighted average of firm-level ratios of travel expenses, printing and stationery expenses, communication and IT-enabled services. The study finds that media and other miscellaneous diversified services have ECI in the range of 3–5 implying non-negligible impacts. According to a report (2021), most contact-intensive sectors agriculture (10%), construction (87%), services (80%), manufacturing (63%), and mining (46%) with high risk of infection and hence, consumer wariness matter most.[2] In a paper, Ahumada *et al.* (2021) showed in an empirical analysis that ever-growing degree of social interaction and high degree of mobility at the local and regional levels matter for the speed of transmission across economic sectors with variability. Thus, they showed that government intervention and social response led to adaptation of activities differently during the pandemic, and sectoral performances have suffered mostly in the subsectors of domestic services esp. those without job protection, along with manufacturing and construction. All these adverse effects of COVID-19 are shocks in service subsectors —cultural or performance sector is one such—due to restrictions on social behavior and hence could have direct and indirect effects through their long-lasting impacts on other sectors. Leibovici *et al.* (2020a) constructed proximity index as proxy for "contact" across various occupations for USA using O-NET survey to find that typically service workers, audiologists, serving workers have medium level of proximity-index (75). In another study, Leibovici *et al.* (2020b) found that amusement and recreation (NAICS code 713) has quite moderate to high proximity index of 67.41 (low CI index is below

[2] CI of sectors matter for spread of the virus due to high risk. However, very few studies have constructed such measures on a global or even a national scale for an economy. However, several evidences exist behind our motivation. We summarize these here. We are immensely grateful to two referees who have given valuable comments in this aspect to update this information The Economic Times (2020).

60 usually). According to this study, above 66.77 value implies "affected high contact-intensive" industry group and recreation and entertainment presumably falls into this category.

CI of services differs across groups and entertainment or cultural sectors like drama, theater and opera have a high degree of vulnerability. Some sectors face threat owing to "consumer wariness" (risk of infection) where CI of final demand is high like in airports, cinema, opera, entertainment, and malls. CI of services differs across groups with high CI of final demand in trade, tourism, etc. On the contrary, manufacturing has low CI of final demand (6%). Performing arts or ES has high CI, while manufacturing has much less CI, and online sector has the least CI.

Based on this background, we focus on the cultural sector facing "shutdown" threat due to COVID-19. This is because containment measures or state-of-emergency leads to job-separations thanks to restricted mobility, while teleworkability has mitigating effect due to social distancing as case growth rate falls with more precautionary behaviors. Hoshi *et al.* (2021) accounted for these damages in retail, tourism, and entertainment industries with unemployment and bankruptcies.

2.2. *Empirical studies on cultural sector*

Performing arts or cultural sectors are considered as creative economy with huge potential for shared prosperity. As cultural sectors are part of creative goods, it is important to see the links between culture, economics, and development because this creativity work in tandem with diverse sources of economic progress (Sen, 2001). Cultural sectors are not luxury; rather, they could promote economic and social progress as a cross-cutting economic sector for jobs, employment, diversification into services, and trade. Thus, the need for such holistic approach has been emphasized by Sen (2000, 2004) and World Bank (2015). Constructing "proximity intensity index" and "occupational CI index", Famiglietti *et al.* (2020) showed for USA that *non-essential CI-industries*, i.e., opera and entertainment have suffered the most from job losses suffering from decline in activities. Empirical studies have documented factors, such as institutions, "teamwork" or "customer-proximity" underlying heterogeneous paralyzing effects of business closures on race, gender disparities, and socio-economic outcomes—see, for example, Hardin (2021), Koren and Peto (2020), Karabulut *et al.* (2021), Buesa *et al.* (2021), Baqaee and Farhi (2021), and Singh *et al.* (2022). Uncertainty of contagion, possibilities of close contact among customers, firms or service providers, and apprehension of widespread health-fallout create "reallocation shock" (Crane *et al.*, 2020). Hu and Zhang (2021) showed that firm performance suffered during 2020–2021 in countries with worse healthcare systems, and low-quality institutions. Glocker and Piribauer (2021) estimated output losses in 130 nations due to CI of services and spatial distancing. The demand side impacts are felt more in the services and cultural sectors facing vulnerability (Cunningham *et al.*, 2020; Famiglietti *et al.*, 2020). Crosby and McKenzie (2021) are an important study in the context of Australia where surveying 203 musicians has provided valuable evidence—doing a partial equilibrium (PE) econometric modeling exercise—that the severity of pandemic has not only led to loss of primary and secondary

income, but has also caused substantial loss of employment, weakening the sentiment about restoring future income and industry demand despite supply-side measures such as income/subsidy support. For example, Masi and Porrini (2021) studied the impact of natural disasters on cultural heritage and the role of insurance for mitigating the impact or reducing the damages, or asymmetric information. Chen and Tang (2021) analyzed empirically the determinants of live performing arts attendance in case of China, with emphasis on leisure time, cultural capital, income and occupation in an econometric exercise. Often, gravity model framework is adopted to investigate demand for exports of creative goods from developing economies without emphasis on external factors that could impede it (Dong and Truong, 2020). However, macroeconomic fluctuations caused by cases like pandemic or disasters affect the return on holding valuable creative capital like a violin (Chan *et al.*, 2020) while with the rise of virtual platform-led online transactions the demand for online creative activities is surging as paradigm changes (Towse, 2020). Hou *et al.* (2021) empirically showed how even within a county the mobility is hampered by heterogeneities across age and race with health challenges. Sheridan *et al.* (2021) found a loss in economic activities in case of Scandinavia due to a cut in spending. Understanding this would offer critical insights for formulating recovery policy (such as policy acceleration, policy movement) and planning strategy as has been discussed for case studies in the context of Australia, South Korea, Japan and China (Cunningham *et al.*, 2020; Hardin, 2021; Lee *et al.*, 2021.

Barrero *et al.* (2021) showed negative employment growth and contraction in leisure, hospitality, other services and retail trade. For India, contact-intensive tourism, aviation, hospitality, trade, hotels, transport, communication and services contracted by 31.5% in 2020–2021, with an overall contraction of 16% only in the first-half of 2020–2021.[3] Other issues are impact on inequality, family migration and job losses of low wage workers and wage-cuts of high-wage workers, unemployment due to "dampened economic activity", "decreased production", CI of "non-essential" sectors, consumer wariness on "non-essential" sectors (Grigsby *et al.*, 2021; Das *et al.*, 2021; Court *et al.*, 2021; Mahata *et al.*, 2022; Singh *et al.*, 2022). The role of containment for economic growth at the country level based on country-specific attributes is crucial. In an interesting study, Feng *et al.* (2022) highlighted the role of pandemic-containment effectiveness (PCE) by constructing a measure of such indicators combining aspects of risk factors and protective factors to show that countries with better PCE have done better by improving government effectiveness and stringent regulations. For sectoral or micro level, the effects could be differences across sectors for their respective contributions and importance in the overall macro-level performances of the national economies.

However, the apocalyptic change facing the cultural economy is heart-rending. Given the importance of the cultural activities in creating psychological benefits, the immense importance of "cultural sector" for "creative wealth of nations" can no way be undermined (Kabanda, 2018; Feinig, 2020). Gu *et al.* (2021) showed that in Chinese cultural industries, lockdown restrictions have *inordinate impact on already suffering independent sector… …with many music venues especially not expected ever to re-open forcing*

[3] https://www.business-standard.com/article/printer-friendly-version?article_id=121012901523_1

them to undergo re-evaluation of cultural value. In a meta-analysis, Comunian and England (2020) also considered the impact on the precarious situation of the livelihoods of the workers in the creative and cultural industries (CCIs), concluding that COVID-19 "represents a moment of crisis" pushing CCIs into an "unsustainable" territory. In the context of Germany, Dumcke (2021) has also documented the important roles for arts and culture (CCIs), and the crisis encountered without government funding for resilience. To quote (p. 7): "The general crisis of social inequality — rich and poor, permanent employment and *casualisation*, and so on — has now become much unavoidable in the art and culture sector." Even for the "online livestreamed concerts" — during lockdown phase under pandemic stringencies — "omission of physical audience" due to social isolation deterred proper functioning with a typical cultural ambience and thus, losing the demand as the attraction does not persist (Vandenberg *et al.*, 2021; Cornelia, 2021). Also, Banks and O'Connor (2021) discussed in the context of the UK that the arts and cultural sector faces huge uncertainty not only now, but even in the post-COVID-19 phase as "[it is] unclear how many venues will have survived to stage performances of which workers would be there to stage them" (p. 5). In fact, the chance of "collapse in income and revenues" can't be ruled out and hence, the government's financial support is the desirable policy recommendation.[4] For example, Betzler *et al.* (2020) showed in the context of five European nations, viz., Switzerland, Czech, Slovenia, Netherlands and Portugal, that early policy measures matter and it depends on the state involvement, public policy during different phases before and after the crisis, and "propensity of self-employment" specific to policies. This is important for the CCIs and workers losing jobs there. As mentioned before, with better PCE-measures these sectors could absorb such adverse shocks of demand collapse with less severities.

Most importantly, drawing parallels to the Global Financial Crisis (GFC) of 2008–2009 and its aftermath, Hardin (2021) particularly mentioned the necessity of exploring the "complex field of cultural economy" in the present juncture of "economic, health and governance crises". Alike Conley and Johnson (2021), Hardin (2021) emphasized the necessity of "generalized" research focus for "curing" COVID-19, adopting *policy*, and understanding the socio-economic behavior.[5] Further, Hardin (2021) mentioned that the pandemic has a larger devastating impact with higher job losses and unemployment than the GFC, and thus, points to the necessity of providing theoretical underpinning in several dimensions, such as languishing unemployment and job losses: thus, "[theoretical] explorations of the coronavirus pandemic can help us understand what economic logic might be at work when the virus is left to spread relatively (*Ibid*., p. 5)" Analogously, Kob (2020) highlighted emphasizing on research focus on "economic and/or political decision-making", adopting policy, and understanding the multi-pronged nature affecting different

[4] It mentions the case of New Zealand's rescue package of NZ$175 million to support cultural industries to cover up lost jobs and income, in the form of wage subsidy.

[5] This paper develops Neo-Classical General Equilibrium framework based on the researches published in the *PNAS* in the recent issues of 2020–2021. In fact, that motivates us to offer an analytical framework to reflect upon such adverse contractionary effects. A framework of interrelationships across multiple variables is important for COVID-19 crisis and *generalizability of results* with longstanding effects (Conley and Johnson, 2021). Here, analytical results are discussed intuitively, and presented succinctly in mathematical propositions. See Jones (1971, 2019) and Jones and Scheinkman (1977).

facets of a productive economy, rather than focusing only on the science-based "catastrophic simulation modeling".[6] Giuntella *et al.* (2021) researched the impact on mental health and well-being of the "displaced" and the underemployed, such as depression. Proto and Zhang (2021) also studied the adverse impacts of pandemic-induced disruptions in mental health across different personalities.[7]

Our value-addition lies in offering a GE model capturing these stylized facts. Marjit and Beladi (2002) and Beladi *et al.* (2011) have used a GE model to address the aspects of wage-differentials due to unionization and informality in a small open developing economy and discussed the cases of "involuntary self-employment or underemployment". However, ours is novel in its approach as nobody has so far modeled the GE effects and a "finite change" accounting for structural change in the cultural sector although narratives or anecdotal evidence floating around. Various stages of such impact are carefully analyzed in terms of a mix of well-recognized and innovative approaches, for example, *quasi-specific factor or stages of mobility* of factors of production disturbed by unprecedented bad shock in their own occupation.

In this paper, we use the Specific Factor (SF) model as the benchmark based on Jones (1971). The work of Jones (1971) is one of the most cited works in this area. But we go way beyond the conventional approach. In our model, in the economy, we have *only three sectors* which are experiencing the pandemic-led disruptions: a Virtual sector, a casual informal sector organizing manufacturing activities, and a contact-intensive entertainment industry encompassing multifarious activities in close contact. Thus, any disturbance in one will bound to have repercussions in the others even if the extent depends on the share of that sector in the macroeconomy. As discussed in Sections 1 and 2 with factual evidence, these play a crucial role for those who are not technical professionals. Consumption demand for culture and connectivity matters more than production-centric policy and closure of "crowd-based" events due to COVID-19 was a double blow for creative sectors (Cunningham *et al.*, 2020). In particular, our research investigates the sectoral impact of pandemic crisis and its aftermath on the labor market via sectoral adjustments. In this context, one of the important aspects to look at is the impact of stringent lockdowns, spatial distancing, and rigorous health policy regulation curbing demand for culture and in allied

[6] Although Neo-Classical General Equilibrium framework is adopted, this paper derives the results and policy implications in tune with the research papers published in the *Journal of Cultural Economy* in the recent issues of 2020–2021, especially, *inter alia*, Hardin (2021) and Kob (2020), where concern about collapse of arts and entertainment sector is echoed repeatedly. In fact, that motivates us to offer an analytical framework to reflect upon such grave scenarios of adverse contractionary effects. In brief, the model offers general analysis and results which are intuitively discussed, and presented succinctly in mathematical propositions. Importance of such explorations of interrelationships across multiple factors and variables are important for Covid-19 crisis and generalizability of results for social, economic, and political behavior with longstanding effects (Conley and Johnson, 2021).

[7] First author of this paper is a North Indian Classical Vocalist with numerous scores in his portfolio of music — see https://www.youtube.com/channel/UCKzpaSAqQUbxIwCbaGko7ww. Also, he has been featured in the blog such as, http://swaratala.blogspot.com/2007/05/sugata-marjit-i-dont-want-to-know-how.html about his renditions. Given his research focus delving deep into the economic development aspect, the devastating and appalling conditions of performing artists in the cultural sector due to COVID-19 has drawn our attention. In particular, the crisis in this sector has been instrumental in researching on this aspect because in the known circle in the music arena several mishaps have disrupted livelihood of some creative artists. For example, a percussionist has to switch occupation to a food delivery chain, and another was an extremely sad outcome where an artist — without any outlet — had to succumb to self-inflicted death. These two heart-rending episodes amongst others in many countries show the precarity of conditions. Often, sustainability of the arts and performing sector in the traditional systems of arts and culture is a serious concern (Marjit, 1995)

sectors. For tracing that ripple effect, we need an analytical model capturing interrelationships among sectors in an economy so that we get a holistic picture.[8] General equilibrium (GE) framework — capturing intimately interconnected effects of a disruptive supply and demand shock as COVID-19 — is most suitable than a PE analysis offering, as the jargon suggests, a singular focus of a system-wide shock. As mentioned before, a holistic approach is needed to reflect on this. A GE model captures ripple effects across sectors via interlinkages of product market, factor markets, and price mechanism. The rationale for using GE framework to address this issue stems from its usefulness in tracing interrelationships among variables in an endogenous system. As typical of a GE structure, this methodological approach scores over the PE ones because it deals with interrelated systems where all variables are simultaneously determined unlike the PE setup where only some variables are considered as relevant while the others are regarded as unaltered or constant. These genres of models are useful in analyzing problems related to economic development, immigration, technical change, wage inequality, asymmetric changes in relative wages of workers with diverse skill-endowments, informal sectors, outsourcing, etc. (see Jones, 1965, 2018; Acharyya and Kar, 2014; Marjit and Kar, 2011; Coto-Millan, 2002 — to name a few). Now conventional GE methodology for reflecting on the stylized facts or specific issues affecting the appalling conditions of workers under the pandemic needs to be extended to model explicitly the mechanism. One way to justify our model structure is that the existing structures developed in the other contexts do not suit the current problems related to the cultural sector, and hence cannot grapple with the changes. Thus, implications of pandemic-led disruptions need to be analyzed by explicit consideration of the interlinked structure of the labor markets, and their interactions. Our GE model is tailored to this setting.[9]

We trace the extent of damage in the prospects of the ES and relate it to the movement of artists away from this sector to occupations of last resort. In the process, various patterns of wage movement, and output movements occur as the price of the entertainment performance drops from little to substantial and the system passes through three stages. Each stage is analyzed carefully and the theory is substantiated by real-life examples (see Section 2). There will be situations where lower wages in ES will stabilize but ES is continuously squeezed out in the intermediate stage and finally it will vanish if prospects continue to move southward. The southward movement of ES goes unabated but with

[8] Performing arts or cultural sectors are considered as creative economy with huge potentials for shared prosperity. As cultural sectors are part of creative goods, it is important to see the links between culture, economics, and development because this creativity work in tandem with diverse sources of economic progress (Sen, 2001). Cultural sectors are not luxury; rather, it could promote economic and social progress as a cross-cutting economic sector for job, employment, diversification into services, and trade. Thus, need for such holistic approach has been emphasized by Sen (2000, 2004), World Bank (2015). It might not be as substantial as ICT or other high-tech sector, but still plays a considerable role, and only the degree of impact will differ across sectors. There are no other sectors in this model economy and hence, we consider only price changes in the concerned sectors only for our comparative static effects. We thank one anonymous referee for bringing this aspect into notice.

[9] GE models are very common in standard international trade textbook at the undergraduate and graduate level. See Caves *et al.* (2007, 10th edition), Krugman *et al.* (2018, 11th edition), and Feenstra (2015, 2nd edition), to name a few. Most of these models are based on the Jones (1965, 1971) paper and its extensions. Novel extensions could explain several phenomena realistically (see Marjit and Das, 2021; Das *et al.*, 2020).

varying patterns of wage gap between the non-CI virtual sector and default occupation. We also highlight how in a more involved theoretical structure, relatively, possibly, extremely talented creative performers will survive. Based on this background, we focus on the cultural sector facing a "shutdown" threat. We ask a specific theoretical research question as to — how the contact-intensive ES or Creative sector is supposed to respond to such a shock in a well-specified GE system, which explores the outcome with interconnected activities (Jones, 1965; Jones and Scheinkman, 1977). It is not only just a causal relation of "what caused what", but also to understand "why" or, "why not" or, "how". Unfortunately, underlying mechanisms are so scantly represented in the empirical literature that it is important that we do this exercise. It is *not* enough to know that a sector will be in trouble during a pandemic, but it is important to know how workers there would try to survive, where they would go and how to integrate the sectoral and systemic consequences in an analytical model. This description will abstract from the context-specific factors of a single empirical exercise and try to extract the essence so that the analysis becomes relevant for many such empirical exercises. Capturing such a mechanism is essential for general replicability of results and its application conducted in different contexts.

Below is the representative three-sector-four-factor mixed *quasi-specific-factor GE model*.[10] The most crucial aspect is the downward mobility of skilled workers and upward rigidity of the unskilled workers. This implies that workers and artists working in the cultural sector (deemed non-essential) will face *forced exit* under severe stress with lack of physical audience, and move to the "casual" one for bare survival. However, the casual informal or manufacturing workers (deemed essential despite CI) will not move easily to booming online sector due to inadequate training. Quasi-specificity of workers refers to this aspect. The analysis shows that voluntary distancing and CI of final demand push contours of contact-intensive performance sector (CIPS) bringing it on the verge of collapse.

3. Formal Treatment: Theory

3.1. *General equilibrium of the rudimentary SF model*

The specific factor model is based on Jones (1971) and Samuelson (1971). In this kind of models, some factors of production are specifically tethered to a particular sector of employment for their particular expertise and hence, they are immobile across other activities (see Jones and Kenen's Handbook (1984) for a lucid introduction and overview of such GE models. Consider three sectors, viz., online (X), entertainment (Y), and a casual or informal sector (Z). The ES needs specific skills (opera singer, ballet dancer, or a theater personality needs skills which is not necessary to run an online trade requiring software expertise. X uses specific skill (S_x) while Y needs performing arts skills (S_y). Informal Z-sector uses

[10] A *general equilibrium (GE)* model captures ripple effects across sectors via interlinkages of product market, factor markets, and price mechanism. This genre of models are useful in analyzing problems of inequality, informal sectors, value-chain, outsourcing (see Jones 1965, Marjit 2008, Acharyya and Kar, 2014—to name a few). Rationale for using GE framework to address this issue stems from its usefulness in tracing interrelationships among variables in an endogenous system.

unskilled (L). Unless compelled or bound to, these individual worker types cannot readily (easily) move across sectors due to their ability differences related to specific functionalities. Capital "K" is homogeneous, mobile, across X, Y, and Z. S_x, S_y, and L are specific factors. It *is a* 3-sector-4-factor specific factor (SF) model based on Jones (1971), and its variants such as Jones and Marjit (2009), Marjit (1990), Das *et al.* (2019), Marjit and Mandal (2015). Z-sector being labor-intensive is also CI-sector; X being virtual, CI impact is assumed away. However, as Y-sector faces imminent threat of obliteration, we focus on it alone.[11]

Following notations are used:

X: Skilled online sector
Y: Skilled ES
Z: informal sector.
P_j: exogenous prices for jth good, $\forall j \in \{X, Y, Z\}$. j is transcript for the sectors and perfect competition with small open economy assumption implies that the economy is a price-taker, and sectors are atomistic entities.
W: Unskilled wage for L-type workers.
W_X, W_Y: Wages in X, and Y-sector. All these wages in the concerned labor markets are determined simultaneously by overall sectoral adjustments in the GE structure or setup of the economy.

Assume originally, $W_x > W$, $W_Y > W$.[12]
r: Return to K.
$a_i^j = i$th input per unit of jth output, $i = L, S_X, S_Y, K$. These are technological coefficients specifying how much capital and different types of labors are used per unit of production in each sector.

$\theta_{ij} = p_i a_i^j / P_j$ is cost-share of ith input in j, p_i is price of ith input[13] such as, wages, rent for capital; it gives shares of labors and capital cost in total cost of production of each sector. More specifically, we write:

$\theta_{lj} = w_l a_l^j / P_j$ is the distributive share of lth labor-types in the production of j, $\forall l \in \{S_X, S_Y, L\}$;

$\theta_{kj} = r_k a_k^j / P_j$ is the distributive share of owner of capital K;

$\overline{K}, \overline{S_X}, \overline{S_Y}, \overline{L}$: Factor endowments (given) for skilled workers as well as the unskilled workers.

[11] With social distancing and contagion risks, skilled occupations in recreation sectors face threat of extinction.
[12] Nature of skills differs across sectors. Generally, skilled attract higher wage than the unskilled ones due to higher productivity. With social distancing prohibiting physical proximity, skilled occupations also face imminent dangers in some sectors like opera, group theater, etc. where chances of spread loom large. In case of manufacturing, such barriers exist too.
[13] θ_{ij} is derived using envelope theorem and considering changes of the variables, viz., prices, quantities, and endowments in the neighborhood of equilibrium, deriving the respective shares of factors in cost-structure as well as sectoral shares for factors out of total endowment. Typically, these are standard methodology for any applied or theoretical general equilibrium models. However, detailed mathematical derivations of each successive steps are not reported for want of space; only important "novel" ones pertinent to the model are presented. Otherwise, it will be repetition.

"∧" = proportional change for variable, V, $\hat{V} = \frac{dV}{V}$. For example, proportional price change is P_j, proportional wage change is $\hat{W}_x, \hat{W}_y, \hat{W}$. Thus, the general functional form of the production technology is expressed symbolically as

$$X = X(S_X, K),$$
$$Y = Y(S_Y, K),$$
$$Z = Z(L, K).$$

Full employment ensures:

$$a_{SX}X = \overline{S_X}, \tag{1}$$

$$a_{SY}Y = \overline{S_Y}, \tag{2}$$

$$a_{LZ}Z = \bar{L}, \tag{3}$$

$$a_{KX} \cdot X + a_{KY} \cdot Y + a_{KZ} \cdot Z = \bar{K} \tag{4}$$

From (4),

$$K_X + K_Y + K_Z = \bar{K}. \tag{4a}$$

Assume perfect competition prevails in the economy with a standard structure with constant-returns-to-scale and diminishing returns (DMR) as in Jones (1965, 1971). Competitive equilibrium implies that price equations are

$$W_X a_{SX} + r a_{KX} = P_X, \tag{5}$$

$$W_Y a_{SY} + r a_{KY} = P_Y, \tag{6}$$

$$W a_{LZ} + r a_{KZ} = P_Z. \tag{7}$$

Given P_j, seven equations determine seven variables, viz., W_x, W_y, W, r; X, Y, Z. That completes the GE. X is assumed numeraire sector, $P_X = 1$. Given S_x and S_y, if K_z rises (or falls), $(K_x + K_Y)$ falls (or, rises) and vice versa. This is the basic model with *two* solutions. *Firstly*, it is a 3-sector-4-factor specific factor (SF) model based on Jones (1971), and its variants such as Marjit (1990), Jones and Marjit (2009), Marjit and Mandal (2015), Das *et al.* (2019) and Marjit *et al.* (2021). The conventional solution is from standard SF solving the wages where W_x, W_y are greater than W. Performing artists can't be programmers and vice versa, while the unskilled can't become artist overnight.[14] Skill-unskilled wage differentials reflect differences in marginal productivities (MP).[15]

Secondly, as mentioned before, we assume that there is *rigid upward immobility* of the unskilled casual workers to X and Y, while at the same time there are *downward mobility* of

[14] Switching skills or occupation entails long-run adjustment. For a musician or theatrical personality without formal training in specialized computer programming it's much harder although s/he can switch to an occupation requiring much less skills, such as, learning "mechanical" skills for casual sector. However, this is extremely painful adjustment in less developed country where unemployment benefits are scarce unlike in the advanced nations. Post-COVID, this is also a problem in the developed nations as fiscal crunch makes coffers empty.

[15] In fact, according to Eikhof (2020) "workers" differing abilities to buffer short-term income security' matter for COVID-19 impact and its threat to "inclusion and workforce diversity (p. 2)".

the skilled types to *Z*. This is the novel feature in this model where the *quasi-specific* types move.

3.2. *Impacts on entertainment and casual sector: Ceteris paribus fall in P_Y*

Here we explore the effects of dampened demand causing a decline in prices for shows/performances in times of COVID-19-led social distancing prohibiting onsite shows. For CIPS, income elasticity of demand is high. However, sluggish economic activities dampen demand due to income loss causing decline in prices (tickets) for "performance" in the arts and ES. Thus, even with lower prices for say, opera or ballet performance, COVID-19 containment hurts demand, and squeezes expenditure on cultural-sector (demand inelastic), and hence, the sector contracts. This is modeled as *ex post* GE effect for (1)—(7) to derive (see Caves *et al.*, 2011; Jones, 2019):

$$\theta_{SX}\widehat{W_X} + \theta_{KX}\hat{r} = \widehat{P_X} = 0, \tag{8}$$

$$\theta_{SY}\widehat{W_Y} + \theta_{KY}\hat{r} = \widehat{P_Y}, \tag{9}$$

$$\theta_{LZ}\widehat{W} + \theta_{KZ}\hat{r} = \widehat{P_Z}, \tag{10}$$

$$\theta_{SX} + \theta_{KX} = 1, \quad \theta_{SY} + \theta_{KY} = 1, \quad \theta_{LZ} + \theta_{KZ} = 1. \tag{11}$$

The above equations show that the percentage (or proportional) changes in the prices of sectoral outputs are cost-shares weighted average of the percent changes in the costs of inputs (labor and capital costs), if they change at all.

For CIPS, income elasticity of demand is high. However, sluggish economic activities dampen demand due to income loss causing decline in prices (tickets) for "performance" in the arts and ES. Like the financial crises, the pandemic has an overall recessionary impact affecting the macroeconomy. For example, more severe (compared to the financial debacle) sectoral and spatial impacts, implications for skill development and deployment, forced closure of cultural services, are studied in Gardiner *et al.* (2021). Green (2021) focused on inclusivity-productivity trade-offs, resilience of the labor market, flexibility and skills in a challenging scenario like COVID. However, during the pandemic-led crisis, governments were proactive to adopt Keynesian demand-management policies to boost up demand for economic revival (Blanchard and Bernanke, 2023).[16] This could not immediately pick up as it takes some adjustment-lags to pick-up demand in the post-pandemic period resulting in price spiraling and inflationary trend in the "key product market" thanks to sectoral composition of demand and price shocks. For example, Harding *et al.* (2023) showed a structural GE model that cost-push effects on inflation were much stronger during post-COVID-19 period and this had adverse effects on demands for firms with strategic complementarities, and also worsened the inflation-output trade-off. That means, with cost-push inflation, output falls and demand could also subside for some sectors, esp. those which are non-essential in terms of living. For non-essential CI sectors such as cultural sector, however, such effects were not so prevalent as they showed that shifts

[16] We thank the referees for extremely valuable comments for highlighting this useful aspect.

mainly occurred in consumer spending to durables affecting aggregate demand composition. As Gopinath (2020) studied, despite the utter necessities of targeted fiscal and monetary policies the epidemic involved dual effects of supply and demand shocks due to reluctance of spending especially on those sectors which are not imperative. In fact, despite the importance of stimulus-package Baldwin and di Mauro (2020) opined that negative demand effects for some sectors could have Keynesian multiplier effect to spill over across other sectors. In fact, the demand shock during, and along the period of pandemic hit hard some sectors which were not life-saving services. Of course, online demand for alternative psychological benefits flourished gradually for those staying at home. Thus, we see cases where contact-intensive and less teleworkable sectors suffered reduction in work-hours and loss in occupations — see Diala *et al.* (2021) in the context of Brazil where income transfer or emergency aid did not offset the labor income decline and earnings fall immediately.[17]

Given such dampened demand, even with lower prices for say, opera or ballet performances, COVID-19 containment hurts squeezes expenditure on cultural-sector (demand inelastic), and hence, the sector contracts. In our context, therefore, *ceteris paribus*, as P_Y falls, without changes in prices for X and Z sectors, i.e., $\widehat{P_X} = 0, \widehat{P_Z} = 0$, cultural sector's output (performances) will contract or decline, i.e., $\widehat{Y} < 0$. Correspondingly, capital from Y-sector will move out so that "K_y" falls, moving into X and Z sectors as they are relatively better off without losing from price cut. Marginal productivity (MP) of labors in X and Z sectors rises resulting in rises in W_X, W, but W_Y falls. This is summarized below:

Proposition 1. *Given* $\widehat{P_X} = 0, \widehat{P_Z} = 0, \widehat{P_Y} < 0, \widehat{W_Y} < 0, W_X$ *and* W *both rise in absolute and relative terms,* $(\widehat{\frac{W_X}{W_Y}}) > 0, (\widehat{\frac{W}{W_Y}}) > 0, (\widehat{\frac{W_X}{W}}) > 0$ *Also,* $(\widehat{\frac{W_X}{W}}) > 0$ *iff* $\theta_{KX} > \theta_{KZ}$.

Proof and intuition. See the discussion above and the appendix.

With pandemic-induced measures, demand will shrink too, and expenditure will fall, even with lower prices (Y-sector demand inelastic). Ceteris paribus, assuming Z is unaffected, as Py falls, Y-sector contracts and Ky falls. Given Kz, the adverse price shock causes r to fall. With K moving into X and Z, $\widehat{P_X} = 0, \widehat{P_Z} = 0$, marginal productivity (MP) of labor in X and Z rises, as r falls, W_x and W rises, W_Y falls. Three possibilities emerge: (a) W_X/W_Y rises implying changes in inequality in the skilled labor types itself so that intra-skill wage inequality increases depending on respective skill-shares in production; (b) as Wx and W rises, depending on K-intensity of these sectors $W_X \geq W$, or $W_X \leq W$; (c) W_Y/W falls, improving wage inequality between entertainment and casual sectors. However, if Y is Sy intensive, via Stolper–Samuelson effect Wy falls by more.

[17] Streaming media such as Netflix or Amazon prime flourished and did extraordinarily well as an alternative avenue to satisfy consumers working at home under mobility restriction for confinement. Thus, online did comparatively better than the physical proximity-based entertainment esp., musicals, drama, or theater. However, the demand still was not as high as the pre-pandemic normalcy level. Also, in this paper our focus is on proximity-based entertainment or cultural sectors which are typically off-line and hence this does not undermine our purpose. On-line and off-line sectors in culture and entertainment are not perfect alternatives or substitutes, and not all can immediately switch to the online or hybrid mode overnight, though. We are thankful to the referee for highlighting this point.

Thus, skilled performers in the ESs are worse off while those in the online sectors are better off.

As mentioned before, we assume that there is rigid upward immobility of the unskilled casual workers to *X* and *Y*, while at the same time, there is downward mobility of the skilled types to *Z*. This implies simply that unskilled workers in informal sectors cannot readily move up the skilled ladder to be absorbed in the skilled sectors like virtual or opera. However, under dire circumstances, left with no choice, endowed with adequate human capital, the skilled ones might queue in the informal or unorganized sector (less demanding in terms of demand for skills as such). Herein comes the role of semi-specific nature of laborers. This is the novel feature in this model where the quasi-specific types move.

3.3. *Quasi-specificity of the initially immobile factors*

As mentioned before, we now turn to quasi-specificity of S_x, S_y and L. More specifically, ceteris paribus, we consider P_y drops further (due to continued lockdown). As COVID-19 shock disrupts the concerned sector, economic rents tend to disappear due to permanent changes in commodity prices (Ruffin, 1981, 2001).[18] The rationale is that prolonged closure of works, uncertainties or unemployment for long time induces skilled workers to seek for alternative occupation. This is possible in this SF model with substantially low P_X, P_Y altering wage structure, triggering downward mobility of S_X, S_Y, and near disappearance of *Y* when all S_X, S_Y *effectively* become *L*. *X* being virtual, CI impact is assumed away. However, as *Y*-sector faces imminent threat of obliteration, we focus on it alone.[19] Similar argument is found in Hardin (2021), Gu *et al.* (2021), Cunningham *et al.* (2020) and Eikhof (2020). Quite realistically, this implies that those working in the cultural sector (deemed non-essential) will face "forced exit" under severe stress with lack of physical audience and move to the "casual" one for bare survival. However, the workers in the informal and/or, manufacturing sector (deemed essential despite CI) will not move easily to the online sector due to inadequate training. Ceteris paribus, we consider P_y drops further (due to continued lockdown). Here, *two* distinct phases of static adjustments occur, viz.

***Case (i)*: P_y *drops substantially low to hinge* $W_y = W$**

Rigid upward immobility of the unskilled casual workers to *X* and *Y* (i.e., unskilled workers cannot move to skilled sectors due to lack of that specific expertise), while at the same time there are *downward mobility* of the skilled types to Z (i.e., the unemployed skilled workers–without any alternative options — try to get in the unskilled sector for even a lower wage). In other words, a *fallback* sector (Z) becomes a source of survival so that even skilled workers *Sy* migrate to *Z* — conceived as *savior of last resort* — and arrest the rock-bottom fall in their *own* wages. This is the downward mobility of S_Y to *Z*. On the contrary, *L* cannot move up to *X*, *Y*. With skilled migration to casual *Z*-sector, W_y could be

[18] Goldin and Katz (1998) showed evidence of movement of skill-labor from white- to blue-collar sectors as goods price changes.

[19] With social distancing and contagion risks, skilled occupations in recreation sectors face threat of extinction. Creativity suffers under crisis (Kabanda, 2018; Hardin, 2021).

depressed to a sufficiently low level. Thus, at some *transitional intermediate adjustment phase* the *second solution* entails when $W_Y = W$. This is a kind of reservation wage where workers in the ES sector is still indifferent between remaining in existing profession and, switching occupation to Z-sector. Then, Y and Z form *nugget* alike structures proliferating in the GE research (see Jones and Marjit, 1992; Marjit, 1990; Jones, 2019). This genre of GE models capture many realistic features such as the one here in the context of COVID-19. This is consistent with Banks and O'Connor (2021), Gu *et al.* (2021) and Section 2 background facts about the evidence of "rapid collapse of jobs due to *venue closure and social distancing rules* after a long period of declining wages and complex employment patterns" (p. 3). Intuition here works as follows: at some stage of this downward price-adjustments due to adverse demand shock facing the cultural sector, at a very low price it will be as low as working in any informal jobs like food delivery or, running errands to meet subsistence needs.

***Case (ii)*: *Further rock-bottom decline in* P_y *causing* $W_y < W$**

Following from above, with stringent social-distancing people will hardly go for cultural show unless it is a throwaway price offer because income is also squeezed due to dampening economic recession. In fact, many performers perform at street-corners where pedestrians (working in other sectors) watch freely as a source of recreation amidst health and wealth crisis. In this case, the return from performing such a show is quite low below the typical informal wage. However, this is possible in this SF model with substantially low P_y altering wage structure, triggering further intensified downward mobility of S_Y, and near disappearance of Y when all of them *effectively* become L. Also, this kind of change is prevalent in genre of *finite change* GE models where one sector almost vanishes due to structural change (see Marjit and Mandal, 2015; Jones, 2019).

In this context, typically such pandemic-induced disruptions cause structural transformation — viz., a finite change — so that the cultural sector vanishes. Theoretically, it resembles the situations analyzed by a class of recently developed GE models (Beladi *et al.*, 2013; Marjit and Mandal, 2015) where new sector appears or disappears — depending on exogenous shocks (adverse or favorable) — due to changes in competitive forces brought about by policy changes, COVID-19, or economic crisis. Here, the number of sectors in the model changes, and a new equilibrium emerges that is qualitatively dissimilar from the pre-COVID scenario. In this kind of collapsing or vanishing scenario, competitive economy will have two sectors, viz., cultural and informal sectors, forming a Heckscher–Ohlin nugget of two industries with 2-factors, but the online sector (outside the nugget) with skilled professional prevails. This kind of nugget model was discussed in the context of analyzing Dutch Disease (Jones and Marjit, 1992).[20] Our model replicates the model in a different context.

Below the mechanism in the *nugget model* and *finite change* of occupational structure is formalized.

[20] Corden and Neary (1982).

3.4. *Substantial fall in P_y and "Nugget" model*

The nugget comprises Y and Z such that the $P = AC$ relation in the GE-structure now becomes

$$Wa_{LY} + ra_{KY} = P_Y \tag{12}$$

$$Wa_{LZ} + ra_{KZ} = P_Z \tag{7}$$

Note that (7) remains the same with the alteration only in Equation (6) as now $W_Y = W$. Further, the full-employment conditions (via 4a) become

$$a_{KY} \cdot Y + a_{KZ} \cdot Z = K - \frac{a_{KX}}{a_{SX}} \cdot X \tag{13}$$

$$a_{LY} \cdot Y + a_{LZ} \cdot Z = L \tag{14}$$

In order to trace the effects of *decline in price in the Y-sector* (e.g., fall in ticket sales), we consider changes as in Sections 3.1 and 3.2 (Jones, 1965; Marjit, 1990) — see the appendix. With further *small* drop in P_y within the nugget, we can envisage the following changes:

- (a) suppose Y is relatively labor intensive than K-intensive Z (i.e., $\theta_{LY} > \theta_{LZ} \Rightarrow \theta_{KZ} > \theta_{KY}$), then following Stolper–Samuelson theorem (Stolper and Samuelson, 1941), W falls, r rises in the nugget, K moves to Z-sector, K_x falls and W_x falls resulting in contraction in X, W_x, and W move in the *same downward direction*;
- (b) if Z is relatively labor intensive than K-intensive Y (i.e., $\theta_{LZ} > \theta_{LY} \Rightarrow \theta_{KY} > \theta_{KZ}$), then, W_x and W move in the *same upward direction*, but W will rise and r will fall, and K moves from Y to Z and X sector. Thus, on the whole, W_x/W can go either way (rising or falling depending on relative magnitude) because W_x and W move in the same direction (either fall or rise) independent of intensity between Y and Z due to the complementarity effect (Marjit and Beladi, 1999). But whatever it is, as K-moves from Y to either Z and/or, X — via Rybczynski effect (Rybczynsky, 1955) a la Equations (13) and (14) — Y-sector keeps contracting and X and Z continue to expand. As online sector (X) is least contact-intensive and Z is sort of essential sector with far less chances of contact, the expansion is natural.[21]
- As W_Y falls there is no guarantee that $W_Y \not\leq W$ (i.e., W_y can have a nosedive below W). This is possible as due to long-term slack in demand and income-shock P_Y falls substantially to very low value $\tilde{P_Y}$ such that at $\tilde{P_Y}$ for any $S_Y > 0$, W_Y also falls substantially.

[21] For example, X is online ordering system or mobile apps for registering order for serving food delivery and Z can be conceived as food processing or food delivery service in person in a vertical service chain. A google search with impact on performing arts and culture sector generated about 142,000 results in 0.60 seconds. Several of them are: Spiro, N., Perkins, R., Kaye, S., Tymoszuk, U., Mason-Bertrand, A., Cossette, I., Glasser, S., and Williamon, A. (2021). The effects of COVID-19 lockdown 1.0 on working patterns, income, and wellbeing among performing. *Arts Professionals in the United Kingdom (April–June 2020). Front. Psychol*, 11, 594086. doi:10.3389/fpsyg.2020.594086; SDA Bocconi School of Management Report: Impact of COVID-19 on the Performing arts Sector. December 2020. https://www.sdabocconi.it/en/news/20/12/the-impact-of-covid-19-on-the-future-of-performing-arts-a-survey-of-top-industry-executives-in-europe-and-the-us. V-shaped recovery is ruled out in arts and performance sector facing "existential crisis" as reported in Fortune for "Broadway" (https://fortune.com/2020/12/13/covid-live-theater-broadway-west-end-reopening-innovation/), also in study by Queen's University Belfast at: http://qpol.qub.ac.uk/performing-artists-in-the-age-of-covid-19/.

Therefore, suddenly Y shrinks to zero and all S_Y have to go to Z (i.e., performance activity declines heavily) causing decline in employment needed for performance. As very less $S_y(\tilde{S_Y}) > 0$ remains in Y (ES), $W_Y < W$ and Y-sector will cease to exist due to *finite change*. If $\widehat{P_Y} < 0$, then $\widehat{W_Y} < 0$, $\hat{W} > 0$. W_y declines below W. $P_Y \cong 0 \Rightarrow W_Y \cong 0$. Then $W > W_Y \cong 0$. Everyone moves to Z-sector, $S_Y \to 0 \Rightarrow Y \to 0$, causing *disguised* unemployment in Z. By continuity, if $\tilde{P_Y} \cong P_Y = 0$, the result must hold in the neighborhood. X and Z survive.

- If Y is labor intensive, again given a low P_y and W/r, if $(K - Kx)/L > Kz/Lz > Ky/Ly$, with rising r and contracting X and Kx, the relative K endowment in the nugget becomes large enough to eliminate the labor intensive Y completely. If Y is K intensive then, given a low enough P_y, and at the corresponding W/r, if $L/(K - Kx) > Lz/Kz > Ly/Ky$, as Kx rises the relative labor endowment available to the Nugget goes beyond the cone of diversification and the Nugget gets completely specialized in Z. So as Py drops independent of the type of technological characterization of the ES sector, it vanishes.

Thus, we write the following:

Proposition 2. *If* $\widehat{P}_Y \ll 0$ (*i.e., substantial decline in prices in the Y-sector with abysmally low demand shock*) *then always there will be severe contraction in the performance or output, i.e.,* $\hat{Y} \ll 0$ *whereas the other two sectors with no drastic shocks will survive with rise in their output level such that,* $\hat{X} > 0$, $\hat{Z} > 0$ *irrespective of* $\theta_{LY} \lesseqgtr \theta_{LZ}$ *or,* $\theta_{KY} \lesseqgtr \theta_{KZ}$. *However, iff* $P_Y \to 0$, *i.e., substantially drops to* $P_Y = \tilde{P_Y}$ *such that at* $\tilde{P_Y}$, *any* $S_Y > 0 \Rightarrow W_Y < W$, *then* $\forall P_Y \leq \tilde{P_Y}$, $Y = 0$.

Proof and intuition. discussion above and see appendix.

Thus, given specific skills with expertise are necessary to be absorbed in the X and Y sectors, they can — with nothing to survive — move to the casual sector Z, while the unskilled or casual workers with no competence or innate talent or adequate skills to perform works in X or Y sector cannot move. Hence, there is rigid upward mobility (taking far longer time or impossible) of L while Sx and Sy have more downward mobility because they can do the work in Z sector requiring no special talent to be trained. This makes possible that Sx and Sy could move to Z where W is flexible unlike in X and Y sector with fixed wages to the skilled. In this scenario, we could get disguised unemployment in Z-sector where unemployed skilled workers mostly from Y-sector crowd along with the existing worker (L) to push W further down. If for some reason W_X and W_Y decline so much that W exceeds them, this downward mobility could also happen. COVID-19 crisis causes permanent damage, and it will have an everlasting impact on wage structure resulting in *forced exit* of the *quasi-specific factors*, finite change with vanishing Y-(arts and cultural) sector and polarization.

With this kind of ensuing change, now we are in a 2-sector SF model instead of a 3-sector one as the decay of ES is complete. Now changes in P_y are irrelevant, it is only changes in P_z and P_x that matters (Jones, 1971). Based on previous notations the model looks like as below:

$$W_s a_s + r a_{KX} = P_X, \tag{15a}$$

$$Wa_{LZ} + ra_{KZ} = P_Z, \tag{15b}$$

$$a_s X = \bar{S}, \tag{16a}$$

$$a_L Z = \bar{L}, \tag{16b}$$

$$a_{KX} X + a_{KZ} Z = \bar{K}. \tag{16c}$$

As this is the standard framework (*a la* Jones, 1971), we don't reproduce the result. Note that if post-pandemic P_y revives considerably, with the perception that we will be safe from pandemic, the structure should reverse. First, the S_y group in i will go out of Z as K becomes attracted to Y and for a while, with P_y rising within a range, we will encounter a Nugget and then we land up in the 3-sector rudimentary SF model.

But this may not happen if skills are lost without practice and the reverse process can be far more time-consuming than what it took to decay. ES crashes down very fast and cannot recover that fast. A point to note is that for a successful performer regular practice and rehearsals are of supreme necessity and require financial support. During the pandemic if such activities are hugely constrained, the recovery process can be really slow. In fact, Cunningham *et al.* (2020, p. 12) has cautioned that the recovery from the devastation in the live arts and ES of the creative economy *will take years of concerted strategy and planning worldwide*. Based on our model, this could be an interesting empirical exercise for the future direction of cultural policy. The necessity of 'consumer-oriented demand-side policies' to restore demand is immensely important for long-term recovery so that the artists don't leave the industry with a sentiment of despair (Crosby and McKenzie, 2021). Their findings support our theoretical results that, without curing the demand-side issues via active policy — as has been analytically modeled in our theory — performers quit for a more stable income with long-term adverse repercussions. In fact, as Feng *et al.* (2022) have highlighted the efficacies of pandemic containment measures in controlling risk factors via adoption of protective policies, the model has important implications for such measures in "saving" these kinds of contact-intensive sectors in general from near-collapse to survive in the pandemic. Thus, the analytical framework corroborates the importance of such policies for restoring growth and livelihoods.

Based on this rudimentary model, the following section concludes and further outlines how different scenarios about differences in the qualities of performers in cultural activities might lead to changes in the economy due to Corona crisis.

4. Concluding Remarks and Outline of Extensions

Based on circumstantial evidence supporting the precariousness of the arts professionals in the performance sectors, we developed a framework to replicate the stylized facts and casual observations about ramifications in the factors, goods and services sectors. This analytical framework is based on the interlinkage of balancing equilibrium conditions of factors and product markets and offers results generalizable in capturing future disruptions in society and polity due to exogenous perturbations such as climate or epidemic. We show that — without pandemic containment effectiveness (PCE) measures — as the pandemic

triggers closures of entertainment industry or the cultural sector, high-wage workers undergo "forced" reallocation to the informal or casual sector. Online commerce or virtual trade flourishes with benefits accruing to the skilled computer professionals. Skill-switching from artists to different professions is hard. This kind of potentially imminent finite change could transform most of the art personality to become casual/informal workers.

Two realistic extensions are contemplated:

(a) Moving one step back, so far as the decisions regarding occupational choice or skill formation are concerned, as "creative sector" collapses, it's rational to argue that people might not invest time and effort to become performing star *if* the threat is permanently damaging. Thus, cultural sector will face severe crisis without prior policy. *Unemployment or underemployment* can also be easily accommodated in this framework to show that the results are robust with similar conclusion.

(b) With *quality differentiation* among the artists, we can model culture-sector (Y) with a continuum of differentiated talent with productivity spectrum $0 < \mu \leq 1$, higher μ implying more productive peer performers. Let $a_{SY}(\mu), a'_{SY}(\mu) < 0$ and $W_Y = f(\mu)$, $f' > 0$. W_Y is high for superstars. Thus,

$$W_y(\mu) \cdot a_{sy}(\mu) + r \cdot a_{ky} = P_y. \tag{17a}$$

Let $\mu = \tilde{\mu} \Rightarrow W_Y(\tilde{\mu}) = \tilde{W}$ be cut-off wage. Supply of factor is endogenously determined depending on W_Y and μ, such that a cut-off point divides the ranges of workers from entertainment industry (S_Y) migrating to casual Z sector, while the outlier talented ones remaining in there. Thus, if $0 < \mu < \tilde{\mu}$, and $\mu > \tilde{\mu}$, $\tilde{\mu} \to 1$. Then,

$$Wa_{sy}(\tilde{\mu}) + r \cdot a_{ky} = \tilde{P}_y. \tag{17b}$$

In this type of model, we can show that only exceptionally talented entertainers or performing artists, i.e., for $\mu > \tilde{\mu}$, $\tilde{\mu} \to 1$, will remain in the cultural sector and the rest, for $0 < \mu < \tilde{\mu}$, will quit for casual informal economy, giving rise to wage inequality. That means only the superstars with exceptional talents might survive without moving to Z-sector while a large thick distribution in the middle will be on the brink of collapse. Only high-end sophisticated ESs (e.g., opera or ballet singers) with very high reputation might survive with highest returns giving rise to intra-group inequality.

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Conflict of Interest

The authors declare that they have no conflict of interest.

Disclosure statement

No conflict of interest is reported by the authors.

Appendix

Proof of Proposition 1. From (8), (9) and (10),

$$\widehat{W_X} = -\frac{\theta_{KX}}{\theta_{SX}}\hat{r}, \tag{8a}$$

$$\widehat{W_Y} = \left(\frac{\tilde{P_Y}}{\theta_{SY}}\right) - \frac{\theta_{KY}}{\theta_{SY}}\hat{r}, \tag{9a}$$

$$\widehat{W} = -\frac{\theta_{KZ}}{\theta_{LZ}}\hat{r}. \tag{10a}$$

Hence, $\widehat{P_Y} < 0 \Rightarrow \hat{r} < 0$, $\widehat{W_Y} < 0$, $\widehat{W_X} > 0$, $\widehat{W} > 0$, $\widehat{Y} < 0$.

Also, $\widehat{P_Y} < 0 = \widehat{P_X} \Rightarrow \widehat{W_Y} < \widehat{P_Y} < \hat{r} < 0 < \widehat{W_X}$.

$\widehat{W_X} > 0 > \widehat{W_Y}$ and $\widehat{W} > 0 > \hat{r} \Rightarrow (\widehat{\frac{W}{W_Y}}) > 0$, $(\widehat{\frac{W_X}{W_Y}}) > 0$.

Further, $\widehat{W_X} > \widehat{W}$ iff $\frac{\theta_{KX}}{\theta_{SX}} > \frac{\theta_{KZ}}{\theta_{LZ}} \Rightarrow \theta_{KX}\theta_{LZ} > \theta_{KZ}\theta_{SX} \Rightarrow \theta_{KZ} < \theta_{KX}$ and $\widehat{W_X} > \widehat{W_Y}$, $\widehat{W_X} > \widehat{W} \Rightarrow \widehat{W_X} > \widehat{W} > \widehat{W_Y}$ iff $\theta_{KX} > \theta_{KZ} > \theta_{KY}$, $\widehat{P_Y} < 0$, $\widehat{P_Z} < 0$.

Proof of Proposition 2: Using "hat" algebra (see the text), from price equations (12) and (7),

$$\theta_{LY}\widehat{W_Y} + \theta_{KY}\hat{r} = \widehat{P_Y} \tag{12a}$$

$$\theta_{LZ}\widehat{W} + \theta_{KZ}\hat{r} = \widehat{P_Z} \tag{7a}$$

From endowment equations (13) and (14):

$$\lambda_{KY}\widehat{Y} + \lambda_{KY}\widehat{a_{KY}} + \lambda_{KZ}\widehat{Z} + \lambda_{KZ}\widehat{a_{KZ}} = -\lambda_{KY}(\widehat{a_{KY}} - \widehat{a_{SX}})$$

From Jones (1965), as, $\delta_K > 0$, $\lambda_{KY}\widehat{Y} + \lambda_{KZ}\widehat{Z} = -\lambda_{KY}\widehat{a_{KY}} - \lambda_{KZ}\widehat{a_{KZ}} + \lambda_{KX}\sigma_X(\hat{r} - \widehat{W_X})$. Thus,

$$\lambda_{KY}\widehat{Y} + \lambda_{KZ}\widehat{Z} = \delta_K(\hat{r} - \widehat{W}) + \lambda_{KX}\sigma_X(\hat{r} - \widehat{W_X}) \tag{13a}$$

Similarly,

$$\delta_L > 0 \quad \text{and} \quad \lambda_{LY}\widehat{Y} + \lambda_{LZ}\widehat{Z} = -\delta_L(\hat{r} - \widehat{W}) \tag{13b}$$

From (13a),

$$\lambda_{KY}\widehat{Y} + \lambda_{KZ}\widehat{Z} = \delta_K \frac{\widehat{P}_Y}{|\theta|} + \lambda_{KX}\sigma_X\alpha\frac{\widehat{P}_Y}{|\theta|} = \frac{\widehat{P}_Y}{|\theta|}[\delta_K + \lambda_{KX}\sigma_X\alpha] \tag{13c}$$

Let

$$\theta = \begin{pmatrix} \theta_{LY} & \theta_{KY} \\ \theta_{LZ} & \theta_{KZ} \end{pmatrix}, \quad \lambda = \begin{pmatrix} \lambda_{LY} & \lambda_{LZ} \\ \lambda_{KY} & \lambda_{KZ} \end{pmatrix}$$

Here $|\theta| \lessgtr 0$ iff Y is K-intensive (L-intensive). When $\widehat{P}_Y < 0$, if $|\theta| > 0$, $\hat{r} > 0$, $\widehat{W_X} < 0 \Rightarrow \widehat{X} < 0$, $\Delta K_X < 0$ causing more K into the nugget, $\alpha > 0$.

Using (13b) and (13c), and Cramer's Rule:

$$\widehat{Y} = \frac{\begin{pmatrix} \frac{\hat{P}_Y}{|\theta|}(\delta_K + \lambda_{KX}\sigma_X\alpha) & \lambda_{KZ} \\ -\delta_L\frac{\hat{P}_Y}{|\theta|} & \lambda_{LZ} \end{pmatrix}}{|\lambda|} = \frac{\widehat{P}_Y}{|\theta||\lambda|}[\delta_K + \lambda_{KX}\sigma_X\alpha]\lambda_{LZ} + \delta_L\lambda_{KZ}]$$

Note $|\theta||\lambda| > 0$ always independent of intensity. Hence, whenever $\widehat{P}_Y \leq 0 \Rightarrow \widehat{Y} \leq 0$.

Here when $|\theta| > 0$, $\widehat{P_Y} < 0 = \widehat{P_X}$ implies: $\widehat{W_Y} = \widehat{W} < \widehat{P_Y} < 0 < \hat{r}$, $\widehat{W_X} < 0$.

When $|\theta| < 0, \widehat{P_Y} < 0 = \widehat{P_X}$ implies: $\hat{r} < \widehat{P_Y} < 0 < \widehat{W_Y} = \widehat{W}$, $\widehat{X} > 0$, $\widehat{W_X} < 0$.

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