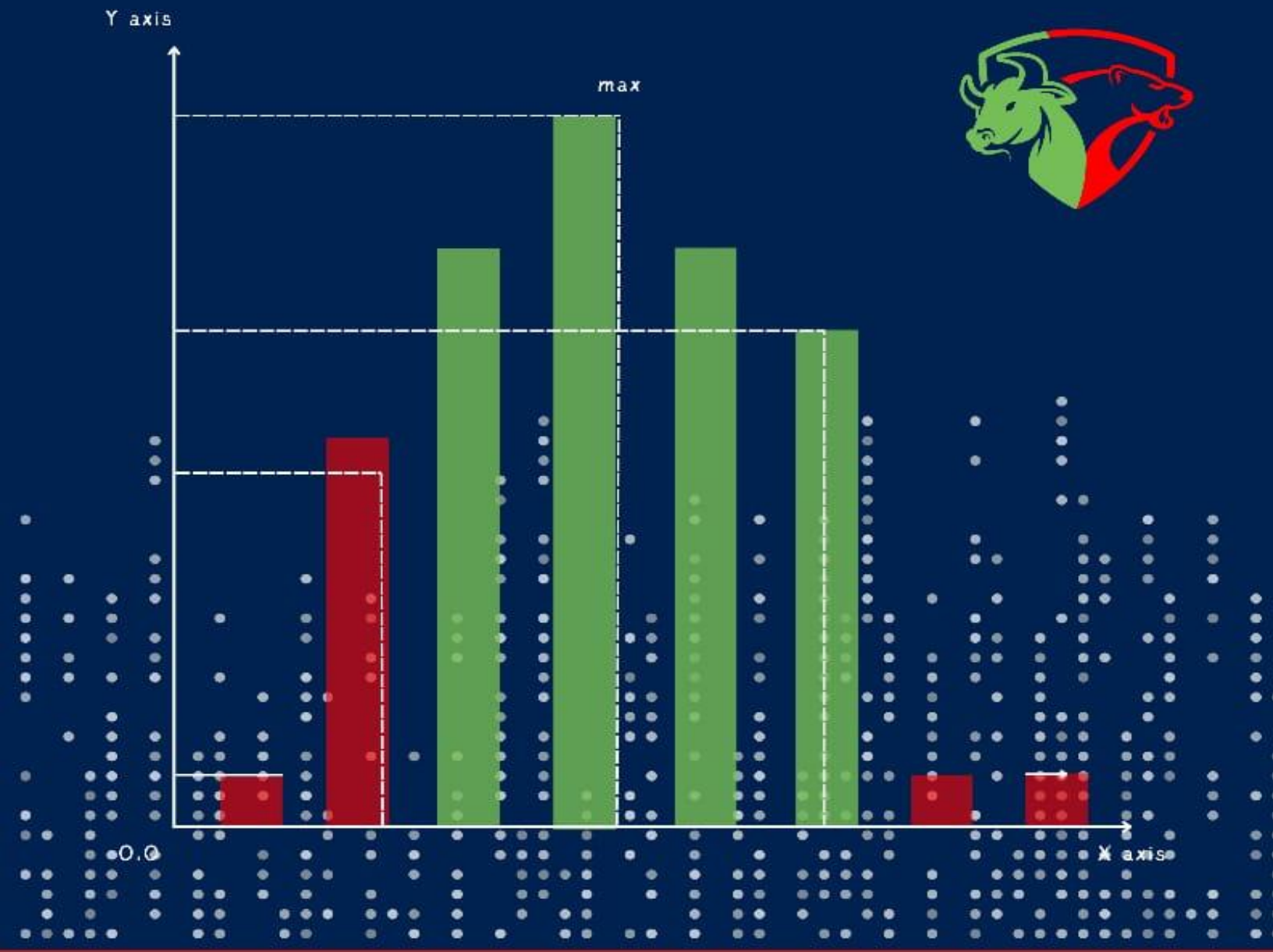
AUER.

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Letter from the Editor

The Ashoka University Economic Review strives to provide research opportunities for undergraduate students to explore diverse fields of economics and demonstrate their superior research skills and academic bent of mind. In that regard, the Editorial Board is proud to present the second volume of the Ashoka University Economic Review with a collection of manuscripts that vary in the fields they delve into and meet the high standard that is demanded of economic research.

I am immensely grateful for the support of the Department of Economics for all the help that was given in pursuance of the AUER. Furthermore, supporting the vision that was established by the previous Editor-in-Chief took effort from the team that comprised of four individuals. I am thankful for the three editors: Aniruddh Bhaskaran, Ritvi Jain and Sudarshan RSA, for their time and effort in going through all the submissions, and patiently reviewing and editing the manuscripts that best suit the standards devoted for the AUER.

This issue hosts papers that cover all the three broad categories of economic research: theoretical models that seek to understand microeconomic behavior including household fuel choice and how it impacts gender and environmental pollution, and how the ‘platform economy’ fares amidst a global economic crisis. There are econometric models researching the female labour force participation, autonomy of women, child health outcomes being impacted by domestic violence experienced by their mothers, amongst other prevalent development issues. Finally, there is a brilliant manuscript investigating China and how its foreign aid giving aligns with its larger foreign policy, a combination of international finance and how it interplays in domestic financial economy.

Thus, the issue promises a thoughtful read, hoping to encourage a larger number of undergraduates in making economic research more accessible, inviting research from myriad perspectives, and contributing, even if marginally, to the larger body of economic literature.

This edition is a manifestation of the spirit of rigorous research and critical thinking, two facets that form the core principles of Ashoka University. I have faith that the following editions will continue to echo the research culture fostered carefully at Ashoka, continuing to grow as more Centers are opened to bolster research and academia.

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Editor-in-Chief

Editorial Board

Tejaswini Vondivillu, Editor-in-Chief
Aniruddh Bhaskaran, Editor
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Household Fuel Choice and Gender Impacts of Environmental Pollution: A Micro-theoretic Analysis

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Abstract

Extensive research has shown that the use of fuels like firewoods, cow dung, coal etc. in cooking is the primary cause of indoor air pollution. This in turn is responsible for the deterioration in the health of the members of the households. Despite this the proportion of population using non-pollution intensive cooking fuel, like electric stoves, LPG gas or solar stoves etc. has increased only slightly. The role of socio-economic and environmental factors in influencing fuel choice of the households is yet to be explored theoretically. Our paper aims to model the decision of household in the choice of cooking fuel by taking into account factors like, indoor pollution, female' say in the family, labour efficiency and family's reputation of using modern fuels. We also explore that how this choice of cooking fuel affects the female labour force participation. Additionally, we also look into the role played by global (outdoor) pollution levels in affecting the optimum allocation of time by females inside as well as outside the household following which indoor pollution is also affected.

JEL Classification: D13, D19, Q50.

Keywords: Outdoor pollution, Indoor pollution, Fuel choice, Female labour force participation, bargaining power.

1. Introduction

Use of traditional biomass fuels—wood, dung, and coal are widespread in rural India especially in the lower income households. According to the 55th round of the National Sample Survey conducted in 1999–2000, which covered 120,000 households, 86 percent of rural households and 24 percent of urban households rely on biomass as their primary cooking.[1] Combustion of these solid fuels inside the home for the purposes of heating or cooking produces particulate and gas emissions that may contain a number of harmful chemicals, such as benzene, carbon monoxide, formaldehyde, and polycyclic aromatic hydrocarbons. The table 1 below shows the expenditure share of 'clean' fuels among rural households improved marginally from about 19 per cent to 23 per cent during the past two decades. On the other hand, the expenditure

[1] National Sample Survey Office Government of India , "India - Employment and Unemployment Survey: NSS 55th Round, Schedule 10.1, July 1999 - June 2000," icssrdataservice.in, October 23, 2015, http://www.icssrdataservice.in/datarepository/index.php/catalog/10.

share of 'clean' fuels in the urban households almost doubled from 39per cent in 1983 to 70 per cent in 1999–2000. In the rural household's firewood and dung accounted for about 80 per cent of the total expenditure on cooking fuels during the entire study period, with the expenditure on kerosene accounting for the rest. The penetration of LPG is very weak with only 4 per cent of expenditure going towards this 'clean' fuel even in 1999–2000.[2]

Table 1. Showing the expenditure share of clean and dirty fuels

Average expenditure shares (%) of different fuels for all India

	Rural			Urban		
	1983	1993–94	1999–2000	1983	1993–94	1999–2000
Firewood	59.0	59.7	58.5	42.1	28.7	22.5
Dung	19.6	19.3	18.0	6.7	5.6	4.0
Kerosene	19.3	18.3	18.2	31.7	32.2	28.2
LPG	0.1	1.4	4.1	6.9	28.7	41.9
'Clean' fuels	19.5	19.9	22.5	38.8	60.9	70.1

Indian households use a variety of fuels for cooking. Figure 1, based on IHDS Wave 2, documents the pervasive use of firewood and cow-dung cakes, followed by that of LPG.[3] It is to be noted from the figure that about 45 percent of the households use LPG and kerosene. If we focus on households that only use clean fuels the corresponding figure is barely 22.5 percent. The rest of the households use a combination of kerosene and LPG for some cooking, while retaining the use of firewood and other biomass for items that do not have to be prepared quickly and are required to simmer.

[2] National Sample Survey Office Government of India , "India - Employment and Unemployment Survey: NSS 55th Round, Schedule 10.1, July 1999 - June 2000," icssrdataservice.in, October 23, 2015, http://www.icssrdataservice.in/datarepository/index.php/catalog/10.

[3] Sonalde Desai and Reeve Vanneman, India Human Development Survey-II (IHDS-II), 2011-12, August 8, 2018, https://doi.org/10.3886/ICPSR36151.v6.

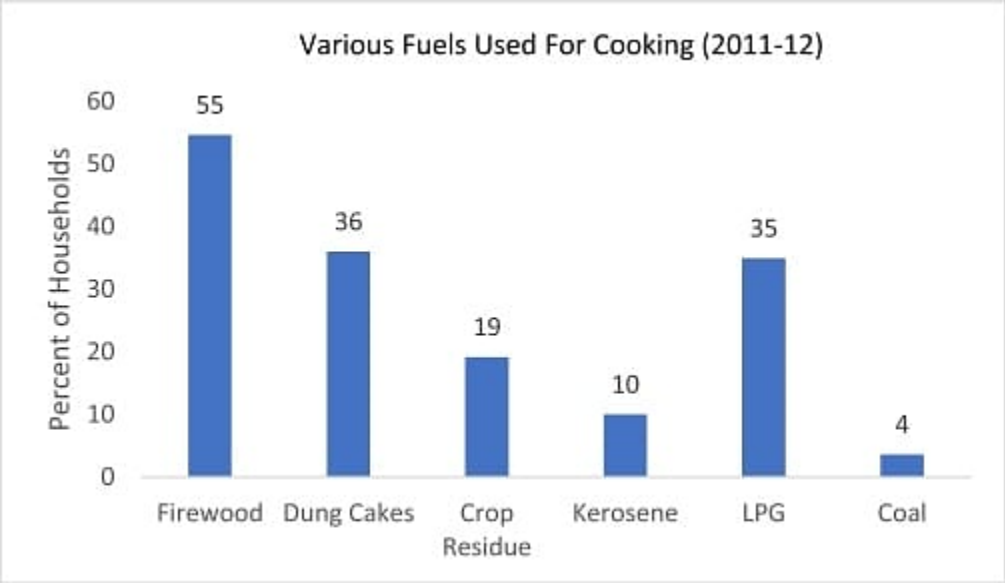


Fig 1: Various fuels used for cooking (2011-12) based on IHDS II data, 2011-12

The concentrations of these harmful indoor pollutants are often significantly higher than those outdoors. Among those who are exposed to these higher levels of air pollutants are mainly women. Smoke, in the indoor environment, is associated with chronic obstructive pulmonary disease and lung cancer among adults.[4] The World Health Organisation estimates that two million people die every year from the resultant smoke from household solid fuel use. Of these deaths, 65% occur in low-income countries and 35% in middle-income countries. Globally, indoor air smoke causes approximately 21% of lower respiratory infection deaths, 35% of chronic obstructive pulmonary deaths and 3% of lung cancer deaths[5]. Several recent studies have shown strong associations between biomass fuel combustion and increased incidence of chronic bronchitis, lung cancer, asthma, tuberculosis in women.

The energy ladder model of fuel use predicts that households will switch from traditional, dirtier fuels such as solid fuels to modern, cleaner fuels such as gas and electricity with an increase in

[4] "Indoor air pollution and lower respiratory tract infections in children, Geneva" WHO Press, World Health Organization, 2007

[5] World Health Organization. *Global health risks: mortality and burden of disease attributable to selected major risks*. World Health Organization, 2009.

income[6] . The dependency of the energy ladder model on income suggests the strong association of poverty with fuel choice and consequently exposure to indoor pollution. Pfaff et al.[7] argued that households cannot directly purchase environmental quality, but it can be improved by substituting more expensive cleaner inputs to production for less costly dirty inputs. However, they observed that a shift towards the cleaner inputs with increase in income only holds for middle-income households. Among poor households as income rises, the pollution also rises due to an abundance of dirty inputs and their unwillingness to substitute. The cheap availability of solid fuel, unawareness of the link between fuel choices, cooking technology and health costs due to indoor air pollution, unavailability or high set-up costs of cleaner fuels and cultural factors may make cleaner fuels less attractive. South Asia is among the low-income regions of the world and poverty is wide spread. A sizeable proportion of the population has no access to clean household energy [8]. Table 2 below depicts the proportion of population using solid fuels and resultant deaths and disability-adjusted life years (DALYs) in India.

Table 2: Proportion of population using solid fuels and associated deaths

Region/Country	Population (000)	Population using solid fuel (%)	Deaths per year	DALYs/1000 capita per year
India	1,11,6985	82	4,88,200	8
Afghanistan	24,076	>95	54,000	78
Bangladesh	1,50,528	89	49,400	8
Bhutan	623	67	200	7
Maldives	291	43	<100	1.6
Nepal	26,554	81	8700	8
Pakistan	1,55,333	81	56,100	9
Sri Lanka	19,040	67	4300	3.2

Owing to the gender-discriminating socioeconomic and cultural norms still prevalent in society, it is the women of the household who customarily cook. Only about 18 percent of

[6] Barnes, Douglas F., Kerry Krutilla, and William F. Hyde. *The urban household energy transition: social and environmental impacts in the developing world*. Routledge, 2010.
[7] Pfaff, Alexander SP, Shubham Chaudhuri, and Howard LM Nye. "Household production and environmental Kuznets curves–examining the desirability and feasibility of substitution." *Environmental and Resource Economics* 27, no. 2 (2004): 187-200.
[8] World Health Organization. *Global health risks: mortality and burden of disease attributable to selected major risks*. World Health Organization, 2009.

women participate in employment and related activities in a day, against 57 percent of men, following a wide gender disparity in India. On the other hand, women in India spend 299 minutes (almost 5 hours), thrice as much as men (97 minutes or 1 hour 37 minutes) on unpaid domestic work. While only 26.1 percent of men in India participate in activities like cooking, most women have revealed they take part in some cooking on a daily basis.[9] The IHDS finds that in about 98 percent of the households, the primary cook is female. Moreover, among households that rely on wood, the responsibility of collecting it also lies heavily on women and girls.[10] This indicates the possibility that gender inequalities in Indian society may play an important role in shaping household decisions about investing in clean fuel, and forms the central theme of this paper, which we examine using nationally representative sample from the second wave of the Indian Human Development Survey (IHDS). The figure below shows that the time spent by women in food preparation is more than that spent by men. Women are exposed to high levels of indoor air pollution, especially because they tend to be the primary caregivers and are in charge of cooking for their families, which exposes them to high levels of indoor air pollution.

[9] Statistics, Energy. "Central Statistics Office, Ministry of Statistics and Programme Implementation. Government of India, New Delhi." (2019)

[10] Desai, Sonalde B., Amaresh Dubey, Brij Lal Joshi, Mitali Sen, Abusaleh Shariff, and Reeve Vanneman. "Human development in India." *New York: Oxford University* (2010).

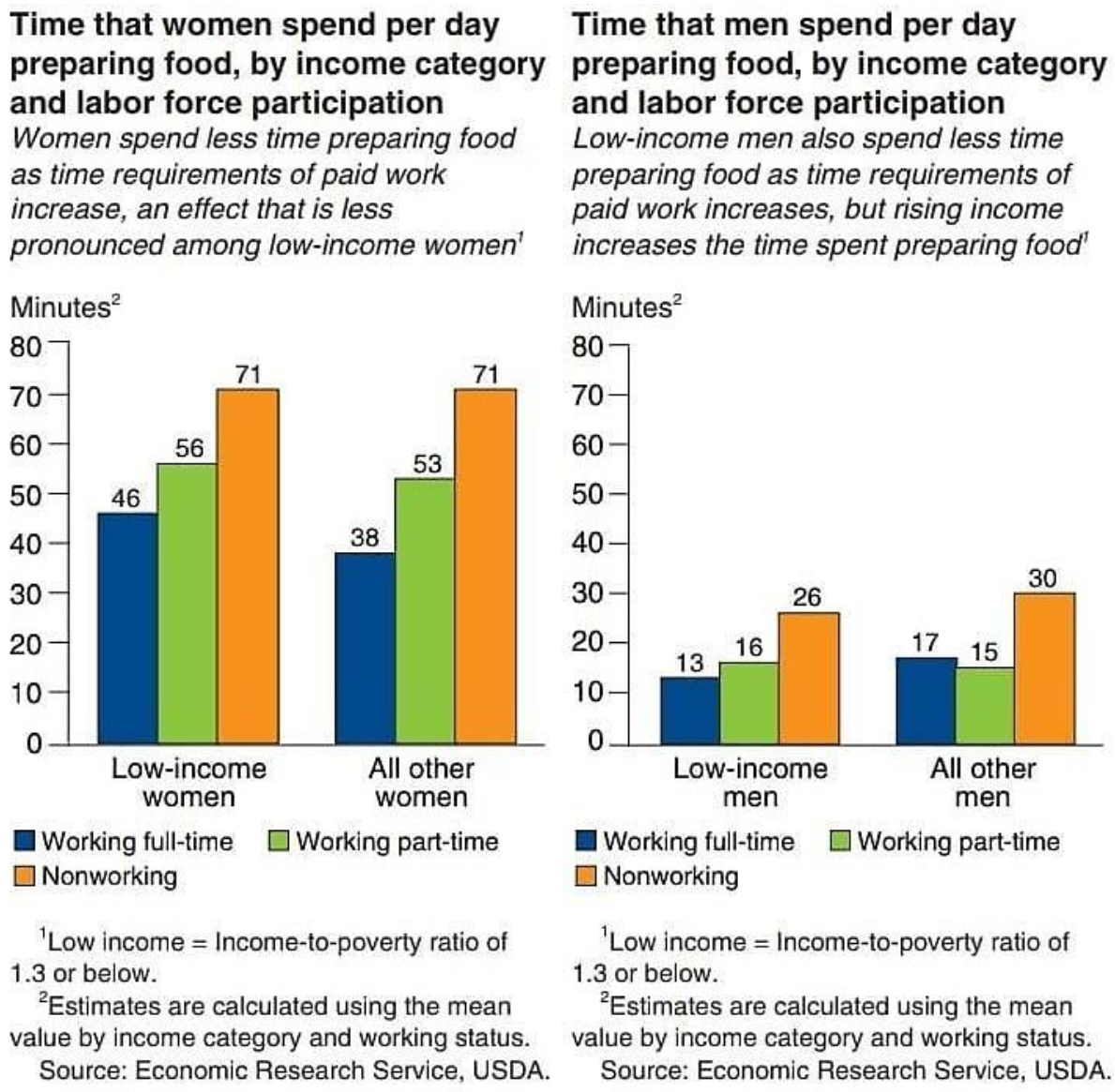


Figure 2 : Women and Men Time Distribution

The most significant issue that concerns indoor air quality in household environments of developing countries is that of exposure to pollutants released during combustion of solid fuels, including biomass (wood, dung, and crop residues) or coal used for cooking and heating. Assessments of the burden of disease attributable to use of solid fuel use in India have put the figure at 3–5 percent of the national burden of disease[11]. Least attention has been given on the

[11] Smith, Kirk R., and Sumi Mehta. "The burden of disease from indoor air pollution in developing countries: comparison of estimates." *International journal of hygiene and environmental health* 206, no. 4-5 (2003): 279-289.

hurdles in fuel choice and quantity decision of fuel consumption at household levels in developing countries like India. Traditional fuels like coal, charcoal, firewood, dung cakes, crop residues, etc. are termed as dirty fuels and create pollution during their combustion which leads to several health hazards. Modern fuels like petroleum, LPG, biogas, electricity, etc. are termed as clean fuels which are more efficient than traditional fuels. Firewood, which is often considered as a renewable source of energy,[12] is considered as dirty fuel since it adds to CO2 emissions upon combustion. Large part of supply of firewood comes from deforestation, which acts as a threat to environment. Till today, the dirty fuels are the major source of cooking fuels for households of developing economy like India. It is important to understand the determinants of cooking fuel choice at household level under different constraints. Household fuel consumption decision depends on their socio-economic backgrounds. Various studies pointed out several determining factors of fuel consumption at household level like income, fuel price, religion, caste, sex of household head, age of household head, educational level etc.[13]

This paper focuses on how climate change influences fuel choice of a typical low income household of rural India. The paper includes all the analysis on a micro level. This paper focuses on the outdoor and indoor air pollution, income of the household and the sex of the household head as the major factor determining the choice of fuel. This paper aims to analyse the association of poverty, fuel choice and exposure to indoor as well as outdoor air pollution. This paper will not only provide an insight into fuel choice and poverty but would also be helpful in designing control strategies to arrest the elevating levels of indoor air pollution. With the help of comparative statics this paper aims to show that with increase in bargaining power of women consumption of solid fuels like firewood, coal, etc decreases. This paper also provides the linkage between indoor air pollution and outdoor air pollution. The paper provides an insight on how the time spent by women in wage earning activities affects the total utility of the household given the individual utility and income function of the male and female member. Increased awareness through education and removing social barriers might help to reduce firewood consumption and take India towards sustainable development.

[12] Couture, Stéphane, Serge Garcia, and Arnaud Reynaud. "Household energy choices and fuelwood consumption: An econometric approach using French data." *Energy Economics* 34, no. 6 (2012): 1972-1981.
[13] Jingchao, Zhang, and Koji Kotani. "The determinants of household energy demand in rural Beijing: Can environmentally friendly technologies be effective?." *Energy Economics* 34, no. 2 (2012): 381-388.

This rest of the paper is organised as follows: In section 2, we review literature focusing on the pollution issues and fuel choice. In section 3, we provide a brief description of the economy which includes the model assumptions. A couple of comparative statics has been carried out in section 4. Finally, section 5 concludes the paper.

2. Review of Literature and Interventions

The negative environmental and health effects of using traditional fuels like firewood for cooking in domestic households have been documents in several literatures.

According to Kim et al.[14] pollutant emissions from domestic and commercial cooking were previously overlooked. Concerns about human health exist all across the world. Its health implications are significant for not just individuals in less-developed nations that use low-quality food ingredients, but also affluent individuals enjoying higher-quality food in more developed countries. A wide range of hazardous air pollutants (HAP) are emitted during the cooking of food using traditional fuelwood. The level of pollutants emitted by such activities might pose major hazards to the environment and human health, particularly for those undertaking cooking and their household members. The health consequences of such exposure affect the respiratory tract and can easily penetrate the alveolar-capillary barrier and reach key bodily organs via the circulatory system. Indoor air pollution must consequently be monitored in household settings, restaurant kitchens, and eating spaces. Furthermore, determining the safety of indoor air requires a deeper knowledge of the harmful effects of indoor air pollution. Moreover, Rohra and Taneja[15] further claim that among the various sources of IAP, the contamination of indoor air environments by solid fuel accounts for 1.6 million deaths annually and is also responsible for holding back the country's development through resulting ill health. It remains the leading environmental cause of disease after contaminated water, a lack of sanitation, and poor hygiene.

Several papers have established various determinants of fuel choice as the topic of study. Socioeconomic factors influence fuel consumption decisions in rural Indian households. Daripa

[14] Kim, Ki-Hyun, Sudhir Kumar Pandey, Ehsanul Kabir, Janice Susaya, and Richard JC Brown. "The modern paradox of unregulated cooking activities and indoor air quality." *Journal of Hazardous materials* 195 (2011): 1-10.
[15] Rohra, Himanshi, and Ajay Taneja. "Indoor air quality scenario in India—an outline of household fuel combustion." *Atmospheric Environment* 129 (2016): 243-255.

and Dinda[16] (2002) suggest, firstly, firewood consumption decisions depend on whether or not households participate in firewood consumption. Secondly, it depends on the amount of consumption for those who participate. The participation equation indicates average household age composition, age of household head, land owned, family size, social groups of ST, SC, and OBC, female headed households, and education of household head at below primary, primary, and middle levels all have a positive effect on the probability of firewood selection. The average education level of the household, religious group, and secondary and higher education level of the household head all have a negative effect on the use of firewood as a cooking fuel. According to the quantity equation, income, household size, average age of household, average education of household, ST social group, Islam, Christianity, and other religious groups, and education of household head at primary level indicate a positive effect on firewood consumption, whereas land holding, female headed household, and secondary education indicate a negative effect on firewood consumption. Minimizing fuelwood usage requires raising awareness through education and eliminating societal barriers.

Malla and Timilsina[17] (2014) reveal that a wide variety of factors, including socioeconomic, health, behavioural, cultural, local environment, technology, legislation, and access to infrastructure, influence family cooking fuel choice and Improved Cooking Stoves (ICS) adoption. Although households with greater incomes and education are more likely to utilise modern fuels, their choice for cooking fuel selection and ICS implementation is both complex and multifaceted; a thorough grasp of the interplay of these components is required for the creation of government programmes and policies and ways to promote the availability of modern cooking fuels and ICS adoption. Several studies show that indoor pollution has a major detrimental influence on one's health. Existing research also indicates that biomass burning for cooking is a significant source of black carbon emissions, which have a negative impact on the climate system. In low-income households, the cost of cookstoves and the opportunity cost of time spent gathering biomass outweigh the perceived health advantages of using ICS and the financial benefits of fuel savings. The study also identifies substantial limits in the methodology

[16] Daripa, Sanchita, and Soumyananda Dinda. "Hurdles in Fuel Choice and Consumption in Rural India." In *Persistent and Emerging Challenges to Development: Insights for Policy-Making in India*, pp. 109-123. Singapore: Springer Nature Singapore, 2022.

[17] Malla, Sunil, and Govinda R. Timilsina. "Household cooking fuel choice and adoption of improved cookstoves in developing countries: a review." *World Bank Policy Research Working Paper* 6903 (2014).

used to estimate the societal costs and benefits of ICS adoption and fuel choice, as well as a need for more research to better understand ICS adoption over time.

Findings from the paper by Akter and Pratap[18] (2022) show that the true societal benefits of using clean cooking fuel outweigh the social welfare effects of lower greenhouse gas emissions and the health benefits of lower indoor air pollution. Clean cooking fuel adoption provides immediate and direct benefits to women's wellbeing. Given that women have less time and a greater burden of unpaid labour than men, clean cooking fuel adoption has the potential to close the gender gap in unpaid household work by lowering fuel collection/preparation and cooking time, as well as moving fuel collection responsibilities from women to men. By freeing up time and minimising smoke exposure, it can thereby increase women's possibilities for education, work, and well-being. Choudhuri and Desai[19] (2020) concludes households where women have greater market engagement and control over spending decisions tend to be more willing to invest in the use of clean cooking fuels. Women's income must be separated from total yearly family income; women's earned money can impact household adoption of clean fuel through both the income and substitution effect. Increases in women's salaries increase overall household income, creating a larger percentage of disposable money available for clean energy adoption through the income effect. However, data shows that households in the top quintiles continue to use alternative solid fuel sources, which are frequently determined by local energy markets or taste and preferences. The findings also show that when women are engaged in relatively stable and independent work, households appear to be more inclined to invest scarce resources in clean fuels due to the substitution effect, which frees up their time from collecting fuelwood or other biofuel and cooking for long hours, reducing the negative health impacts for women who are the primary cooks. Women appear to value clean fuels significantly more than other home commodities, and that when women have more power over family expenditure decisions, this is mirrored in greater investment in clean fuel by the household. Public policies that promote women's access to and control over independent resources may increase their usage of clean fuels.

[18] Akter, Sonia, and Chitra Pratap. "Impact of clean cooking fuel adoption on women's welfare in India: The mediating role of women's autonomy." *Sustainability Science* 17, no. 1 (2022): 243-257.
[19] Choudhuri, Pallavi, and Sonalde Desai. "Gender inequalities and household fuel choice in India." *Journal of cleaner production* 265 (2020): 121487.

The distinguishing feature in our paper with respect to the previous papers lies in how we aim to establish the environment as a major determinant of fuel choice in rural Indian households besides female empowerment. Adverse environmental conditions have a detrimental effect on the health and, thereby, the efficiency of rural workers. Workers who are less efficient have lower productive capacity and, as a result, earn lower wages due to low output production. When household income is low, rural households have little choice but to use traditional fuel wood, which is a free good, for cooking. We go on to relate how fuel choice induces indoor pollution. Combustion of biomass, i.e., firewood, releases HAPs and induces indoor pollution, which has a harmful effect on human health, further worsening the efficiency level of household members, primarily the women of the household engaged in the cooking activity. Indoor pollution from rural households contributes to outdoor pollution and affects humans worldwide. Therefore, we are trapped in a vicious cycle of low productive capacity and pollution.

However, we consider an alternate possibility where rural households offset their low productive capacity by switching to clean fuel such as LPG in spite of their low income. This would turn our previous scenario on a positive note such that adoption of LPG would eliminate indoor pollution and improve the health of household members. Better health implies higher efficiency and improved productive capacity of household members participating in the workforce. The consequent result is more output, which increases the wages and overall income of the household. Again, the contribution to outdoor pollution by indoor pollution caused by the use of firewood is eliminated. As a result, the global environment is improving. We can break free of the vicious cycle.

As in previous papers, we consider socio-economic determinants of fuel choice as well. Our paper investigates the roles of the bargaining power of male members, (α) outdoor air pollution (Z_0) and fiscal policy in changing preferences for the type of fuel consumed for cooking purposes.

3. Description of the Economy

For the purpose of our model, we consider a representative household comprising of a male (M) and a female member (F) . The members of the household consume food that they cook.

We denote the total household requirement of food by C .This production of food for consumption takes place within the household. We assume that the household uses two main resources for food preparation – pollution-intensive fuels like firewood, charcoal, etc (denoted by w) and non-pollution-intensive fuels, here, as LPG and electricity (denoted by g) by devoting time available for cooking on either or both of these inputs. Hence the inputs for our model are time spent on burning solid fuels (w) and time spent on burning LPG.[20] Thus we write the production function of the household as follows:

$$C = ag + bw \tag{1}$$

These two inputs are assumed to be perfect substitutes implying that a household either uses only dirty fuel or clean fuel or a combination of both during cooking. The marginal rate of technical substitution of dirty fuels for LPG varies from one household to the other and is influenced by several behavioural and cultural factors like food tastes, lifestyle, traditional norms etc. However, the MRTS remains constant for a particular household. The combustion of solid fuels causes indoor air pollution. So, we consider indoor pollution to be directly proportional to time spent on burning fuelwood, where the constant of proportionality represents factors like poor ventilation, fuel-inefficient stoves, etc.

The utility derived by the female member of the household depends on the consumption of food cooked and indoor air pollution. We assume that the proportion of food consumed by her is half of the total food cooked. Thus, the quantity of food consumed is a good for the female. However, exposure to the pollutants emitted during cooking (denoted by Z_I) has a negative impact on the health of the female, who customarily cooks for the entire household. So, we consider indoor air pollution to be a bad for the female.

$$U_f = \log(C/2) - \log Z_I \tag{2}$$

The quantity of food consumed is the only determinant of the male member's utility. We consider that the male member does not associate himself with cooking, and hence is not exposed to indoor air pollution. He derives positive utility from consuming half of the total food

[20] The time used in burning the fuel is positively correlated to the quantity of fuel burned.

cooked. Again, we consider that the reputation of the male member increases with increase in LPG.[21]

$$U_m = \log(C/2) + \chi \log(g) \tag{3}$$

The total time (hours) available to both male and female members for work is constant positive, denoted by $\bar{T}$. We make a further assumption that while the female allocates her time between unpaid household work – cooking and paid work, the male solely engages in wage-earning activities (l_f) and hence allocates his entire time to it. Here time spent on cooking is measured as the sum of time spent on burning the dirty and clean fuels. Hence, the time constraint is written as

$$l_f = \bar{T} - (g + w) \tag{4}$$

The male and female members of the household participate in income-generating activities outside the household. The income earned by any individual is determined by the market wage rate, his/her productivity and time spent in paid work. Productivity of any individual is positively correlated to the local and global environmental quality which in turn is inversely related to the level of outdoor pollution. An increase in pollution causes a rise in temperature which has adverse biophysical impacts on human performance. In other words, the higher the outdoor pollution level, the lower the environmental quality and consequently lower the labor productivity. Thus, labour productivity is an increasing function of environmental quality. This is denoted by

$$\begin{aligned} h &= h(\mathrm{E});\ h' > 0,\ h'' = 0 \\ \mathrm{E} &= \mathrm{E}(Z_o);\ \mathrm{E}' > 0,\ \mathrm{E}'' = 0 \end{aligned} \tag{5}$$

The income earned by the female member is the market wage rate for female (μ_f) times the total hours she devotes to paid activities and her individual labour productivity. Similarly, the

[21] George. A. Akerlof (1980) shows how reputation is lost due to non-adherence to social norms. LPG is an aspirational fuel and there is widespread acknowledgment of its superiority as a cooking fuel. Hence use of LPG can be viewed as a symbol of education and wealth.

product of market wage rate for males (μ_m), totals hours spent on aid activities by male and his labour productivity is equal to the income earned by the male member.

$$I_f = h(E)\mu_f l_f$$

$$I_m = h(\mathrm{E})\mu_m \bar{T} \tag{6}$$

Thus, the total income of the household is the sum of the income of male and female members of the household. We consider that the food the household cooks is the only good consumed by the household. Hence money spent on cooking or more specifically on purchasing cooking fuels is the only expenditure incurred by the household. Additionally, we assume that traditionally used dirty fuels are free goods. This is because majority of the dirty cooking fuels such as cow dung cakes, wood, dry leaves etc. are freely available as by-product of other main economic activity or available at a very negligible cost. Hence the total cost of cooking is the expenditure on LPG calculated as the product of the price of LPG per unit of time (P_g) and the total time spent on using LPG. The total expenditure of the household cannot exceed its total income. Therefore, the budget constraint of the household gives us equality between total income and total expenditure incurred by the household.

$$P_g g = h(\mathrm{E})l_f \mu_f + h(\mathrm{E})\mu_m \tag{7}$$

Finally, we assume that the total utility of the household is the weighted average of the utility of male and female members of the household where the weights assigned reflect the bargaining power of the individual member in the household. Bargaining power is an important determinant of household economic decisions and depends on factors like income, societal norms, assets owned among others. However, these factors are exogenous to our model and hence the bargaining power. Thus, the utility function of the household is denoted by

$$V = \alpha\mu_m + (1-\alpha)\mu_f \tag{8}$$

The following notations are used in the model:

C - Production of food to be consumed

g - Total time spent in using Liquified Petroleum Gas (LPG)

w - Total time spent in using traditional fuels

a - Proportion of time spent on using LPG

b - Proportion of time spent on using dirty fuels

Z_I - Indoor air pollution

$\overline{T}$ - Total time endowment of male and female members to be spent on work

l_F - Time spent by female in wage earning activities

W_F - Market wage rate for females

W_M - Market wage rate for males

E - Outdoor environmental quality

$h(\mathrm{E})$ - Labour productivity

I_F - Income of female member

I_M - Income of male member

P_g - Price per unit time spent on using LPG

Z_O - Outdoor air pollution

V - Total Household utility

α - Bargaining power of male members

Lemma 1: $l_f(\alpha, Z_o, \mu_m, \mu_f) > 0$ is implied by the condition $\frac{1}{C}\left(\frac{ah(E)\mu_f}{P_g}\right)+\frac{\chi\alpha h\mu_f}{gP_g}+\frac{(1-\alpha)}{W}\left(1+\frac{h(E)\mu_f}{P_g}\right)=\frac{b}{C}\left(1+\frac{h(E)\mu_f}{P_g}\right)$.

Proof: For mathematical derivative, see appendix.

In what follows, we offer an intuitive explanation of lemma 1. As the time spent by female member in wage earning activities increases, income earned by her rises leading to rise in overall household income. This induces the household to replace pollution-intensive fuelwood with more of the expensive but cleaner fuels like LPG. Thus, time spent on dirtier fuels reduces and time spent on cleaner fuels increases. Consequently, indoor pollution generated by firewood decreases and female health improves. The social position and reputation of the male member is positively related to use of LPG. Hence the increase in use of LPG is further amplified by this effect.

On the other hand, there is an overall decrease in the time spent by the female on unpaid domestic work, here cooking, which implies that the total time spent using both LPG and firewood reduces. Hence, we can deduce that the fall in the use of firewood must dominate the rise in the use of LPG. However, a fall in cooking time will cause a fall in the production of food in the household. Hence marginal consumption of food reduces for both male and female causing overall satisfaction level to plummet. Lemma 1 puts fort the condition that the marginal gain of the household due to increase in female labour force participation must equal the consequent marginal loss in order to obtain a strictly positive interior solution of female labour force participation.

Lemma 2: Household choice of $l_f(\alpha, Z_o, \mu_m, \mu_f) > 0$ maximizes family utility if and only if

$$\frac{\alpha(1-\alpha)}{W^2}\left(1+\frac{h(E)\mu_f}{P_g}\right)^2 < \left(\frac{\chi\alpha h(E)\mu_f}{P_g g}\right)\left\{\frac{h(E)\mu_f(1+\chi\alpha)}{P_g g}+\frac{2(1-\alpha)}{W}\left(1+\frac{h(E)\mu_f}{P_g}\right)\right\}.$$

This condition in Lemma 2 guarantees that optimal value of maximizes household utility. In other words, it represents the second-order sufficient condition of maximization.

4. Comparative Statics

4.1 Increase in global pollution level (rise in Z_0)

To obtain the effect of rise in Z_0 ,we differentiate the first order condition in Lemma 1 with respect to Z_0 which leads to the following expression:

$$\frac{\partial l_f}{\partial Z_o} = \frac{\begin{array}{l} \dfrac{-(a-b)h'E'}{C\,P_g}\left[\mu_f - \left\{\dfrac{\chi\alpha h\mu_f}{gP_g} + \dfrac{(1-\alpha)}{W}\left(1+\dfrac{h(E)\mu_f}{P_g}\right)\right\}\left(\dfrac{l_f\mu_f + \mu_m\bar{T}}{P_g}\right)h'E'\right] \\ \qquad - \dfrac{(1-\alpha)h'E'}{W\,P_g}\left\{\mu_f + \dfrac{\left(1+\dfrac{h(E)\mu_f}{P_g}\right)\left(l_f\mu_f + \mu_m\bar{T}\right)}{W}\right\} \end{array}}{\dfrac{\alpha(1-\alpha)}{W^2}\left(1+\dfrac{h(E)\mu_f}{P_g}\right)^2 - \left(\dfrac{\chi\alpha h(E)\mu_f}{P_g g}\right)\left\{\dfrac{h(E)\mu_f(1+\chi\alpha)}{P_g g} + \dfrac{2(1-\alpha)}{W}\left(1+\dfrac{h(E)\mu_f}{P_g}\right)\right\}}$$

Proposition 1: *An increase in the level of global (outdoor) pollution leads to fall in the female labour force participation. Reduction of the wage-earning activities of the female member influences the household to increase the use of pollution intensive fuels. This increase in the use of dirty fuels accentuates indoor air pollution provided a>b.*

Proof: In what follows we offer an intuitive explanation to the Proposition 1

Due to rise in outdoor air pollution the environmental quality degrades which affects the health of the female member of the household. Poor health of the female reduces her work efficiency and leads to reduction in her income. The time spent by her in outdoor work also decreases as in increased absence from work leading her to devote more time to domestic work (here cooking). The gender bias we have integrated in our model focuses on the fact that the female member is the sole contributor to unpaid household works related to food preparation. The male member also gets affected by the outdoor air pollution which leads to degradation of his health. In this situation the female member has to sacrifice her wage-earning hours in order to focus on her spouse's health. So, the female member spends more time in unpaid indoor work than paid outdoor work. This leads to fall in income of the female which adversely affects the income of the household. As a result, the household switches to cheaper alternatives of cooking fuel. The cheaper fuels are the pollution intensive fuels which lead to rise in indoor air pollution. This effect is observed in the case where a is greater than b where a is the marginal productivity of LPG and b is the marginal productivity of dirty fuels. This condition entails that as the income of the household decreases it substitutes 1 unit of the costlier fuel i.e., LPG by more than 1 unit

of the cheaper fuels to produce the same amount of food for consumption. This increased consumption of the cheaper fuels leads to rise in indoor air pollution. Thus, we get a positive relation between outdoor and indoor air pollution levels.

4.2. Increase in the female member's bargaining power in household (rise in $(1-\alpha)$)

To obtain the effect of rise in $(1-\alpha)$, we differentiate the first order condition with respect to α which leads to the following expressions

$$\frac{\partial l_f}{\partial \alpha} = \frac{-\left(\chi h \mu_f / P_g\right) + \frac{1}{W}\left(1 + \frac{h(E)\mu_f}{P_g}\right)}{\frac{\alpha(1-\alpha)}{W^2}\left(1 + \frac{h(E)\mu_f}{P_g}\right)^2 - \left(\frac{\chi \alpha h(E)\mu_f}{P_g g}\right)\left\{\frac{h(E)\mu_f(1+\chi\alpha)}{P_g g} + \frac{2(1-\alpha)}{W}\left(1 + \frac{h(E)\mu_f}{P_g}\right)\right\}}$$

$\frac{\partial l_f}{\partial \alpha} > (<) 0$ accordingly, as $\frac{\chi h \mu_f}{P_g} > (<)\left(1 + \frac{h\mu_f}{P_g}\right)\left(\frac{1}{W}\right)$.

The following proposition is immediate:

Proposition 2: *An increase in female's bargaining power in the household results in:*

2a) *lower female labour force participation, the family's demand for clean cooking fuel falls and the indoor pollution resulting from higher use of dirty cooking fuel accentuates if* $\frac{\chi h \mu_f}{P_g} > \left(1 + \frac{h\mu_f}{P_g}\right)\left(\frac{1}{W}\right)$.

2b) *higher female labour force participation, the family's demand for clean cooking fuel rises and the indoor pollution improves if* $\frac{\chi h \mu_f}{P_g} < \left(1 + \frac{h\mu_f}{P_g}\right)\left(\frac{1}{W}\right)$.

Proof: In what follows, we offer an intuitive explanation to the proposition 2a.

2a) The effect of fall in income overpowers the reputation effect of the male member and the health effect of the female member. Even when the use of LPG will increase the male member's reputation, he will not switch to cleaner fuels because of lower household income. If

he tries to buy LPG it will create a pressure on the household's budget constraints owning to low income. Similarly, the female member will not shift her preference to costlier fuel in order to improve her health. Instead of giving preference to her health conditions she will try to adjust to dirty fuels. Thus, use of dirty fuels will increase indoor air pollution.

2b) Higher female labour force participation. This results in increase in the time spent by her in outdoor paid activities. So, her income increases and the household switches to cleaner fuels. The reputation factor and the health factor also play an important role in the fuel choice of the household.

Proof: In what follows, we offer an intuitive explanation to the proposition 2b. Increase in the female member's income allows the household to afford LPG. Thus, increase in use of clean fuel reduces indoor air pollution. In order to stimulate his reputation, the male member will try to switch to LPG and will thus help in the reduction of indoor pollution. As the bargaining power of the female increases, she will try to reduce her disutility by reducing the negative effects on her health. In order to do so she needs to shift her preference to LPG. Thus, the health of the female member also impacts the fuel choice of the household.

5. Conclusion

The aim of this research was to investigate the role of income, outdoor air pollution and female labour force participation in generation of indoor air pollution by identifying the proximate determinants for fuel choice in India. An optimisation model was used to estimate the factors influencing fuel choice. The results indicated that outdoor air pollution, bargaining power of the female member and income of the household are the key factors determining indoor air pollution and fuel choice in India. The study revealed that poor households in rural India tend to use dirty fuels on a larger scale. Sex of the household head was found to be an important correlate of fuel choice. The study showed that reputation of the male member influenced the fuel choice of the household. The paper established that use of LPG increased the reputation of the male which in turn reduced the indoor pollution. In India indoor air pollution is a significant economic burden. Nasir et al.[22]proposed pragmatic intervention strategies (switching to cleaner fuels, improved cooking stoves and improved cooking environment). They also argued that

[22] Nasir, Zaheer Ahmad, Fowad Murtaza, and Ian Colbeck. "Role of poverty in fuel choice and exposure to indoor air pollution in Pakistan." *Journal of Integrative Environmental Sciences* 12, no. 2 (2015): 107-117.

traditional ethno- environmental knowledge can be used as a tool to design and implement sustainable environmental interventions to reduce indoor air pollution in low-income countries and proposed a methodological approach to identify and implement the community based sustainable environmental interventions to reduce the exposure to indoor air pollution. Knowledge on proximate determinants of fuel choice can be used to inform policy and intervention strategies to reduce the exposure to indoor air pollution.

Although this study used data from India, the findings could also be relevant to other low-income countries with excessive use of solid fuel to comprehend the complexity and connectivity of diverse socio-economic factors in the transition from unclean to clean fuel usage, in order to design sustainable intervention strategies to improve indoor environmental quality in developing world. The estimated model results must be interpreted with caution. They basically provide indicative broad patterns, but not the specific causal relationship. Nonetheless, information on the proximate determinants for fuel choice can greatly assist in informing policy and in designing sustainable intervention strategies to combat indoor air pollution. The economic, social and environmental conditions at all levels are continuously changing which may lead to rapid changes in the economic conditions and behaviour of households.

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Mathematical appendix

$\partial g / \partial l_f = h\mu_f / P_g ; \partial w / \partial l_f = -(1 + h\mu_f / P_g)$

First Order Derivative

$$= \begin{array}{l} \alpha[1/C\{ah\mu_f / P_g - b(1 = h\mu_f / P_g)\} + rh\mu_f / gP_g] + \\ (1-\alpha)[1/C\{ah\mu_f / P_g - b(1 + h\mu_f / P_g)\} + k / Z_I(1 + h\mu_f / P_g)] \end{array}$$

$$= \begin{array}{l} 1/C\{ah\mu_f / P_g - b(1 + h\mu_f / P_g)\} + r\alpha h\mu_f / gP_g + \\ \{(1-\alpha)k / Z_I\}(1 + h\mu_f / P_g) \end{array} \quad 1/C(ah\mu_f / P_g) +$$

$$\Rightarrow 1/C\{ah\mu_f / P_g - b(1 + h\mu_f / P_g)\} + r\alpha h\mu_f / gP_g +$$
$$\{(1-\alpha) / w\}(1 + h\mu_f / P_g) = 0 \ldots\ldots (7)$$

$$\Rightarrow 1/C(ah\mu_f / P_g) + r\alpha h\mu_f / gP_g + \{(1-\alpha) / w\}(1 + h\mu_f / P_g) =$$
$$b / C(1 + h\mu_f / P_g)$$

Lemma 1: $l_f(\alpha, \mu_f, \mu_m, Z_0) > 0$ is implied by

$$1/C(ah\mu_f / P_g) + r\alpha h\mu_f / gP_g + \{(1-\alpha) / w\}(1 + h\mu_f / P_g) =$$
$$b / C(1 + h\mu_f / P_g)$$

Second Order Derivative

Derivation of (7)-

$$d^2v / dl_f^{\,2} = -1/C^2\{ah\mu_f / P_g - b(1 + h\mu_f / P_g)\}^2 - r\alpha h^2 \mu_f^{\,2} / g^2 P_g^{\,2} +$$
$$\{(1-\alpha) / w^2\}(1 + h\mu_f / P_g)^2$$

$$= -\{ah\mu_f / P_g C - b(1 + h\mu_f / P_g C)\}^2 - r\alpha h^2 \mu_f^{\,2} / g^2 P_g^{\,2} +$$
$$\{(1-\alpha) / w^2\}(1 + h\mu_f / P_g)^2$$

$$= -\{r\alpha h\mu_f / gP_g + (1-\alpha) / w(1 + h\mu_f / P_g)\}^2 - r\alpha h^2 \mu_f^{\,2} / g^2 P_g^{\,2} +$$
$$\{(1-\alpha) / w^2\}(1 + h\mu_f / P_g)^2$$

$$= -r\alpha h^2 \mu_f{}^2 (1+r)/g^2 P_g{}^2 + [\{(1-\alpha)/w^2\}(1+h\mu_f/P_g)^2](1-1+\alpha)$$
$$-\{2r\alpha h\mu_f (1-\alpha)/gP_g w\}(1+h\mu_f/P_g)$$

$$= -r\alpha h^2 \mu_f{}^2 (1+r)/g^2 P_g{}^2 + \{(1-\alpha)\alpha/w^2\}(1+h\mu_f/P_g)^2$$
$$-\{2r\alpha h\mu_f (1-\alpha)/gP_g w\}(1+h\mu_f/P_g)$$

$d^2v/dl_f{}^2 < 0$ iff $\{\alpha(1-\alpha)/w^2\}(1+h\mu_f/P_g) < r\alpha h\mu_f/P_g g[h\mu_f(1+r)/P_g g + \{2(1+\alpha)/w\}(1+h\mu_f/P_g)]$

Lemma 2:-Household choice of $l_f(\alpha, \mu_f, \mu_m, Z_O)$ maximizes family utility if and only if $\{\alpha(1-\alpha)/w^2\}(1+h\mu_f/P_g) < r\alpha h\mu_f/P_g g[h\mu_f(1+r)/P_g g + \{2(1+\alpha)/w\}(1+h\mu_f/P_g)] < 0$

Comparative statics

Differentiating (7) with respect to Z_0 -

$$(1/C)\{(a\mu_f - b\mu_f)/P_g\}h'E' + [(ah\mu_f/P_g) - b\{1+(h\mu_f/P_g)\}](-1/C^2)$$
$$[a\{((l_f\mu_f + \bar{T}\mu_m)/P_g)h'E' + h\mu_f \partial l_f/P_g \partial Z_0\} -$$
$$b\{(\partial l_f/\partial Z_0)(1+h\mu_f/P_g) + (l_f\mu_f h'E'/P_g) + \bar{T}\mu_m h'E'/P_g\}] +$$
$$[\{(r\alpha\mu_f h'E'/P_g)P_g g\} + r\alpha h\mu_f/P_g g^2]\{(((l_f\mu_f + \bar{T}\mu_m)/P_g)h'E') + h\mu_f \partial l_f/P_g \partial Z_0\} +$$
$$\{((1-\alpha)h'E'\mu_f/P_g w) + (1-\alpha)/w^2(1+(h\mu_f/P_g))\{(\partial l_f/\partial Z_0)(1+(h\mu_f/P_g)) + ((l_f\mu_f + \bar{T}\mu_m)/P_g)h'E') = 0$$

$$\Rightarrow (\partial l_f/\partial Z_0)[(1/C^2)\{b(1+(h\mu_f/P_g)) - ah\mu_f/P_g)\}\{(ah\mu_f/P_g) -$$
$$b(1+(h\mu_f/P_g))\} - (r\alpha\mu_f{}^2 h^2/P_g{}^2 g^2) + ((1-\alpha)/w^2)(1+(h\mu_f/P_g)^2] +$$
$$(1/C)[\{(a\mu_f - b\mu_f)/P_g\}h'E' + (1/C^2)\{(ah\mu_f/P_g)$$
$$-b(1+(h\mu_f/P_g))\}\{a((l_f\mu_f + \bar{T})/P_g)h'E' - h'E'((l_f\mu_f + \mu_m\bar{T})/P_g)\} +$$
$$(r\alpha\mu_f h'E'/P_g g)\{1+h((l_f\mu_f + \mu_m\bar{T})/P_g g)\}$$
$$+((1-\alpha)/w)(h'E'/P_g)\{\mu_f + ((1+(h\mu_f/P_g))/w)((l_f\mu_f + \mu_m\bar{T})\} = 0$$

$$=> (\partial l_f / \partial Z_0)[-(r\alpha {\mu_f}^2 h^2 / {P_g}^2 g^2) - ((1-\alpha)^2 / w^2)(1+(h\mu_f / P_g))^2 -$$
$$((2r\alpha h\mu_f (1-\alpha)(1+(h\mu_f / P_g)) / P_g g w) -$$
$$(r\alpha {\mu_f}^2 h^2 / {P_g}^2 g^2) + ((1-\alpha)^2 / w^2)(1+(h\mu_f / P_g))^2] +$$
$$((1/C)((a-b)h'E') / P_g)[\mu_f + (1/C)\{(ah\mu_f / P_g) - b(1+(h\mu_f / P_g))\}$$
$$\{((l_f \mu_f + \mu_m \bar{T}) / P_g)h'E'\}] + ((1-\alpha) / w)(h'E' / P_g)$$
$$\{\mu_f + ((1+(h\mu_f / P_g)) / w)(l_f \mu_f + \mu_m \bar{T})\} = 0$$

$$=> (\partial l_f / \partial Z_0)[-((h^2 {\mu_f}^2 \chi\alpha / {P_g}^2 g^2)(1+\chi\alpha)) + ((1+(h\mu_f / P_g))^2 / w^2)(1-\alpha)\alpha +$$
$$((2r\alpha h\mu_f (1-\alpha)(1+(h\mu_f / P_g))) / P_g g w)]$$
$$= (-1/C)((a-b)h'E') / P_g)[\mu_f - \{(r\alpha h\mu_f / P_g g) + ((1-\alpha) / w)(1+(h\mu_f / P_g)))\}((\mu_f l_f + \mu_m \bar{T}) / P_g)h'E']$$
$$-\{((1-\alpha)h'E') / wP_g\}\{\mu_f + ((1+(h\mu_f / P_g)) / w)(\mu_f l_f + \mu_m \bar{T})\}$$

$$=> (\partial l_f / \partial Z_0) = [(-1/C)((a-b)h'E') / P_g)[\mu_f - \{(r\alpha h\mu_f / P_g g) + ((1-\alpha) / w)(1+(h\mu_f / P_g)))\}$$
$$((\mu_f l_f + \mu_m \bar{T}) / P_g)h'E']$$
$$-\{((1-\alpha)h'E') / wP_g\}\{\mu_f + ((1+(h\mu_f / P_g)) / w)(\mu_f l_f + \mu_m \bar{T})\}] / [-((h^2 {\mu_f}^2 \chi\alpha / {P_g}^2 g^2)(1+\chi\alpha)) +$$
$$((1+(h\mu_f / P_g))^2 / w^2)(1-\alpha)\alpha +$$
$$((2r\alpha h\mu_f (1-\alpha)(1+(h\mu_f / P_g))) / P_g g w)]$$

$$\partial^2 l / \partial {Z_0}^2 < 0 => [-((h^2 {\mu_f}^2 \chi\alpha / {P_g}^2 g^2)(1+\chi\alpha)) + ((1+(h\mu_f / P_g))^2 / w^2)(1-\alpha)\alpha +$$
$$((2r\alpha h\mu_f (1-\alpha)(1+(h\mu_f / P_g))) / P_g g w)] < 0$$

$(\partial l_f / \partial Z_0) < 0$ if and only if a>b

Differentiating w & g with respect to Z_0

$$(\partial w / \partial Z_0) = -[\{(1+(h\mu_f / P_g))(\partial l_f / \partial Z_0)\} - l_f \mu_f h'E' / P_g] > 0$$

$$(\partial g / \partial Z_0) = [\{(h\mu_f / P_g)(\partial l_f / \partial Z_0)\} + ((h\mu_f + l_f \mu_m \bar{T}) / P_g)h'E')] < 0$$

$$(\partial Z_I / \partial Z_0) = k(\partial w / \partial Z_0) > 0$$

Proposition 1:-

With an increasing level of global pollution, female labour participation falls;the household's preference shifts to higher use of pollution intensive fuel and indoor pollution accentuates provided a>b

$$differenciating\ w.r.t\ '\alpha'$$
$$\left\{ahU_F / P_g - b\left(1+hU_F / P_g\right)\right\}\left(-1/c^2\right)$$
$$\left[(ahU_F / P_g)(\partial l_F / \partial\alpha) - b\left(1+hU_F / P_g\right)\partial l_F / \partial\alpha\right]$$
$$+\gamma hU_F / gP_g - \gamma\alpha hU_F / g^2 P_g \left\{(hU_F / P_g)(\partial l_F / \partial\alpha)\right\}$$
$$+((1-\alpha)/W^2)(1+hU_F / P_g)$$
$$\left\{\left(1+hU_F / P_g\right)\partial l_F / \partial\alpha\right\} - \left\{\left(1+hU_F / P_g\right)/W\right\} = 0$$
$$=> \partial l_F / \partial\alpha \begin{bmatrix} -(\gamma^2\alpha^2 h^2 U_F^2 / g^2 Pg^2) - ((1-\alpha)^2 / W^2)\left(1+hU_F / P_g\right)^2 \\ -(2\gamma\alpha hU_F / gP_g W)(1-\alpha)\left(1+hU_F / P_g\right) - \\ (\gamma^2\alpha^2 h^2 U_F^2 / g^2 Pg^2) + ((1-\alpha)^2 / W^2)\left(1+hU_F / P_g\right)^2 \end{bmatrix}$$
$$+(\gamma hU_F / gP_g) - \left\{\left(1+hU_F / P_g\right)/W\right\}$$
$$=> \partial l_F / \partial\alpha \begin{bmatrix} -(\gamma^2\alpha^2 h^2 U_F^2 / g^2 Pg^2) - ((1-\alpha)^2 / W^2)\left(1+hU_F / P_g\right)^2 - \\ (2\gamma\alpha hU_F / gP_g W)(1-\alpha)\left(1+hU_F / P_g\right) - \\ (\gamma^2\alpha^2 h^2 U_F^2 / g^2 Pg^2) + ((1-\alpha)^2 / W^2)\left(1+hU_F / P_g\right)^2 \end{bmatrix}$$
$$= -(\gamma hU_F / gP_g) - \left\{\left(1+hU_F / P_g\right)/W\right\}$$
$$=> \partial l_F / \partial\alpha = \left[-(\gamma hU_F / gP_g) - \left\{\left(1+hU_F / P_g\right)/W\right\}\right] /$$
$$\begin{bmatrix} -(\gamma^2\alpha^2 h^2 U_F^2 / g^2 Pg^2) - ((1-\alpha)^2 / W^2)\left(1+hU_F / P_g\right)^2 - \\ (2\gamma\alpha hU_F / gP_g W)(1-\alpha)\left(1+hU_F / P_g\right) - \\ (\gamma^2\alpha^2 h^2 U_F^2 / g^2 Pg^2) + ((1-\alpha)^2 / W^2)\left(1+hU_F / P_g\right)^2 \end{bmatrix}$$
$$\partial^2 l_F / \partial\alpha^2 < 0$$
$$implies \begin{bmatrix} -(\gamma^2\alpha^2 h^2 U_F^2 / g^2 Pg^2) - ((1-\alpha)^2 / W^2)\left(1+hU_F / P_g\right)^2 - \\ (2\gamma\alpha hU_F / gP_g W)(1-\alpha)\left(1+hU_F / P_g\right) - \\ (\gamma^2\alpha^2 h^2 U_F^2 / g^2 Pg^2) + ((1-\alpha)^2 / W^2)\left(1+hU_F / P_g\right)^2 \end{bmatrix} < 0$$
$$\partial l_F / \partial\alpha > 0$$
$$when(\gamma hU_F / P_g) > \left\{\left(1+hU_F / P_g\right)/W\right\}$$
$$\partial l_F / \partial\alpha < 0$$
$$when(\gamma hU_F / P_g) < \left\{\left(1+hU_F / P_g\right)/W\right\}$$
$$differenciating\ 'g'\&'w'\ w.r.t\alpha,$$
$$\partial g / \partial\alpha = (hU_F / P_g)(\partial l_F / \partial\alpha) > 0$$
$$when \partial l_F / \partial\alpha > 0$$
$$and\ (hU_F / P_g)(\partial l_F / \partial\alpha) < 0$$
$$when \partial l_F / \partial\alpha < 0$$
$$\partial Z_I / \partial\alpha = k(\partial W / \partial\alpha)$$
$$\partial W / \partial\alpha = -(\partial l_F / \partial\alpha)(-(\partial g / \partial\alpha)) > 0$$
$$when \partial l_F / \partial\alpha > 0$$
$$and\ -(\partial l_F / \partial\alpha)(-(\partial g / \partial\alpha)) > 0 < 0$$
$$when \partial l_F / \partial\alpha < 0$$

The Platform Economy in the face of a Global Economic Crisis: A Micro-theoretic Analysis

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Abstract

Our paper attempts to study the platform economy, with our interest being in the peculiarity of the platform hiring workers as "sub-contractors," instead of having them work directly under them. For our analysis, we construct a micro-theoretic multi-sector multi-factor market optimisation model besides laying down its foundation with a partial equilibrium household modelling. We demonstrate that the platform economy serves as a modern technology-driven fallback option or a substitute for the traditional informal sector and the formal sector in times of collapse of all the other sectors of the economy. Sub-contracting however makes the platform workers vulnerable to economic shocks. Next, we extend the model to analyse whether regulating the platform economy in terms of recognising platform partners as workers with formal wage contracts can counteract the global economic shocks.

JEL Classification: D13, D50, F20, J31

Keywords: Household Economics, Multi-sector general equilibrium, Wage Gap

1. Introduction

The recent phenomenon in sectoral trends highlights how platformisation has been a transformative phenomenon across sectors, reorganising value chains and restructuring the labour market. The basic understanding of the business model of any platform economy, or the gig economy (we will be using both the terms interchangeably in this paper), is that the platform, using software applications (apps), acts as a digital mediator between service providers and the service requesters.[12] "*Gig work*" is central to the platform economy in general. It is basically the temporary and short-term work that is often available on websites that link employers and employees. The aggregators refer to the people who supply their services as "*platform partners*," highlighting the fact that their relationship with them is only day-to-day. This untypical form of employment is referred to as "*sub-contracting*". The tactic of considering their services as entrepreneurial, places the risk and labour costs on the workers. This raises the question whether platformisation of the workforce is a modern variant of the traditional informal sector.

[1] Jeremias Prassl, *Humans as a Service: The Promise and Perils of Work in The Gig Economy* (Oxford: Oxford University Press, 2019).
[2] Andrew Stewart and Jim Stanford, "Regulating Work in the Gig Economy: What Are the Options?," *The Economic and Labour Relations Review* 28, no. 3 (2017): 420–37, https://doi.org/10.1177/1035304617722461.

Against this backdrop, we attempt to model explicitly the platform sector, the subcontracting between the platform owner and the platform partner, and the decision-making of workers in choosing to engage in the platform sector. In what follows, we examine the consequences of global economic crises on the dynamic rise and fall of the platform economy. In so doing, we build a micro-theoretic multi-sector multi-factor market optimisation model besides laying down its foundation with a partial equilibrium household modelling.

Any nation's Banking Financial Services and Investment sector is impacted by domestic macroeconomic issues and the world's political economic environment. Despite being uncommon, globally disruptive events, like the COVID-19 pandemic, force the economy towards change, as observed in the patterns of economic activity across the globe for the better part of the years 2020 and 2021. Another such incident, which is expected to have a significant impact on the Indian economy and the financial industry, is the Russian invasion of Ukraine. While India maintains a neutral political stance and only depends on Russia and Ukraine for a small portion of its imports (2.1%) and exports (1%), their conflict is slowing down India's GDP development.[3] In February 2022, when the military action took place, global oil prices shot up to $92 per barrel, then further up to $130 per barrel.[4] Oil prices are considered a *mark-up* of the prices of all goods and services produced in an economy. So, the increase in oil prices increases the price level for any given level of output, causing the aggregate supply curve of an economy to shift upwards to the left. The sharp surge in oil prices increased the cost of necessities, with the annual inflation rate rising to 7.8% in April 2022, the highest level since May 2014[5]. Economists believe that the oil shock will mean prolonged inflation if the *Reserve Bank of India* (RBI) fails to take adequate measures to anchor inflationary expectations. "*Global uncertainties emanating from the Western sanctions on Russia and supply chain disruptions of oil can exacerbate fuel price conundrum to long term*," Lekha Chakraborty of the National

[3] "Impact of Russia and Ukraine War on Indian Economy by Ajay Amar Associates - Times of India," The Times of India, 2022, https://timesofindia.indiatimes.com/business/india-business/impact-of-russia-and-ukraine-war-on-indian-economy-by-ajay-amar-associates/articleshow/92273933.cms.
[4] Samantha Subin Subin and Patti Domm, "U.S. Crude Oil Spikes to 13-Year High of $130 Overnight, Then Gives up Most of That Gain," CNBC, March 7, 2022, https://www.cnbc.com/2022/03/06/us-crude-oil-jumps-to-125-a-barrel-a-13-year-high-on-possible-western-ban-of-russian-oil.html.
[5] "Impact of Russia and Ukraine War on Indian Economy by Ajay Amar Associates - Times of India," The Times of India, 2022, https://timesofindia.indiatimes.com/business/india-business/impact-of-russia-and-ukraine-war-on-indian-economy-by-ajay-amar-associates/articleshow/92273933.cms.

Institute of Public Finance and Policy told DW.[6] Additionally, Morgan Stanley has revised down the GDP prediction for India to 7.9% for 2023.[7] Again, when Wall Street in the US and the stock markets in Europe fell as a result of the financial crisis of 2008, its effects spread to India, and our stock market (Dalai Street) was severely affected.

An abundance of papers have been written on economic recessions and quite a few on the platform or the gig economy, but research performed on the platform economy during a global crisis has been very little. In this paper, we have tried to discuss the impact of various global crises such as the COVID-19 pandemic and the widening tensions in Russia-Ukraine on a section of the Indian economy, namely, the platform economy. The platform economy got some importance for the first time when COVID-19 hit, and now in the wake of another recession, the question remains: how will the platform economy fare—and most importantly, how will the presence of the platform sector affect the economy at large?

Although it may seem that there exists job autonomy among the platform workers, in practice there is none. For instance, there is no interaction between the management and the workers regarding issues like pay, incentives, or the nature of the labour, and employees provide no input in the price charged for delivery to clients. During the COVID-19 pandemic, the workers were seen as independent individuals facing difficulties as a result of the pandemic.[8] They were experiencing a scenario in which aggregators were absolved of any need to give socioeconomic help to the workers. Since more than 92% of the Indian economy is unorganised, this was largely acceptable.[9]

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[6] Murali Krishnan, "India: Is the War in Ukraine behind Fuel Hike? – DW – 04/08/2022," dw.com, April 8, 2022, https://www.dw.com/en/india-is-the-war-in-ukraine-behind-rising-fuel-prices/a-61407074

[7] "Impact of Russia and Ukraine War on Indian Economy by Ajay Amar Associates - Times of India," The Times of India, 2022, https://timesofindia.indiatimes.com/business/india-business/impact-of-russia-and-ukraine-war-on-indian-economy-by-ajay-amar-associates/articleshow/92273933.cms.

[8] Sazzad Parwez and Rajiv Ranjan, "The Platform Economy and the Precarisation of Food Delivery Work in the COVID-19 Pandemic: Evidence from India," *Work Organisation, Labour & Globalisation* 15, no. 1 (2021), https://doi.org/10.13169/workorgalaboglob.15.1.0011.

[9] National Statistical Commission Government of India , "Report of the Committee on Unorganised Sector Statistics," Ministry of Statistics and Programme Implementation, 2012, https://mospi.gov.in/sites/default/files/committee_reports/nsc_report_un_sec_14mar12.pdf.

According to the Online Labour Index (OLI), the demand for services offered by the platform and digital sector initially declined in March 2020 but increased at the end of April 2020. Since the onset of the pandemic, gig workers have been considered "emergency workers" and there has been an increase in the number of gig workers during that time.[10] Due to the crisis, many blue-collar and white-collar workers turned to gig work as a secondary or even primary source of income in historically unfavourable circumstances. Joo and Shawl (2021) concurred with this assessment and quoted the rise in the gig sector as "exponential".[11] This paper states that the positive impact observed in the platform or the gig sector is because of a change induced in the labour market itself, followed by the coronavirus-induced lockdown, showing an increasing trend towards short-term and temporary gig jobs. During the lockdown, when people had to stay indoors, it was the consumers' reliance on the gig workers for the delivery of their daily necessities, that gave these workers promising employment opportunities. It is estimated that there were 68 lakh (6.8 million) platform workers in 2019-20, using both principal and subsidiary status, forming 1.3% of the total workers in India.[12] Following the pandemic, in 2020-21, 77 lakh (7.7 million) workers were estimated to be engaged in the platform economy. They constituted 2.6% of the non-agricultural workforce or 1.5% of the total workforce in India. The gig workforce is expected to expand to 2.35 crore (23.5 million) workers by 2029-30 forming 4.1% of the total livelihood in India by the year 2029-30.[13]

[10] Uma Rani and Rishabh Kumar Dhir, "Platform Work and the COVID-19 Pandemic," *The Indian Journal of Labour Economics* 63, no. S1 (2020): 163–71, https://doi.org/10.1007/s41027-020-00273-y.
[11] Bashir Ahmad Joo and Sana Shawl, "Covid-19 Pandemic and The Rising Gig Economy: An Emerging Perspective," *Global Economics Science*, 2021, 16–23, https://doi.org/10.37256/ges.232021917.
[12] NITI Aayog, "India's Booming Gig and Platform Economy - Niti Aayog," NITI Aayog , 2022, https://www.niti.gov.in/sites/default/files/2022-06/Policy_Brief_India%27s_Booming_Gig_and_Platform_Economy_27062022.pdf.
[13] NITI Aayog, "India's Booming Gig and Platform Economy - Niti Aayog," NITI Aayog , 2022, https://www.niti.gov.in/sites/default/files/2022-06/Policy_Brief_India%27s_Booming_Gig_and_Platform_Economy_27062022.pdf.

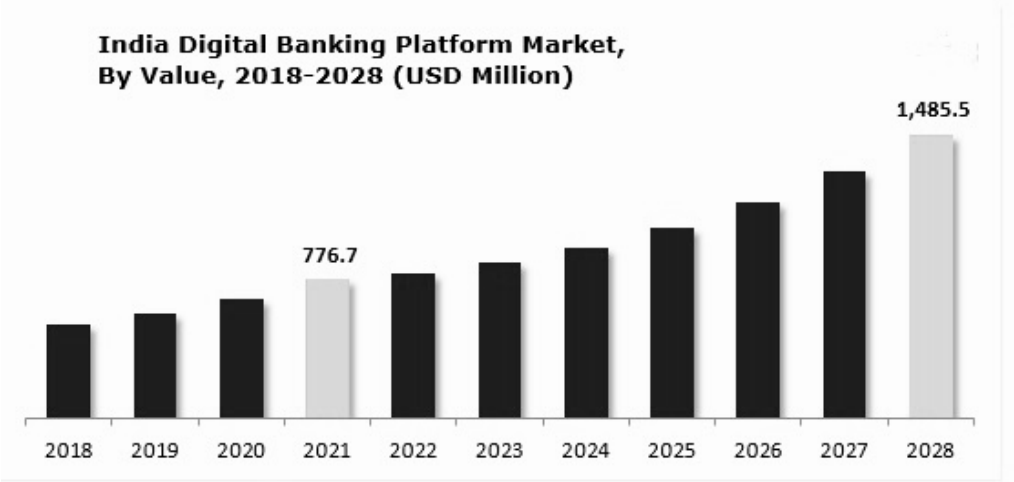


Fig 1. India Digital Banking Platform Market by Value, 2018-2028

The expansion of the gig economy in the pandemic can be seen as workers transferring to "jobs" that offer them no social security or healthcare benefits and leave them vulnerable and exposed to the crisis at large. The gig economy does not ensure any economic stability and compels them to undertake risks that they have no incentive to manage. The expansion of the platform sector during the pandemic essentially meant wastage of intellect, talent, and skills. Later in this paper, we will study how a contraction in the platform economy because of a tightening in the flow of foreign investment (or capital, in general, because of a global recession) will leave a huge number of skilled workers exposed to economic and social crises.

We have organized our paper as follows. *Section 2* comprises a brief literature review of the academic papers and articles we reviewed before writing our paper. In *Section 3*, we have *c*onstructed our model with scrutiny on the gig sector, following which we have described the partial equilibrium of the households in *Section 4*. *Section 5* discusses the general equilibrium analysis, followed by a brief analysis of the model's comparative statics in *Section 6*. In *Section 7*, we recommend strategies for our model to sustain through fluctuations in the global economy so that workers gain at least a modicum of economic and social stability when the economy is faced with a global crisis. Finally, section 8 concludes the paper.

2. Literature Review and Intervention

Although many papers have discussed the ways in which platform and gig workers fared during the COVID-19 pandemic, the results of our analysis when considering another recession would tend to differ. This is because the COVID-19 pandemic, despite being rightly classified as an "economic crisis", is structurally unlike any other recession (like the economic tension developed due to the Russia-Ukraine conflict), particularly by the nature in which it hit the Indian economy. However, some distinguishing features of the digital platform sector are prevalent in those papers, which are instrumental to our analysis.

Rani and Dhir (2020) observed that in most countries, including India, workers who were engaged in online platforms were declared part of the "emergency services" during the COVID-19 lockdown.[14] India had observed a rise in online work demand, mainly in software development and technological activities. There was an increase in the number of registered workers in India as online work demand increased. The platform or gig sector has been positively impacted due to the pandemic, contradicting earlier research which had predicted only devastating effects of COVID-19 on the traditional economy. This sector stood out among many others that had suffered, mainly because of the situational advantages it was given owing to the *queer* nature of the "economic crisis".[15] Joo and Shawl (2021) concurred with this assessment and quoted the rise in the gig sector as "exponential".[16] This paper states that the positive impact observed in the platform, or the gig sector is because of a change induced in the labour market itself, followed by the coronavirus-induced lockdown, showing an increasing trend towards short-term and temporary gig jobs. During the lockdown, when people had to stay indoors, it was the consumers' reliance on the gig workers for the delivery of their daily necessities, that gave these workers promising employment opportunities.[17]

[14] Uma Rani and Rishabh Kumar Dhir, "Platform Work and the COVID-19 Pandemic," *The Indian Journal of Labour Economics* 63, no. S1 (2020): 163–71, https://doi.org/10.1007/s41027-020-00273-y.
[15] Ibid.
[16] Bashir Ahmad Joo and Sana Shawl, "Covid-19 Pandemic and The Rising Gig Economy: An Emerging Perspective," *Global Economics Science*, 2021, 16–23, https://doi.org/10.37256/ges.232021917.
[17] Ibid.

Parwez, however, does not paint the picture in such an optimistic light and points out some of the glaring fallacies which the platform sectors faced.[18] It has described the digital platform sector as a sector "*without employment rights, social security measures, protection and compensation*." The paper drew special attention to food delivery platforms. These platform aggregators do not recognize their delivery workers as employees and instead refer them as "delivery partners," which exempts them from complying to traditional employer-employee laws. Moreover, the arrangement excludes workers from social protection. In the absence of labour rights, the workers remain highly exposed and vulnerable to market forces. This paper also highlights the poor implementation of the COVID-19 guidelines. Even though many of the platform workers' services were labelled as "emergency services," their movements were severely restricted although they were supposedly "available."[19]

These idiosyncrasies paint a very dismal portrait of the digital platform sector, underlining the problem of lack of recognition that the platform workers face despite the media's popularity in the urban sector. Perhaps these shortcomings are more realistic and relevant when we discuss the platform sector in our model, where the economy is approaching an impending economic recession, which is not likely to possess the "situational advantages" that the COVID-19 pandemic did.

3. Description of the Economy

For our analysis, we take into consideration a small, open, developing economy with four sectors, all of which are defined by a perfectly competitive market. Our analysis is performed in the medium run.

Sector 1, or the *traditional informal sector*, has unskilled workers L, earning wages W and using mostly traditional capital K_T at a rental rate of r. The unskilled workers sell their services to the market at a rate of P_1. Domestic workers, street vendors, street food stalls, etc., comprise this sector. This part of the economy is neither taxed nor monitored by any form of

[18] Sazzad Parwez and Rajiv Ranjan, "The Platform Economy and the Precarisation of Food Delivery Work in the COVID-19 Pandemic: Evidence from India," *Work Organisation, Labour & Globalisation* 15, no. 1 (2021), https://doi.org/10.13169/workorgalaboglob.15.1.0011.
[19] Ibid.

government, and most workers are daily-wage earners. It makes up a significant portion of a developing country's economy (83% of the work force in India consists of the informal sector).

Sector 2 represents the *gig workforce*, comprised of skilled workers S earning wages W_S for their labour, where $W_S > W$. This assumption ensures that unskilled workers have enough incentive to undergo training for specialisation to join the gig workforce. The gig workforce requires at least some degree of specialisation to operate within the platform economy. It mainly includes the skills necessary to use advanced capital. Suppose a worker decides to join the Uber platform, then they need formal driving training (which includes the issuance of a driver's license) and be able to surf through the Uber app on the internet. The gig workers need to employ advanced capital K_A, which can also be considered as an entry cost for the workers in the gig economy, with a much higher rental rate of R. Going by the example of the Uber driver, they need to purchase a car to be able to participate in the platform. They earn an income of $\underline{P_2}$ by offering their services to the *platforms* (*sector 3*).[20] These platforms set the wage rate $\underline{P_2}$ (which is also the income of the gig sector workers) by establishing long-term contracts with the workers. They charge a price P_3^N from the consumers for the services they provide. This price depends on the demand function of the services offered by the platforms and is explained in more detail later in this paper. Sector 2 and Sector 3 together form the *gig economy*, the main highlight of our study.[21]

Sector 4 is a high-skilled, capital-intensive sector producing commodities by means of skilled labour S (at a wage rate W_S), unskilled labour L (at a moderated wage rate $\underline{W}$) and advanced capital K_A (at the rental R).[22] If the gig workers decide to leave the gig economy, it is likely they will join this sector as skilled workers and vice versa. Similarly, unskilled workers may also choose to work in this sector. Sector 4 participates in world trade and is thus vulnerable to external shocks.

[20] It is important to note that W_s is the wage rate for the gig workers' labour alone and is exclusive of the rental cost for employing advanced capital K_a.
[21] The gig economy is assumed to be labor-intensive in our analysis.
[22] We are assuming that the wage rate for the skilled workers is remaining the same in both the gig sector and the high-skilled sector. Another important assumption which we make is that the rental rate for hiring advanced capital K_a is the same for sector 2, sector 3 and sector 4.

In the conventional labour market literature, the informal sector is viewed as a shock-absorbing sector which can absorb as many workers retrenched from the formal sector. This is due to the flexibility of wages in this sector.

4. A Worker's Choice to become Skilled: Household Optimisation

In our framework, let us consider $\underline{L}$ homogenous households who can either choose to work as unskilled workers or as skilled workers. For simplicity of calculation, let the number of working members in a household be normalised to 1. We take l_S as the fraction of the members of a household who choose to become skilled by undergoing some training and attaining some degree of specialisation.

We consider a Cobb-Douglas utility function for the households, where the satisfaction a household derives is a function of the goods it consumes C and the satisfaction it derives from acquiring some degree of skill or specialisation, rather than remaining unskilled. The utility function is given as:

$$U = lnC + lnl_S \tag{1}$$

Let P be the price of a typical consumption basket. The income earned by the households from joining the market by contributing skilled labour is $W_S l_S$, while $kW_S l_S$ represents the part of income which the members of the household have to undergo for specialisation training or the purchase of advanced capital to become a part of the skilled workforce ($k < 1$, a trivial assumption which suggests that the worker would not spend more than the wage he earns on training). Those members who choose to remain unskilled $(1 - l_S)$ earn an income of $W(1 - l_S)$. The budget constraint of the household is, thus, given by:

$$PC = W(1 - l_S) + [W_S l_S - kW_S l_S] \tag{2}$$

To maximize the utility of the household given the budget constraint, we substitute equation (2) in equation (1) and solve the equation by the maximisation condition:

$$U = ln\frac{W(1 - l_S) + l_S W_S(1 - k)}{P} + lnl_S$$

The first order condition of utility maximisation:

$$\frac{dU}{dl_S} = \frac{1}{C}\left(\frac{-W + W_S(1 - k)}{P}\right) + \frac{1}{l_S} = 0$$

The second order condition for utility maximisation:

$$\frac{d^2U}{dl_S^2} = -\frac{1}{C^2}(\frac{-W + W_S(1-k)}{P})^2 - \frac{1}{l_S^2} < 0$$

Solving for the first order condition (as the second order condition is almost definitely satisfied) the fraction of members in a household, who choose to enter the skilled labour force is:

$$l_S = \frac{PC}{W-(1-k)W_S} \quad (3)$$

Lemma 1: Strictly positive optimal value of $l_S(W, W_S)$ is implied by $(1-k)W_S < W$.

An intuitive explanation for this condition could be that despite higher wages, the net income of the skilled workers after specialisation training must be less than the wages earned by unskilled workers, otherwise the informal sector would cease to exist. Again, it can be established that, l_S is a positive function of W_S and a negative function of W.

***Proof*:** Taking log on both sides of equation (3), we get:

$$lnl_S = lnP + lnC - ln[W - W_S(1-k)] \quad (4)$$

Differentiating both sides of equation (4) with respect to W:

$$\frac{1}{l_S}\frac{\partial l_S}{\partial W}^{\cdot} = \frac{1}{C}(1-l_S)^{\cdot} - \frac{1}{W - W_S(1-k)}$$
$$\Rightarrow \frac{\partial l_S}{\partial W} = l_S[\frac{1}{C}(1-l_S)^{\cdot} - \frac{1}{W - W_S(1-k)}]$$

Lemma 2: $\frac{\partial l_S}{\partial W} < 0$, iff $\frac{1}{C}(1-l_S)^{\cdot} < \frac{1}{W-W_S(1-k)}$.

Again, differentiating both sides of equation (4) with respect to W_S:

$$\frac{1}{l_S}\frac{\partial l_S}{\partial W_S}^{\cdot} = \frac{1}{C}l_S(1-k)^{\cdot} + \frac{(1-k)}{W - W_S(1-k)}$$

Which means, $\frac{\partial l_S}{\partial W_S} > 0$, given $k < 1$.

Intuitively, l_S is positively dependent on W_S basically translates to, when the wage gap between the skilled labour and the unskilled labour increases, more workers would be interested in forgoing some degree of specialisation, despite the entry costs, and become a part of the skilled sectors. l_S is also, quite trivially a negative function of the wage rate for unskilled

workers W. This is because if the wage rate for unskilled labour rises, the unskilled workers are relatively better off than before, which means less workers would have an incentive to join the skilled workforce.

Therefore, the total number of workers who enter the skilled labour force in the economy is given by:

$$S = \underline{L} l_S(W_{S_+}, W_-) \tag{5}$$

5. Equilibrating the Sectors in our Model

The general equilibrium system consists of four sectors, and the competitive industry equilibrium of the sectors is given as follows:

$$W a_{L1} + r a_{K1} = \underline{P_1} \tag{6}$$

$$W_S a_{S2} + R a_{K2} = \underline{P_2} \tag{7}$$

$$\underline{P_2} a_{23} + R a_{K3} = P_3^N \tag{8}$$

$$\underline{W} a_{L4} + W_S a_{S4} + R a_{k4} = \underline{P_4} \tag{9}$$

In the above equations, a_{ji} represents the input-output ratios. For example, Sector 1 needs to employ a_{L1} units of unskilled labour and a_{K1} units of traditional capital, at the wage rate of W and rental rate of r respectively, to produce one unit of output. So, $(W a_{L1} + r a_{K1})$ is the cost incurred by Sector 1 to produce one unit of output. The price rate $\underline{P_1}$ is the revenue from selling one unit of output, and by the zero economic profit condition in a perfectly competitive firm in the medium run, we get equation (6). Equations (7), (8) and (9) are derived in a similar fashion.

The full employment conditions for the unskilled workers (in the traditional informal sector and Sector 4), skilled workers (in the platform sector and Sector 4) and capital, are explained by the equations as follows:

$$a_{L1} X_1 + a_{L4} X_4 = \underline{L} - S(W_{S_+}, W_-) \tag{10}$$

$$a_{S2} X_2 + a_{S4} X_4 = S(W_{S_+}, W_-) \tag{11}$$

$$a_{K1}X_1 = \underline{K_T} \quad (12)$$

$$a_{K2}X_2 + a_{K3}X_3 + a_{K4}X_4 = \underline{K_A} + \underline{K_F} \quad (13)$$

In equation (13), $\underline{K_F}$ represents the foreign direct investment. An influx of investment from abroad naturally increases output in the gig sector and Sector 4.

The demand function for the services offered by the gig sector is given by:[23]

$$X_3 = X_3^D\left(\frac{W_S a_{S4} X_4}{P_3^N}, \gamma_+\right) \quad (14)$$

Here, we are assuming that the skilled workers from Sector 4 are the ones who demand the services offered by the platform sector. The nature of the demand function suggests that the consumers have a Cobb-Douglas type utility function, dependent solely on their income and the price the platforms charge for their services. $W_S a_{s4} X_4$ is the income earned by the skilled workers in Sector 4, and naturally, if their income increases, the demand for the platform services would increase. If the price of the services offered by the platform workers P_3^N increases, the demand for their services will fall. γ is an exogenous parameter which will determine willingness of a consumer to purchase their services. To elaborate on the γ parameter further, we consider the situation when the COVID-19 lockdown was imposed. People were forced to stay at home and so the demand for transportation services offered by *Uber* or *Ola* had fallen massively, with almost negligible demand for their services in the urban sector. However, people wanted the daily necessities to be delivered at their doorstep, so services offered by *Bigbaske*t and *Grofer*s (online grocery selling platforms) received a spike in demand, so much so that people were booking slots one week or ten days in advance. Even food delivery platforms like *Swiggy, Zomato, Amazon* and fast-food chains like *Domino's* started providing groceries through their delivery services, when previously they had limited their services to only delivering food from restaurants.

The equations have the endogenous variables $W, W_S, r, R, P_3^N, X_1, X_2, X_3$ and X_4.

Solving equations (7) and (9), we get:

$$W_S = W_S(P_{4_})$$
$$R = R(P_{4_+})$$

[23] X_3 is assumed to be demand determined and the platforms set the prices for their services keeping the inverse demand function in mind.

From equation (8), we find P_3^N in terms of R as:

$$P_3^N = P_3(P_{4_+})$$

From equation (12), we get: $X_1 = \frac{K_T}{a_{K1}}$, which is a constant.

From equation (10), we find X_4 in terms of S, which comes down to:

$$X_4 = X_4(W_+)$$

From equation (11):

$$X_2 = X_2(W_-)$$

And equation (13) gives us:

$$X_3 = X_3(W)$$

From equation (14), we equate: $X_3 = X_3^D$, to get the value of W.

Substituting the value of W in equation (6), gives us r.

6. Comparative Statics: Entry points of a Recession

In this section of the paper, we theorise how an impending world recession would affect the gig economy, given our framework. The effect on the gig economy would vary depending on how the recession enters the country and there might be varying outcomes observed, as a result. We have already discussed how the platform sector was affected by the COVID-19 pandemic induced lockdowns and now we try to draw the situation of the pandemic in our model to see if the model supports what had been observed. Then we try predicting how a recession (say, because of the Russia-Ukraine conflict) will enter the economy, and how dissimilar the effects will turn out to be compared to the pandemic.

6.1. Positive Parametric Shift in the Demand for Platform Services (Increase in γ)

Agreeably, the COVID-19 pandemic did not follow the most quintessential routes through which one might expect a recession to enter an economy. As previously discussed in this paper, the government had imposed a lockdown to control the spread of the coronavirus, which essentially prevented people from coming out of their homes unless they were a part of the "emergency services". In such a situation, people started hoarding their daily necessities and turned to online delivery platforms to fulfil their demand. Many of these delivery services had been exempted from the restrictions imposed by the lockdowns, which suited people's need. We take the following series of events as a ***positive change in the parameter*** γ.

From the demand function represented in equation (14), there is an increase in demand for services offered by the platform sectors X_3^D, and naturally, the quantity X_3 increases. While the variables W_S and R suffer no change, the increase in quantity of X_3 produced, consumes much of the capital and therefore capital availability for Sector 2 and Sector 4 decreases. Because Sector 4 is a capital-intensive sector, *quantity of output produced X_4 by this sector decreases*. However, because *Sector 2*, where platform workers are hired, *is a labour-intensive sector*, the demand for labour (i.e., demand for services offered by the platform sector) increases, as a result of which quantity produced in Sector 2, X_2 *increases*. From equation (10), the wage rate for the unskilled workers in the traditional informal sector W decreases, and rental rate r for traditional capital falls (from equation (6)). The reduction in wage rate in the traditional informal sector means workers have more incentive to become skilled, as the *wage gap expands*. So, the *number of skilled workers in the economy S increases*.

Proposition 1: *A favourable demand shock owing to the pandemic crisis, results in the expansion of the gig economy. This falls in line with the observation which was made concerning the gig sector during the COVID-19 pandemic and the amount of skilled labour in the economy rises.*

6.2. A cessation in the flow of Foreign Direct Investment (Fall in $\underline{K_F}$)

A recession has alternative routes through which it can enter the Indian economy. It has often been observed that ***obstruction in the flow of foreign capital*** is one of the most immediate consequences of a recession, so in our analysis we consider how a restriction in foreign direct investment affects our model.

If the flow of foreign direct investment ceases, from equation (13), it is apparent that quantity produced by Sector 4 will get affected. *Sector 4 being a capital-intensive sect*or, X_4 *will fall*. Seeing as *Sector 2 is labour intensive*, the workers' willingness to work in the platform sector X_2 *will increase*. Output produced by Sector 1, X_1, the wage rate of the skilled workers W_S, rental rate R of advanced capital $\underline{K_A}$ and price the platforms charge for their services P_3^N will

remain unchanged. The fall in X_4 will however bring the income of the skilled workers in Sector 4 down and given equation (14), *the demand for platform services will shrink*.

Moreover, the decrease in X_4 and increase in X_2, will together bring *the wage rate in the informal sector down*, which induces people to undergo specialisation training to join the skilled labour workforce S (from equations (10) and (11)). Although the skilled workforce in the economy expands, X_3 being demand determined leaves much of the skilled workforce, who were willing to work in the platform sector, unemployed.

Proposition 2: *Disruption in the flow of foreign investment will create* a contraction in the platform economy. *Although* the specialised labour in the economy increases, *they remain underutilised and subjugated to unemployment because of lack of contracts offered by the platform economy. Because X_3 is also decreasing, it implies that the platforms may choose to even layoff some of the workers who were previously working in the sector.*

6.3. A Fall in Exports (P_4 falls)

Another alternative route by which a recession may crawl into our economy is through ***a fall in demand for the economy's exports***. A fall in world demand for the goods produced by Sector 4 will decrease the price P_4 which it charges. From having solved equations (7) and (9), a fall in P_4 will will reduce the rental rate R for advanced capital K_A and *increase the wage W_S for skilled workers* (Sector 4 being capital intensive, if their revenue decreases then they would employ less capital and more labour). From equation (8), the price for services offered by the platforms P_3^N will fall and given the demand function in equation (13), the demand for platform services X_3^D will increase.

Expansion in Sector 3 leaves less capital for Sector 2 and Sector 4. Sector 4 being capital intensive, means there is a fall in output X_4. The contraction in Sector 4 implies that the *skilled labour moves from Sector 4 to the platform sector* (equation (11)) as a result of which, X_2 increases. We had already established that: $X_2 = X_2(W_)$, *the wages in the traditional informal*

sector would thus fall and the rental rate for traditional capital r would increase. *More workers would hence be attracted to the prospect of becoming skilled*, as the wage-gap between the two professions increase. The wage gap between the skilled and unskilled workers would increase (as W falls and W_S increases) and give incentive to the workers to become skilled and so the *number of skilled workers S in the economy would increase*. However, since there is a contraction in Sector 4, the skilled workers would choose to work in the platform sector.

Proposition 3: *A trade shock in terms of fall in volume of export leads to an expansion of the gig economy. The number of skilled workers in the economy expands because of the increase in the wage gap between the skilled and the unskilled workers.*

The crux of the comparative statics analysis is to exemplify the role of the platforms: that the platform economy serves as a modern technology-driven *fallback option or a substitute for the traditional informal sector and the formal sector* in times of collapse of all the other sectors of the economy.

7. An Alternative Model: Can Regularizing the Gig Economy Combat Recession?

The gig economy does not highlight a proper employer-employee trade-off relationship. In the gig economy, the platforms shift a portion of their burden of risk-taking to their "workers." This striking feature of the platforms *subcontracting* workers and calling them "working-*partners*," might be a clever tactic from the perspective of the platforms, but bluntly speaking, it is simply the exploitation of the skilled workers. An expansion of the gig economy with such characteristic features is undesirable. In a developing country, characterised by high population, unemployment, underemployment, and with the employed population mostly being in the informal sector, if remotely skilled workers also must endure the crudeness of economic and social instability, then it portrays a rather unflattering image of "developing." The emergence of the platform sector, on the other hand, has also had the positive effect of creating more employment (both directly and indirectly), increasing the flexibility of urban life and boosting the economy as a whole.

We, therefore, suggest a model that removes the inconsistencies and shortcomings of the gig economy. The changes are elementary—removing sub-contracting and establishing a proper employer-employee relationship between the platform and the workers. We dissolve Sector 2 entirely and leave the platform (Sector 3) to employ workers at a regulated wage W_S. Sector 1 and Sector 4 remain unaffected. Even mathematically, this simplifies our model to a huge extent, being scaled down to three sectors, the equations being represented by:

$$Wa_{L1} + ra_{K1} = \underline{P_1} \qquad (15)$$

$$\underline{W_S} a_{S3} + Ra_{K3} = P_3^N \qquad (16)$$

$$\underline{W} a_{L4} + W_S a_{S4} + Ra_{k4} = \underline{P_4} \qquad (17)$$

(Note: Although we have removed Sector 2, we still call the platform as sector 3 and the high-skilled sector as Sector 4 for relatability with the previous picture drawn)

The full employment conditions for the skilled and unskilled workers and capital will now be given by:

$$a_{L1}X_1 + a_{L4}X_4 = \underline{L} - S(W_{S_+}, W_-) \qquad (18)$$

$$a_{S3}X_3 + a_{S4}X_4 = S(W_{S_+}, W_-) \qquad (19)$$

$$a_{K1}X_1 = \underline{K_T} \quad (20)$$

$$a_{K3}X_3 + a_{K4}X_4 = \underline{K_A} + \underline{K_F} \quad (21)$$

The demand function for the platform services remains unchanged:

$$X_3 = X_3^D\left(\frac{W_S a_{S4} X_4}{P_3^N}, \gamma_+\right) \quad (22)$$

(Note: Equation (18) is equivalent to equation (10), equation (20) to equation (12) and equation (14) to equation (22) respectively from the original model)

Having established this new model, we consider the effect of ***a contraction in the flow of foreign direct investment*** on the platform economy and the other sectors. In our previous model, we had seen that although the number of skilled workers in the economy increases, some of them remain unemployed as production falls both in Sector 4 and the gig economy. In the current model, however we see an altered picture:

The disruption in the flow of investment from abroad will bring X_4 *down* (from equation (21)), *Sector 4 being a capital-intensive sector* and *increase* X_3, *seeing as Sector 3 is a labour-intensive sector*. To sustain the equality of equation (18), the *number of skilled workers in the economy* S *will have to increase*, which can be written off as *an increase in* W_S *and a fall in* W (in other words, a rise in the wage-gap between the skilled and the unskilled workers provides more incentive for the workers to become skilled and thus the skilled workforce in the economy expands). Since W_S increases, from equation (17), we can say the rental rate for advanced capital R will fall as a result of which the price the platforms charge for their services P_3^N falls (equation (16)). The demand for the platform services would rise (the increase in demand due to fall in P_3^N overrides the effect of a fall in income of the skilled workers in Sector 4 as X_4 decreases. Moreover, W_S is also increasing which makes the fall in income relatively less, that is if income falls).[24]

There is thus an *expansion of the gig economy* accompanying the *contraction of Sector 4*. The number of skilled workers in the economy S is also increasing, so we can say that as more

[24] A simple assumption of price elasticity of demand being greater than income elasticity of demand for platform services will assure that ${X_3}^D$ would increase.

workers become skilled and join the platform sector—there is a *flow of workers from the high-skilled sector to the gig sector*. This shift in employment, unlike the previous cases discussed, is not necessarily a harmful effect because in this paradigm, the workers are directly employed under the platforms instead of having been "subcontracted." Here, the gig workers enjoy the same benefits of social and economic security that the Sector 4 workers do. In a way, it can be said that *the economy is benefitting because of the presence of the gig economy* because this sector is there to absorb the skilled workers when the other high-skilled sectors contract, and account for the expansion in the skilled workers in the economy.

We can observe similar adjustments when the economy is faced with external shocks on amending the given model as we have discussed. The economy benefits from a platform economy expansion if the government makes it mandatory for the platforms to hire the workers, adhering to proper employer-employee relationship.

8. Conclusion

The paper primarily focuses on the gig economy, analysing how *sub-contracting*, a practice which, despite being one of the main reasons behind the platform economy's almost exponential growth in India in the last decade, exploits workers to a huge degree by making them undertake risks with deceitful promises of incentives, and has a detrimental effect on the overall health of the economy. Since most platform workers are only engaged temporarily as needed for a project, they do not often receive the benefits that a full-time employee would, which leaves them economically and socially vulnerable, especially in the face of a crisis. When developing our model, the sub-contracting of workers has been one of our main highlights. We constructed two sectors to describe the platform economy as a whole, while the other two sectors describe the other two facets of the economy.

Having described our model, we tried to analyse the various channels through which an impending recession could impact the platform economy. As discussed in the comparative statics section of the paper, we have opined three propositions by which the same could happen. A *positive parametric shift in the demand* for services offered by the platform sector (mainly

because of its convenience when facing a crisis such as the lockdowns during the pandemic) would cause *an expansion of the gig sector* despite a contraction in the number of skilled workers in the economy. We also tried analysing more quintessential routes through which a recession might enter our model, a *cessation in the flow of investment from abroad* being one of them. From our analysis, we theorise that a fall in foreign direct investment would lead to a *contraction in both the high-skilled sector and the gig sector*. The number of skilled workers in the economy would increase, but they would *remain unemployed* because of a shortage of contracts offered by the platform sector. There may also be a *fall in exports* due to a global recession, which would lead to a *contraction in the high-skilled sector and an expansion in the platform sector*. The number of skilled workers in the economy would increase, signifying that *skilled workers would shift to the platform sector*.

To remove the shortcomings of the platform sector, we alter our model such that platform partners are now recognised as workers with formal wage contracts. The gig workers are required to be *employed directly under the platforms* instead of being "sub-contracted." In our new paradigm, we see the effect of a restriction on foreign investment on the economy, and where *previously there had been a contraction*, we see *an expansion of the gig economy*. However, it has more of a positive impact this time around because workers receive proper healthcare and social security benefits, which puts them in an economically stable position even during a time of crisis. The platform economy's expansion, in this case, boosts the economy, giving it some reprieve despite the fall in economic activity in the other sectors.

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Vox Populi, Vox Dei: Modelling the Economic Divergence Between Classical and Modern Populism

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Abstract

In this paper, we introduce a model of populist macroeconomics. Populism is a political ideology which seeks to represent the interests of the "people", as opposed to that of the "elites". Using techniques of mathematical modelling, we find that modern populisms last longer than classical populisms because the strategy of fiscal consolidation used by new populist regimes lends itself easily to the task of conforming to fiscal constraints. We study the divergence of new populisms from classical populisms and prescribe that to maintain a positive growth rate modern populisms must increase taxation rates as time goes on. We also argue that though the economic wellbeing of modern populisms lasts longer than their counterparts this phenomenon is likely to be short-lived.

JEL Classifications: E02, E61, H11, H63, P16

Keywords: Populism, Macroeconomics, Fiscal consolidation, Fiscal expansionism, Classical Populism, Modern Populism, Economic well-being, Fiscal constraints, Economic modeling, Long-run growth

1. Introduction

Populism is on the rise globally. According to one estimate, the number of populist governments across the world rose from four in 1990 to 20 in 2018[1]. What makes this all the more striking is that populist politics are winning in strong democracies such as the USA, Italy and India. Besides, populisms are spreading to previously unseen domains such as Europe and Asia.[2]

Since it is a political objective that may be achieved through a variety of economic means, populism lacks a specific view on how the economy must be organized. Hence, it may be combined with a variety of political enterprises including left-wing and right-wing ideologies. Additionally, populisms possess a penchant for authoritarianism, anti-liberalization and anti-

[1] Jordan Kyle and Limor Gultchin, "Populism in Power around the World," SSRN Electronic Journal, 2018.
[2] Ibid.

elitism.[3] They also last longer and culminate in fewer macroeconomic crises than previously assumed.[4] It is thus important that we talk about populism.

While the re-emergence of populism has triggered renewed academic interest in the subject from economists, political scientists, and sociologists alike, the vast majority of the economic literature is concentrated on identifying the economic *causes* precipitating a populist revolt.[5] In comparison, the literature examining the economic effects and offering policy prescriptions pales. The closest analyses there exist towards these purposes are Magud & Spilimbergo[6] and Funke et al.[7] However, these suffer from three limitations. Firstly, they do not make a distinction between new and old types of populism, with Funke et al. collectively examining all populist regimes since 1900. This runs the risk of conflating outcomes associated with one type of populism with the other, which, as shall presently be seen, are drastically different political enterprises. Secondly, their purview is limited to Latin America, which, despite being the epicentre of classical populism, does not constitute the heart of the modern type.[8] Lastly, their approach is more empirical than theoretical, making it difficult to provide policy prescriptions through a mathematical model. In this paper we attempt to plug this gap in the literature.

One of the principal challenges observed while attempting an economic exploration of populism is arriving at a standard definition. Political scientists have debated the definition for years, leading Dornbusch and Edwards (1991) in their famous inspection of Latin American populism to present an economic definition which is as follows: "(A)n approach to economics

[3] Dani Rodrik, "Populism and the Economics of Globalization," Journal of International Business Policy, 2018.
[4] Nicolas Magud and Antonio Spilimbergo, "Economic and Institutional Consequences of Populism," CEPR Discussion Papers, 2021.
[5] Dacron Acemoglu, Georgy Egorov, and Konstantin Sonin, "A Political Theory of Populism," Quarterly Journal of Economics, 771-805; Yann Algan, Elias Papaioannou, Evgenia Passari, and Sergei M. Guriev, "The European Trust Crisis and the Rise of Populism," 2017; Luigi Guiso, Helios Herrera, Massimo Morelli, and Tommaso Sonno, "Demand and Supply of Populism," 2017; Ronald Inglehart and Pippa Norris, "Trump, Brexit, and the Rise of Populism: Economic Have-Nots and Cultural Backlash," 2016; Tito Boeri, Prachi Mishra, Chris Papageorgiou, and Antonio Spilimbergo, "A Dialogue between a Populist and an Economist," 2018, 191-95; Sebastian Edwards, "Left behind: Latin America and the False Promise of Populism," The University of Chicago Press, 2010; Barry Eichengreen, "The Populist Temptation: Economic Grievance and Political Reaction in the Modern Era," Oxford University Press, 2018; Federico Finkelstein, "From Fascism to Populism in History," University of California Press, 2017.
[6]Magud and Spilimbergo, "Economic and Institutional Consequences of Populism."
[7] Manuel Funke, Moritz Schularick, and Christoph Trebesch, "Populist Leaders and the Economy," CEPR Discussion Papers, 2020.
[8] Kyle, "Populism in Power," 2018.

that emphasizes growth and income redistribution and deemphasizes the risks of inflation and deficit finance, external constraints, and the reaction of economic agents to aggressive nonmarket policies."[9] The flaws of this definition have been pointed out since. Dornbusch and Edwards' is a post-facto categorization which results in a tautological definition: populist regimes employ unsustainable economic policies because they are defined as those employing unsustainable policies.[10] Additionally, it fails to capture the changed characteristics of modern populism. The workhorse definition used in this paper is offered by the political scientist Cas Mudde (2004) whereby populism is "an ideology that considers society to be ultimately separated into two homogeneous and antagonistic groups, 'the pure people' versus 'the corrupt elite', and which argues that politics should be an expression of the … general will of the people."[11] Though we explore more modern interpretations in a later section, Mudde's is the basic definition this paper falls back on.

The rest of this paper is divided into sections. Section 2 provides an overview of the political enterprise of populism. Section 3 summarizes the economic literature surrounding classical populisms. Section 4 reviews the economic literature on modern populism. This is so engineered because without an accurate understanding of populist politics it becomes difficult to offer meaningful solutions. In Sections 5 and 6 we set out a mathematical model which explains, among other things, why modern populisms last longer than classical populisms, and advance a prescription to minimize the economic damage caused by populism. Finally, in Section 7 we examine a limited set of challenges to our model. The primary conclusion drawn is that modern populisms tend to last longer because fiscal consolidation as an economic strategy pays greater heed to exogenous constraints than fiscal expansionism.

2. Populist Politics: An Overview

Populisms have historically been defined as "multiclass coalitions."[12] This is short-hand for a political system in which the leader rises to power by appealing to large sections of the masses, including the rich and the poor, often seen in the form of explicit yet tokenistic appeals

[9] Rudiger Dornbusch and Sebastian Edwards, "The Macroeconomics of Populism in Latin America," 1991.
[10] Magud and Spilimbergo, "Economic and Institutional Consequences of Populism."
[11] Cas Mudde, "The Populist Zeitgeist," Government and Opposition, 541-63.
[12] Eliana Cardoso and Ann Helwege, "Populism, Profligacy and Redistribution," National Bureau of Economic Research, 2007.

to the lower classes and policy choices which reap rewards for the upper classes that wield political power. More recently, it has been suggested that this definition fails to take account of the nativist tendencies of populism.[13] This caused Dornbusch and Edwards (1991) to offer their familiar definition of "economic populism", which shall be revisited momentarily, but this too is rife with inefficiencies for it leads to classifications incongruous with what political scientists agree with.[14] In the aftermath of Dornbusch and Edwards, a strange stagnation was witnessed in the economic research on populism, driven possibly by the assumption that countries with populist histories might not repeat their mistakes. Political scientists, meanwhile, have advanced their inquiry and arrived upon somewhat of a consensus.

This consensus was put forth by Cas Mudde in 2004. Mudde defines populism as an ideology founded on a conflict between two clear and homogeneous segments of society, "the elites" and "the people."[15] This conflict, being everlasting and unsolvable, must be resolved to maximize the common good, and since the common good resides with the masses, populism sides with "the people". According to populism, the elites are corrupt, flagrant members of a "self-serving cartel"; whereas the people, notwithstanding their lack of access to affluent resources, are owners of a "common sense", and such common sense elevates their value over that of the elites.[16] Note that the *conflict* is the essential part of the definition here – the set of social groups comprising "the elites" and "the people" are incidental, giving rise to a variety of populisms. Contingent on the individuals comprising these groups, the conflict can take various forms, with populism prescribing that policymaking must be driven by the will of the people.

Based on this, it is possible to think of three different kinds of populisms. In "cultural populism", the elites are composed of non-natives and religious minorities whereas the people are composed of native citizens. In "socio-economic populism", big businesses and capitalist powers form the elites while the working class constitutes the people. As one might guess, the former lends itself to right-wing politics with an emphasis on religious traditionalism while the latter lends itself to left-wing politics and anti-capitalist rhetoric. A third kind of populism is "anti-establishment populism", where the elites represent the prior regime and the people are

[13] Kyle, "Populism in Power," 2018.
[14] Cardoso and Helwege, "Populism, Profligacy and Redistribution."
[15] Mudde, "The Populist Zeitgeist."
[16] Kyle, "Populism in Power," 2018.

hard-working citizens clobbered by the government. An analysis by the Institute for Global Change shows that while anti-establishment populism has receded since 1990, cultural populism has mushroomed. Comparably, socio-economic populism has also advanced despite peaking around 2011-2.[17]

A plethora of techniques are used to attain the desired effect. Prominently, populist leaders attempt to identify themselves with the voice of the people by reflecting attitudes towards society commonly seen in the people. This may range from swearing to espousing misogynist or racist views. A virulent campaign of delegitimizing the elite is often launched. It is common for a crisis of magnitude, real or imaginary, to be publicized. The inability of the elites to "represent" the people is brought to the common conscience and the populist's strong leadership is presented as an alternative.[18] Populist politics are, then, the means through which the will of the common people is translated into policy.[19] It may be borne in mind that while non-populist leaders too have been known to advertise the prioritization of the common will as their political strategy, populist leaders are distinguished from this by the ambition of their claims, and by their own approach towards macroeconomics such as their disregard of constraints and their denial of expert opinion.[20]

But populism today has changed from an enterprise dominated by anti-establishment rhetoric to one whose centrepiece is cultural populism. In the next section, we examine the macroeconomics of the first kind of populism, henceforth referred to as "classical populism."

3. The Macroeconomics of Classical Populism

The genesis of classical populism resides in the economic instability caused by war or the previous government which leads to an atmosphere of discontent and dissatisfaction amidst the masses. Populism, derived from the Latin word "populus", is thus a range of policies that appeal to the masses and reinforce the idea of a people-driven government. In this section, we elucidate the foundational principles of macroeconomic populism of the old and point the microscope on

[17] Ibid.
[18] Kyle, "Populism in Power," 2018.
[19] Eichengreen, "The Populist Temptation," 2.
[20] Ibid, 5.

what led to its collapse. For this, we build on the examples of the Latin American economies in the 1970s and 1980s.

3.1. Main Framework: Dornbusch and Edwards (1991)

It is hard to speak of classical populism without alluding to Dornbusch and Edwards' landmark framework (1991). Classical populism, as modelled by Dornbusch and Edwards, can be divided into five phases. In Phase 1, charismatic leaders come to power after a period of economic and political turmoil that gives rise to a deep dissatisfaction amongst the people. Such a state is usually experiencing economic stagnation or depression due to the previous government's policies. Attempts at reducing inflation are carried out because higher prices translate to lower standards of living. The dearth of real results amplifies frustration, compelling people to move to heterodox policies. This leads to the installation of a populist government, usually through a coup d'etat. After assuming power, the populist government moves further away from fiscal discipline and austerity and begins to incur extravagant expenditure for the promotion of expansionary policies in order to realize its promise of increasing real wage and employment. In the words of Edwards (2018), "Risks of fiscal deficit are portrayed as exaggerated. Populists argue that monetary expansions are not inflationary because there is unutilized capacity and it is always possible to squeeze profit margins by price controls."[21]

In Phase 2, the economy reacts to the aggregate demand shock which provides respite from the evils of inflation as real wages and employment rise and remain high. Populist policies are deemed to be successful. The temporary stabilisation vindicates the populist leader and strengthens the people's trust in the government. Foreign borrowing finances high government spending and the price controls put in place keep a check on inflation while shortages are met with an increase in imports. The demand expansion does not affect the price as increasing demand is met by the existing inventories and overseas imports, which are financed through the dwindling foreign reserve. These populist leaders professed the necessity of fiscal expansion even at the expense of fiscal deficit, predicting that increased demand will augment production,

[21] Sebastian Edwards, "On Latin American Populism, and Its Echoes around the World," Journal of Economic Perspectives, 2018.

thus decreasing per unit cost. For this reason, they believed that a fiscal deficit was not inflationary in nature.

As Phase 3 looms, the shortcomings of these policies come to light and the economy finds itself in bottlenecks. The governments and Central Banks are forced to deal with depleted foreign reserves, high international debt, and domestic inflation. Wages are revised with a lag due to government-mandated indexation. With the rise in inflation, the frequency of wage adjustment increases from annual to quarterly to monthly. The budget deficit is exacerbated with the compulsory expenditure on subsidies, public services and transportation, among others.

Phase 4 is characterized by shortages, increased capital flight, and highly aggravated inflation. This can be considered as the precursor to the collapse of the populist regime. The common people bear the brunt as more rigid price controls are imposed, subsidies are cut off and the currency is devalued. Wages fall despite indexation and government revenues lag behind since the general indexation increases government wage bills considerably. The government also faces the threat of defaulting on foreign debt. The disparity between exchange rates and inflation worsens and results in real exchange rate overvaluation. Consequently, foreign currency becomes a medium of exchange for the people. Multiple exchange rates are introduced. This leads to Phase 5, where the economy is restabilised, usually under an orthodox new government. In many cases, the International Monetary Fund (IMF) is seen to enter the country. The direction of transition observed in the first phase, from orthodox to heterodox policies, is reversed by the fifth and the final phase, as the country moves back to orthodox policies.

3.2. Causes of Downfall

A most interesting observation is the appropriation of the Keynesian standard to substantiate the populist government's economic aspirations and defend its fiscal laxity.[22] In this part of the section, we highlight the causes behind the collapse of classical populism in reference to the above observation and the Keynesian framework.

[22] Luiz Bresser Pereira and Fernando Dall'Acqua, "Economic Populism versus Keynes: Reinterpreting Budget Deficit in Latin America," Journal of Post Keynesian Economics, 29-38.

As populist governments aggressively pursued their expansionist goals with scant regard for the dangers of the budget deficit, fiscal indiscipline reigned supreme aided by the assumption that "demand pressure on the prices arising from an excess of absorption is not a crucial determinant of inflation."[23] Existing reserves and idle capacity are considered scope for non-inflationary expansion. Scaffolding these policies was an appropriated form of Keynesianism. Under this school of thought, it is held that a wage increase promotes consumption and sustains aggregate demand. Thus, to increase aggregate demand, an indiscriminate use of budgetary deficits was advocated. This is not only bad economics but also a misinterpretation of Keynes, for, far from this self-suited appropriation Keynes considered deficit financing a "desperate expedient" and propounded that a balanced budget should only be suspended during periods of recession and that the government should fall back on the budget deficit to re-establish full employment, which initially dwindles due to the loss of aggregate demand, caused by a decrease in foreign demand or a decline in private investment. The budget deficit was, then, to be used as a stabilisation device in the short-run in periods of recession and withdrawn in periods of prosperity.[24] As opposed to the true ideals of the economist they cited, classical populists used deficit financing as a mechanism for rapid and sustained economic growth and income redistribution goals, paying little heed to the original Keynesian framework.

The reasons for the collapse of classical populism can thus be pinned down to two misassumptions. Firstly, classical populists failed to take account of the fact that public expectations and socio-economic conduct changes with a period lag. Therefore, they cannot be instantaneously changed for rapid economic growth and simultaneous expansion of production capacity without spiralling into an inflationary trap and external constraints. Secondly, they miscalculated the effects of increased government spending. One of the central assumptions of the Keynesian framework is as follows: "Changes in flows, such as government borrowing and monetization, do not significantly affect the outstanding stocks, such as government debt, of high-powered money."[25] However, this too is consistent with the condition that deficit financing must only be adopted as a temporary measure because outstanding stocks are assumed to be unchanged in the very short-run. Therefore, monetary policy is considered to be the

[23] Ibid.
[24] Ibid.
[25] Ibid.

discriminatory variable. The effect of public deficit is contingent on the level of accommodation introduced into the money supply by the central bank.

While these diagnoses offer a preliminary foundation to base future analysis off from, its drawback is that it is produced entirely from anecdotal evidence and does not involve the usage of a theoretical framework from which one may make policy prescriptions. Starkly, there is a tendency to assume a logically consistent argumentative process implicit to populist economics, rather than seeing it as the product of an inference-observation confusion or loosely thought-out models despite the lack of evidence to support such an outlook. Additionally, it is difficult to unearth the effect of populism on economy or institution empirically because of the dual problems of reverse causality and omitted variable bias.[26] A theoretical model, unlike this, addresses all three of the above deficiencies, as we do in Sections 6 and 7 of this paper.

These qualities, however, are diametrically opposed to the economic effects of modern populism, as shall be seen in the next section.

4. The Macroeconomics of Modern Populism

Modern populisms are founded on the ideal of fiscal consolidation.[27] This refers to the pursuit of minimal government spending and high tax rates with the aim of achieving a towering budgetary surplus. Largely cultural in nature, modern populism has been diagnosed as being a product of the failure of meritocracy and the resulting inequality and economic crises of the twenty-first century.[28] Notably, the evidence indicates that new populism does not lead to debilitating experiences of hyperinflation as populisms of the old.[29]

We start this section by outlining three proposed causes for the coming of this brand of populism – one political, two economic – before turning to its economic effects.

4.1. Causes for Rise

[26] Magud and Spilimbergo, "Economic and Institutional Consequences of Populism,"
[27] David Lubin, "The New Macroeconomics of Populism," Financial Times, 2019, https://www.ft.com/content/5b7c4c2c-8eb3-11e9-a1c1-51bf8f989972; Pulapre Balakrishnan, "India's Economy from Nehru to Modi: A Brief History," Permanent Black, 2022; Eichengreen, "The Populist Temptation."
[28] Eichengreen, "The Populist Temptation," 12.
[29] Edwards, "On Latin American Populism, and Its Echoes around the World."

According to the philosopher Michael Sandel, populism is the result of the failure of meritocracy - the idea that one's merit determines one's social status - in theory and in practice. Because of the prominence of the meritocratic ideal in political rhetoric, the concept of meritocracy is welded deep into the collective psyche. However, not only is true meritocracy impossible to achieve, it is also sufficiently borne out by the increasing inequality of our world that adequate measures towards birthing a meritocracy have not been undertaken. Due to the resultant contradiction between rhetoric and reality, the "losers" of meritocracy – the poor – live in eternal shame whereas the "winners" of meritocracy – the rich – live in hubris. Populist emotiveness, Sandel claims, has succeeded in shaping this shame into anger.[30]

A surfeit of economic causes too has been proffered. Firstly, new populisms have been said to have risen out of the handicaps spawned by globalization. As the world underwent expeditious globalization in the 1990s, although many countries voluntarily opened up to foreign trade certain nations were forced to restructure by pressure from the foreign market and international agents.[31] In the post-globalized world, this presented an advantage to first-world countries as their competitors in the international market included countries which remained ill-prepared to do away with protectionist norms and open up to the globalized economy. The economic injustice and unfair allocation of resources that followed caused these countries to be economically weaker. Since populisms arise out of a climate of economic crisis, this generated a base for populism.[32] The political outcome is there to see: modern populism is cultural in nature and antagonizes foreign and non-native entities.

Secondly, Lubin (2019) posits that nations which have had the experience of classical populism in the past, as economists of the 1990s predicted, reject fresh uprisings of classical populism – possibly because hyperinflation has profound effects on peoples' lives.[33] But unlike what was once assumed, this does not necessarily cull populist proclivities; instead, many succumb to a new type of populism that is different in variety but produces comparable outcomes. While the subjective experience of the people discourages deficit finance, fiscal discipline thrives. This perhaps explains the observation that nations which have had experiences

[30] Michael J. Sandel, "The Tyranny of Merit, Penguin, 2020, 27-32.
[31] Eichengreen, "The Populist Temptation," 117.
[32] Lubin, "The New Macroeconomics of Populism."
[33] Robert Shiller, "Why Do People Dislike Inflation?" NBER Working Paper, 1997.

of populism in the past are likelier to turn to populism in the future than those which have not.[34] The economic outcome is that contemporary populists are wary of granting foreign entities access into their countries and look inwards to generate economic self-reliance through the political awakening nationalistic pride.

4.2. Macroeconomic Effects

As previously mentioned, there is a paucity of literature documenting the economic effects of modern populism. One study worth mentioning is Magud and Spilimbergo (2021). By analysing economic outcomes in Latin American populisms between 1990 and 2020, Magud and Spilimbergo confirm that modern populisms indeed do last longer than their counterparts and that hyperinflation is uncommon in these economies. However, contrary to the bulk of the literature, they find that government spending rose in these populisms. Consequently, they claim that the absence of inflationary tendencies in new populisms is attributable to the commodity super-cycle of the 2000s and consumers having greater incentive to spend on domestic rather than foreign goods, while also discouraging imports and encouraging exports. In our analysis, we attribute this observation to usage of the unrepresentative sample set of Latin American populisms and proceed by assuming the conventional finding of reduced government spending. Given the absence of such research, the ideal response is to look at the data to uncover economic truths about modern populism. However, this is beyond the scope of our paper as our focus remains on modelling populism. It is illuminating, however, to briefly survey the anecdotal evidence to both illustrate these trends and also check for additional pointers. In the next part of this section this goal is pursued.

A perspicuous example is seen in the form of Hungary under Viktor Orban. Tacconi (2018) notes that the primary goal of Orban's macroeconomics is to "rebalance the ratio between foreign and Hungarian capital" and to "pay down Hungary's inflated debt burden."[35] At the time of writing, the government owns 20% of the banking sector – the end-product of financing the country's deficit by selling bonds to people at rates higher than what was to be paid to external

[34] Edwards, "On Latin American Populism, and Its Echoes around the World."
[35] Matteo Tacconi, "'Orbanomics' or Why Hungary Needs Europe," Reset Doc, https://www.resetdoc.org/story/orbanomics-hungary-needs-europe/

creditors.[36] Similarly, under Alberto Fujimori's rule Peru's balance of payments shifted from approximately -6% at the start of the tenure to -3% at the end[37]. These practices, seemingly at odds with the redistributive agenda of the old populism, lie at the heart of the new.

It is also illuminating to consider a case which lies at the geographical centre of modern populism, Asia. A suitable example is that of India under Narendra Modi. According to one analysis, Modi's populism is an example of cultural populism where religious minorities form "the elites" and native Hindus form "the people."[38] Rodrik (2018) notes the political tactic used: "They (the populist leaders) present a story that is meant to resonate with their base, the demand side: here is what is happening, this is why, and these are the people (enemy) who are doing it to you."[39] Like most new-age populisms, the economics of Modi's India are built on fiscal consolidation. It has been noted that the three strings in the bow of Indian macroeconomic policy are fiscal discipline, inflation control and macroeconomic stability.[40] One manifestation of this is that less than one-third of the fiscal stimulus required to put the economy back on track in the aftermath of India's first COVID-19 wave was pumped into the economy. A general trend of declining aggregate public expenditure in social and welfare schemes ranging from education to healthcare is also witnessed. The budget for FY 2022-23 also reveals the financial strategy: hike tariffs and enlarge incentives to increase production.[41]

However, the future remains uncertain. On the one hand, certain literature predicts that through proactive means such as increasing tax rates on "sinful" commodities like alcohol and tobacco while decreasing government expenditure it is possible for these economies to thrive.[42] On the other hand, the propagation of populist ideology may result in hardship for the government to provide public commodities to marginalized sections of the society, as has been

[36] Marton Dunai, "Hungary's Economy Poses Immediate Challenge for Orban after Election Win," Financial Times, April 24, 2022, https://www.ft.com/content/6566766a-0e0c-42a2-b31d-190a12ba6f94.
[37] Efraín Gonzales Olarte, "Economic Stabilization and Structural Adjustment under Fujimori," Journal of Interamerican Studies and World Affairs, 51-80.
[38] Kyle, "Populism in Power," 2018.
[39] Rodrik, "Populism and the Economics of Globalization."
[40] Balakrishnan, "India's Economy from Nehru to Modi," 145-9.
[41] Suyash Rai, "India's New Budget Reveals a Shift in Fiscal Strategy," Carnegie India, 2022, https://carnegieindia.org/2022/02/17/india-s-new-budget-reveals-shift-in-fiscal-strategy-pub-86453.
[42] Chadi Abdallah, David P. Coady, Sanjeev Gupta, and Emine Hanedar, "The Quest for the Holy Grail: Efficient and Equitable Fiscal Consolidation in India," SSRN Electronic Press, 2015.

witnessed in the Americas.[43] It is here that our model steps in. We summarize some of the important distinctions between classical populism and modern populism in the below table.

	Classical Populism	**Modern Populism**
1.	Fiscal expansionism	Fiscal consolidation
2.	Negligible taxation rates	High taxation rates
3.	Large government spending	Small government spending
4.	Hyperinflation is witnessed	No hyperinflation
5.	Initial GDP boost	No significant initial GDP boost

We now turn to the model.

5. Modelling: Classical Populism

Our model of classical populism focuses on five variables: output at time t (y_t), consumption (C), time (t), investment (I) and borrowing at time t (b_t). The time variable is crucial for it helps formalize the fact of growth over time witnessed at least in the short-run in populist macroeconomies and aids in comparing monetary variables of the present and past periods. We start by assuming a closed economy.

According to the classical output function,

$$y_t = C + I + G, \tag{1}$$

where G represents the government spending.

We assume for simplicity that I is exogenous and constant.

5.1. Assumptions concerning *G*

[43] Eichengreen, "The Populist Temptation," 13.

The model's critical assumption concerning the government spending function is that spending is directly proportional to the public money at hand and inversely proportional to time.

$$G = f(R_t, b_t, t) \tag{2}$$

such that $G \propto R_t$, b_t and $G \propto 1/t$.

Upon combining the two equations we get,

$$G \propto (R_t + b_t)/t \tag{3}$$

where R_t and b_t are assumed to enter additively, not multiplicatively, for the sake of dimensional homogeneity and mathematical simplicity. Eliminating the proportionality sign we get,

$$G = k(R_t + b_t)/t \tag{4}$$

where k is a proportionality constant.

We may further simplify this by making two assumptions. Firstly, if τ is assumed to be the tax rate,

$$R_t = y_t\tau \tag{5}$$

becomes the revenue. The implicit assumption here is that there is only one tax and this is levied equally on all. Secondly, we assume that there exists a constraint on spending. The government must repay its borrowings of the last period and spend the remaining amount. The fact that populist policymakers pay no heed to fiscal constraints does not affect this assumption; it remains vacuously true nevertheless that one cannot spend more than what they must pay back. Therefore,

$$G \leq k(y_t\tau + b_t - (1+r)b_{t-1})/t \tag{6}$$

Since populist regimes practise fiscal expansionism and spend as much as they can,

$$G = k(y_t\tau + b_t - (1+r)b_{t-1})/t \tag{7}$$

This gives us our spending function.

5.2. Putting It All Together

Assuming the classical $C = c_0 + c_1y_t$ function for consumption, we get

$$y_t = c_0 + c_1y_t + I + k(y_t\tau + b_t - (1+r)b_{t-1})/t \tag{8}$$

$$\Rightarrow (1 - c_1 - k\tau/t)y_t = c_0 + k(b_t - (1+r)b_{t-1})/t \tag{9}$$

However, classical populisms enforce minor tax rates that tend towards zero. Substituting for $\tau = 0$,

$$(1 - c_1)y_t = c_0 + k(b_t - (1+r)b_{t-1})/t \tag{10}$$

Differentiating y_t with respect to t yields,

$$(1 - c_1)dy_t/dt = k[tdb_t/dt - b_t + (1+r)b_{t-1}] \tag{11}$$

Now, for growth to be positive; i.e., for $dy_t/dt > 0$,

$$k[tdb_t/dt - b_t + (1+r)b_{t-1}]/(1 - c_1) > 0 \tag{12}$$

Since $c_1 < 0 \Rightarrow 1 - c_1 > 0$ we get,

$$tdb_t/dt - b_t + (1+r)b_{t-1} > 0 \tag{13}$$

But since b_t stands for international borrowing and due to the constraint on the populist policymaker such borrowing cannot fluctuate rapidly, for small time periods, $tdb_t/dt << b_t, b_{t-1}$. Therefore we attain,

$$b_t < (1+r)b_{t-1} \tag{14}$$

In other words, growth will occur and the first phase of classical macroeconomic populism will surge if and only if the populist policymaker borrows less in the present period than they borrowed in the past period.

It is easy to see why this is a stringent condition. If $b_t < (1+r)b_{t-1}$, then the highest value the function for government spending, $G = k(y_t\tau + b_t - (1+r)b_{t-1})/t$, can take approaches zero. This contradicts the populist regime's raison d'être of spending luxuriously despite negligible taxation.

Our model thus reveals what occurs in the classical populist macroeconomy: faced by the ambitiousness of their goal and confronted by growth constraints, the populist policymaker is forced to ignore the constraint. As a result, classical populism rapidly gives way to economic downfall.

In the next section, we tweak our output function to model the macroeconomics of new populism.

6. Modelling: New Populism

The new model is composed of the same five variables: output at time t (y_t), consumption (C), time (t), investment (I) and borrowings at time t (b_t). There are two key differences. Firstly, we do not consider tax rates to be approximately zero as modern populisms, focused on fiscal consolidation, impose heavy taxes on citizens. Secondly, we model investment (I) to be endogenous.

6.1. Assumptions concerning *I*

It is non-controversial to conceptualize I as progressively receding with an increase in interest rate (r). The vital assumption introduced is in modelling a trust variable (α). This variable represents the trust that the government is able to induce in investors. Should the investor believe a macroeconomic surge is impending, an increase in α is witnessed; and vice versa. Consequently, investment increases as α increases. Thus, we may write the investment function as follows.

$$I = f(r, \alpha) \tag{15}$$

$$I = a_0 - a_1(1 - \alpha)r \tag{16}$$

Here, α enters multiplicatively because trust is a dimensionless quantity. Also, we make the choice of preserving the originality of the investment function so that the positive constants a_0 and a_1 can take their conventional values.

6.2. Assumptions concerning *G*

It is assumed that there is negligible borrowing from domestic sources. This is in conjunction with the literature on the topic which reflects that modern populist policymakers target fiscal consolidation. Consequently, b_t and b_{t-1} disappear. Therefore,

$$G = k(y_t\tau)/t \tag{17}$$

6.3. Putting It All Together

Assuming the classical $C = c_0 + c_1y_t$ function for consumption, we get

$$y_t = c_0 + c_1(1 - \tau)y_t + a_0 - a_1(1 - \alpha)r + k(y_t\tau)/t \tag{18}$$

$$\Rightarrow (1 - c_1 + c_1\tau - k\tau/t)y_t = c_0 + a_0 - a_1(1 - \alpha)r \tag{19}$$

Treating r as a constant, differentiation yields,

$$(1 - c_1 + c_1\tau - k\tau/t)dy_t/dt = a_1rd\alpha/dt \tag{20}$$

As populist policies progressively reduce the trust investors possess in the government, $d\alpha/dt < 0$. Hence, for growth to be positive; i.e., for $dy_t/dt > 0$,

$$1 - c_1 + c_1\tau - k\tau/t < 0 \tag{21}$$

$$\Rightarrow 1 - c_1 < k\tau/t - c_1\tau \tag{22}$$

Now, since $0 < c_1 < 1$ and $0 < \tau < 1$, though individually they may not be approximated to zero, their product can be; i.e., $c_1\tau$ approaches zero. Hence the growth condition becomes,

$$1 - c_1 < k\tau/t \tag{23}$$

It is observed that this is a looser condition than the one achieved for classical populist macroeconomies. Since populisms arise out of conditions of macroeconomic crises, and since c_1 tends to be a large value for poor agents, in the short-run $1 - c_1$ is a small number. Thus, for small values of t, $k\tau/t$ will be comfortably greater than $1 - c_1$.

Our model thus reveals the central reason why classical populisms perish in speed but modern populisms last longer: the growth condition for modern populist schemes is more achievable than the one for the classical populisms.

7. Discussion and Conclusion

The model returns three actionable conclusions, the last of which may be used by well-meaning policymakers embroiled in a populist setting to minimize the damage wrecked by populist politicians. Firstly, we see that the key point of divergence between the economic outcomes of classical populism and modern populism is the degree of conflict between the political ambition and the nature of the growth constraint each face. Secondly, we see that although modern populisms keep a tight ledge on the macroeconomy for longer time periods, one must expect growth to occur only in the short-run since as time goes on and t increases and c1 increases it is unlikely that $k\tau/t$ remains greater than $1 - c_1$. Finally, we also see that as time goes on the modern populist government is advised to progressively hike taxation, τ, to conform to the growth constraint, $1 - c_1 < k\tau/t$.

A brief discussion of the limitations of the model may be pursued. Firstly, we consider a singular tax rate. Since the taxation system is central to the dynamics of our model, determining the major part of the spending function and returning the final conclusions, it is possible that the imposition of a multiple-slab system may complicate the outcome. In counterargument, of course, it may be said that it is common in our discipline to make this assumption. Further effort must be directed towards performing comparative statics on this framework by considering a

multiple-slab system and other means. Secondly, the implicit assumption in making the policy prescription that populist policymakers raise tax rates as time goes on is that the rest of the framework remains the same. Whether there exist second-order effects of a tax hike which alter the dynamics of the model is a question worth pondering about but one which is out of the scope of this paper. Thirdly, our focus, as dictated by the literature, has been on international borrowing as comprising the bulk of the monetary deficit. Domestic borrowing, albeit small, in the form of bonds and other sources, is not taken account of. While it is unlikely that this might be a major concern, the prominence of the assumption that the rate of change of borrowing with respect to time is small to our model makes it essential that we test this assumption using real-world data after accounting for domestic borrowing. This leads us to the final limitation, which is that the majority of our assumptions remain informed by anecdotal evidence rather than quantitative data. Future models of macroeconomic populism must combine such subjective intuition with objective data.

In sum, in this paper we produce what is to our knowledge the first theoretical model that formalizes the macroeconomics of modern-day populism. It explains why modern populisms last longer than classical populisms, while also offering the prescription that populist policymakers raise their tax rates as time goes on. At a practical level, knowing the basis of the economics of populism provides an informed basis from which policy decisions can be made.

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China's Foreign Aid: Altruism or Neocolonialism?

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ABSTRACT

In the past few decades, China has emerged as a primary lender to nations - for many developing countries a lender of last resort, and for others a strategic investor. In volume and geographical penetration of credit, by many estimates it is matched only by the World Bank and no other multilateral or bilateral international financier. The nature of its investments and the terms of its credit have prompted debates on China's objectives, and has led to discussions on 'debt-trap diplomacy' and its lending strategy. This paper aims to explore existing literature on China's lending practices and discuss why countries increasingly seem to prefer Chinese aid and investment. It examines China's motivations to invest in other nations, particularly in those having poor credit ratings - do they have a desire to aid the economic development of low-income nations, or are they driven by neo-colonial interests?

JEL Classifications: F35, F51, F65, F55, P45

Keywords: China, Debt-trap diplomacy, neocolonialism, foreign aid, information asymmetry

1. INTRODUCTION

After the end of the Maoist era, the People's Republic of China (PRC) started closely following a new yin-yang philosophy of 'welcoming in' and 'going out'.[1] 'Welcoming in' promotes domestic capital formation whereas 'going out' refers to the subsequent exit of surplus capital through investments in foreign countries. The combination of both increases access to foreign markets, resources and technological advancement, leading to accumulation of foreign reserves.[2] Introduced by Deng Xiaoping, these economic development policies first encouraged foreign direct investment (FDI) in China by introducing foreign capital into the economy in the late seventies and early eighties. Once internal development was achieved, the 'going out' policy kicked in from the late eighties and early nineties with non-state-owned enterprises now allowed to invest in foreign countries as well, given that they formed partnerships with "suitable foreign entities" and invested enough capital.[3] In the nascent years of the 'going out' policy, China

[1] "China's 'Going Out' Strategy," n.d. https://www.diplomaticourier.com/posts/china-s-going-out-strategy.
[2] Ibid.
[3] Ibid.

invested with a major focus on trade and supporting businesses in industries such as distribution and marketing. Since the early 2000s, after gaining membership to the World Trade Organisation (WTO), China transformed itself from a country that exported goods to a country that now exported capital by exploiting the free trade guidelines of the WTO and a global investor.[4]

The Belt and Road Initiative (BRI) announced by Xi Jinping in 2013 aimed at increasing Chinese investments specifically in foreign infrastructural development projects such as development of the Silk Road economic belt (China to Europe through central Asia), the maritime Silk Road (connecting south-east Asia, Africa, Middle East and China through sea) and the Digital Silk Road that would foster regional cooperation in finance and technology in almost one hundred and fifty international organisations and countries.[5] Goh and Liu show that Chinese investment presence in Southeast Asia increased at the onset of the 2008 Global Financial Crisis since it coincided with the first peak of the 'going out' policy.[6] The second peak occurred between 2013-17 after the announcement of the BRI. Previously heavily dependent on the energy sector, investments were now diversified into industries such as metal and infrastructure from 2011.[7] According to the Chinese Loans to Africa (CLA) database, Chinese creditors have loaned approximately $160 billion to African government and state-owned enterprises from 2000 to 2020, with the most volume lent to Angola, Ethiopia, Zambia, Kenya and Sudan.[8] The data is similar for investments in Latin America, with natural and raw material resource-rich countries being targeted for increasing investments.[9]

China has increasingly become the sole creditor to multiple countries, so much so that by certain estimates, it has surpassed the World Bank and the IMF as well.[10] Typically, it invests in

[4] "China's 'Going Out' Strategy."
[5] Perla Farias, "A New Era of Neocolonialism: China and the Belt and Road Initiative in the Asian Subcontinent" (B.A. Thesis, University of Texas at San Antonio, 2021), 2.
[6] Evelyn Goh and Nan Liu, "Chinese Investment in Southeast Asia, 2005-19: Patterns and Significance," *SEARBO Policy Briefing, New Mandala*, August 2021, 3.
[7] Ibid.,5.
[8] "Chinese Loans to Africa Database," Boston University Global Development Policy Centre, 2022, https://www.bu.edu/gdp/chinese-loans-to-africa-database/.
[9] "China's 'Going Out' Strategy."
[10] Sebastian S. Horn, Carmen Reinhart, and Christoph Trebesch, "China's Overseas Lending," *Journal of International Economics*, 2019,12, https://doi.org/10.3386/w26050.

energy, telecommunications, and manufacturing, with a special emphasis on infrastructural projects such as dams, bridges, roads and airports.[11]

The primary question this paper examines is regarding China's motivations towards lending to other countries, specifically credit-constrained ones with poor credit ratings. China's official aims for foreign investments are to promote economic, social and human resource development and improve people's livelihoods in Least Developed Countries (LDCs) by improving agriculture, developing infrastructure, ensuring technological cooperation and promoting trade development.[12] However, there exists another viewpoint opining that China is driven by its desire to gain money, gain direct access to raw materials, and secure its position in international politics.[13]

This paper explores whether China's intentions are altruistic, with the aim of helping countries achieve their development goals, or whether their investments are in pursuit of geo-strategic interests. The latter has implications not only for the sovereignty of debtor countries, which has far-reaching impacts on global diplomacy, but also economic relations, considering China's share of the public debt burden of developing countries, making the threat of asset seizure more significant. These questions are poignant in light of China's alleged strategy of lending to economically weak and politically unstable countries, leaving them heavily dependent on Chinese aid and vulnerable to China's influence. This "debt-trap diplomacy" strategy, coined by Brahma Chellaney, is now the subject of much discussion.[14]

The rest of the paper is organised as follows. Section 2 examines China as a creditor and Section 3 discusses the origin of China's funds. The differences between China's and the World Bank's lending policies as well as the terms and conditions of the Chinese government's policy that aims to maximise profit are explored in Section 4. The paper finds that the two differ significantly in terms of the concessionality offered in the terms of foreign loans. Next, Section 5 compares Chinese aid policy with that of Western countries in the context of Africa and

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[11] "China's Foreign Aid (2014)," *The State Council of the People's Republic of China* (Information Office of the State Council, 2014), http://english.www.gov.cn/archive/white_paper/2014/08/23/content_281474982986592.htm.
[12] Ibid.
[13] Moisés Naím, "Opinion | Help Not Wanted," The New York Times, February 15, 2007, https://www.nytimes.com/2007/02/15/opinion/15naim.html?_r=0&mtrref=undefined&assetType=opinion.
[14] Brahma Chellaney, "China's Debt-Trap Diplomacy," Project Syndicate, August 30, 2017, https://www.project-syndicate.org/commentary/china-one-belt-one-road-loans-debt-by-brahma-chellaney-2017-01?barrier=accesspaylog.

examines why African countries seem to distinctly prefer Chinese aid over Western aid. Finally, Section 6 discusses the possibility of China engaging in "debt-trap diplomacy" by analysing its lending behaviour in Latin America to see whether China's motivations extend beyond the financial and the benevolent to political, economic, and other realms. It also considers whether China's 'no questions asked' policy could be detrimental to its interests in the long run.

2. CHINA AS A CREDITOR

2.1 Chinese Data

A key difference between Chinese credit and investments and other forms of international transactions is that China doesn't report its official lending.[15] China's average annual foreign aid budget is $4.8 billion.[16] The Chinese government does not provide a breakdown of how much aid was given to each country, nor do they include project-level reporting. The only data available are global and regional aggregate estimates of foreign aid provision. The most well-hidden details pertain to the Chinese government's more commercially-focused and less concessional loans to developing countries, which by some estimates, account for approximately eighty percent of total Chinese government financing to such countries.[17] Researchers have attempted to overcome this obstacle of data paucity by independently collecting and consolidating information on Chinese lending and aid from borrower governments, multilateral institutions, Chinese contractors, media reports, and other sources. Data constraints have forced this paper to rely on external research published by non-official sources for information on external Chinese projects and investments. However, it must be noted that such sources could suffer from confirmation bias, whereby researchers attempt to find data that confirms their pre-existing hypotheses - this is especially important given the polarisation in scholars' opinions on the Chinese lending debate.

2.2 Largest Creditor to Developing Countries

[15] Horn, Reinhart, and Trebesch, "China's Overseas Lending.",2.
[16] "China's Foreign Aid (2014)."
[17] Scott Morris, Brad Parks, and Alysha Gardner, "Chinese and World Bank Lending Terms: A Systematic Comparison across 157 Countries and 15 Years," *Centre for Global Development* 170 (2021): 4, https://www.cgdev.org/sites/default/files/chinese-and-world-bank-lending-terms-systematic-comparison.pdf.

Another factor that distinguishes Chinese investments is that the Chinese government - through its major policy banks, state-owned commercial banks, and government agencies - undertakes most of the overseas lending and portfolio investments.[18] China has also supplied assistance to regional organisations like the African Union in addition to the 121 countries in Asia, Africa, Oceania, Latin America and the Caribbean that it aided between 2010 to 2012.[19] Most of China's loans go to developing low- and middle-income countries and it is becoming increasingly clear that China now represents the largest official external creditor to such governments worldwide. By some estimates, it is larger than the IMF and World Bank individually both in volume and reach and all of the Paris Club (a group of 22 high-income creditor countries who are supposed to work together towards finding solutions for debtor countries) creditors combined.[20] This is partly due to the fact that wealthy countries such as New Zealand and the United Arab Emirates are ineligible to borrow from the World Bank; by some estimates, New Zealand relies on China for over 50% of its loans, and 100% of the loans undertaken by the UAE are from China.[21]

China's transformation to the largest creditor for developing countries has coincided with an increasing risk of debt burden and distress in these economies due to highly unfavourable lending terms to underperforming domestic economies.[22] According to Hurley, Morris, and Portelance,[23] 23 countries enrolled in the BRI are at risk of debt distress (as per World Bank/IMF debt sustainability analyses), and eight of them are severely vulnerable due to future BRI-related inflows. Horn et al. estimate that over 20 countries owe more than ten percent of their national income to China. They also suggest that low-income countries jointly owe significantly more to China ($380 billion) than they owe to all 22 members of the Paris Club combined ($246 billion).[24]

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[18] Horn, Reinhart, and Trebesch, "China's Overseas Lending.",71.
[19] "China's Foreign Aid (2014)."
[20] Horn, Reinhart, and Trebesch, "China's Overseas Lending.",21.
[21] Morris, Parks, and Gardner, "Chinese and World Bank Lending Terms: A Systematic Comparison across 157 Countries and 15 Years.",39.
[22] Morris, Parks, and Gardner, "Chinese and World Bank Lending Terms: A Systematic Comparison across 157 Countries and 15 Years.",14.
[23] John Hurley, Scott C. Morris, and Gailyn Portelance, "Examining the Debt Implications of the Belt and Road Initiative from a Policy Perspective," *Journal of Infrastructure, Policy and Development* 3, no. 1 (June 28, 2019): 139, https://doi.org/10.24294/jipd.v3i1.1123.
[24] Horn, Reinhart, and Trebesch, "China's Overseas Lending.", 14

2.3 Nature of Investments and Aid

Post the commencement of the BRI initiative, China's main aim has been to deepen trade ties and create seamless connectivity with developing countries. In order to achieve these objectives, China has invested heavily in energy, transport and information and communications technology across continents over the last decade.[25] From 2010 to 2012, a total of 580 construction projects were undertaken in 80 countries that were mainly focused on agriculture and infrastructure.[26] Investments abroad in infrastructure include projects such as roads, dams, ports, and airports in countries like Kenya, Laos and Sri Lanka respectively. Within the realm of infrastructure, aid is most common in the form of construction of factories or development of transport facilities. Other investments are in the sectors of energy, medicine and telecommunications. China's investments in the energy sector are focused on fossil fuel operations that aggravate climate change, specifically coal.[27] China has spent over 40 billion USD FDI for coal-fired power stations since 2000, and 11 out of 20 of the world's biggest developers of coal are Chinese. China has also invested large amounts in Russian, Ecuadorian, Brazilian, Venezuelan and Angolan oil projects.[28] However, Chinese aid is increasingly being used to build low carbon energy-generation projects, with the number of solar and wind projects it has invested in rising since 2009 - in 2014, China's investments in low carbon projects was approximately equal to that in high carbon projects, as compared to 2009, where the former was approximately 10% of the total investments made.[29] This is in line with its commitment to reduce global greenhouse gas emissions as per the Paris Agreement, and is enabled by its comparative

[25] Helena Vieira, "China is investing in developing countries – what is it really up to?," LSE Business Review, October 1, 2018, https://blogs.lse.ac.uk/businessreview/2018/10/01/china-is-investing-greatly-in-developing-countries-what-is-it-really-up-to/#:~:text=In%20fact%2C%20China%20is%20investing,with%20developing%20and%20transitioning%20economies.
[26] "China's Foreign Aid (2014)."
[27] Kevin Gallagher, "China Global Energy Finance: A New Interactive Database," *GEGI Policy Brief Boston University Global Economic Governance Initiative* 002 (March 2017):2, https://www.bu.edu/pardeeschool/files/2017/03/China-Global-Energy.-Gallagher.Finaldraft-1.pdf..
[28] Vieira, "China is investing in developing countries – what is it really up to?"
[29] Helena Vieira, "China is investing in developing countries – what is it really up to?," LSE Business Review, October 1, 2018, https://blogs.lse.ac.uk/businessreview/2018/10/01/china-is-investing-greatly-in-developing-countries-what-is-it-really-up-to/#:~:text=In%20fact%2C%20China%20is%20investing,with%20developing%20and%20transitioning%20economies.

advantage in using greener technology for production.[30] There is also a conscious effort towards promoting better healthcare abroad, with China providing 800 million yuan worth of medical equipment and supplies to African countries.[31]

Telecommunications projects such as those taken up in Turkmenistan, Togo and Eritrea ensure high quality and stable communication systems to citizens, and China's assistance in optical cable transmission networks in Cameroon and Tanzania have promoted their usage in African countries.[32] A large part of the aid is also in the form of human capital building wherein Chinese experts on matters such as agriculture, education and medicine were sent to developing nations to impart knowledge, skills or consult on various matters to increase accuracy, productivity and efficiency. Aid also often comes in the form of zero export tariffs - in 2005, China offered 25 of the least developed African nations zero tariffs on taxable items in 190 categories. From 2008, it was the largest exporter of commodities from these countries for five years consecutively.[33]

3. ORIGIN OF CHINESE FUNDS

China adopted its 'going out' strategy in the late 90s to deal with its accumulation of foreign exchange reserves owing to trade surpluses[34]. To prevent the risk of inflation and currency revaluation if these reserves were to enter the domestic economy, China expanded its official lending to other countries. As of 2022, China's central bank, the People's Bank of China, has the largest foreign exchange reserves in the world, totaling upwards of USD three trillion.[35] Chinese lending institutions have an incentive to not only invest in overseas assets but also lend to indebted countries above their annual domestic return on foreign exchange reserves. However, the lack of transparency in Chinese documentation hinders the authors from knowing the origin

[30] Ehtisham Ahmad, Isabella Neuweg, and Nicholas Stern, "China, the World and the next Decade: Better Growth, Better Climate," *Centre for Climate Change Economics and Policy*, April 2018, 2,7, https://www.lse.ac.uk/granthaminstitute/wp-content/uploads/2018/04/Ahmad-et-al_China-the-world-and-the-next-decade_Better-growth-better-climate-1.pdf.
[31] "China's Foreign Aid (2014)."
[32] Ibid.
[33] Ibid.
[34] Morris, Parks and Gardner, "Chinese and World Bank Lending Terms," 7.
[35] Global Times, "China's Forex Reserves See Largest Single-Month Increase since 2013 in Nov: Data," *Copyright 2021 by the Global Times*, n.d., https://www.globaltimes.cn/page/202212/1281345.shtml.

of the Chinese funds invested or loaned out to countries, beyond their massive resources of foreign exchange.

4. TERMS AND CONDITIONS OF CHINA'S CREDIT

Foreign assistance in China is under the unified management of the Ministry of Finance. According to the 2014 white paper on China's foreign aid in the period 2010-12,[36] China grants three kinds of loans. **Grants** or *aid gratis* and **interest-free loans** are offered to help countries develop social welfare projects including "human resources development cooperation, technical cooperation, material assistance, and emergency humanitarian aid".[37] The last category of these loans is **concessional loans**, which are mainly used to "help recipient countries undertake manufacturing projects and large and medium-sized infrastructure projects with economic and social benefits, or for the supply of complete plants, machinery and electronic products".[38] This section focuses on the terms and conditions of China's loans to other countries and performs a comparison with World Bank policies to analyse how concessional these terms are.

This paper compares China's lending policies with those of the World Bank for two primary reasons. The first is that the scale of China's loans is comparable only to the World Bank, far outdoing all other bilateral creditors and even some multilateral creditors such as the IMF, as aforementioned. The second is that the World Bank has developed certain norms regarding public debt, which other official lenders are encouraged to comply with. This includes standards to make comparability useful, such as identifying debt sustainability risk and measuring the concessionality of lending terms.[39] This section focuses on the latter.

Concessionality is the extent to which loans are offered at below-market rates. The World Bank defines two types of concessionality - **loan concessionality,** measured as the grant proportion of a loan, and **portfolio concessionality**, which measures the overall concessionality of a portfolio of debt to a country or group of countries.[40] The latter includes grants as well as

[36] "China's Foreign Aid (2014)."
[37] Ibid.
[38] Ibid.
[39] Morris, Parks and Gardner, "Chinese and World Bank Lending Terms," 1.
[40] Ibid., 7.

grant elements of all kinds of loans. The literature shows that financing offered on concessional terms, including low interest rates, long maturities, and extended grace periods, reduces the likelihood of recipient countries facing a debt crisis. The terms of concessionality in a loan agreement account for the borrower's ability to repay based on level of development and debt record.[41]

4.1 World Bank's Lending Terms

The World Bank uses a differentiated pricing model based on the repayment ability of the borrower. They offer below-market terms to poorest, least creditworthy borrowers through IDA (International Development Association) grants and non-concessional market terms to more creditworthy middle, upper-middle, and high-income countries. The World Bank manages its credit risk in its portfolio by effectively having low risk countries subsidise the concessional terms it offers to higher risk countries.[42] This is a viable practice only due to the World Bank's status as a preferred creditor compared to other multilateral institutions; this implies that it receives assured repayment even when the debtor countries are unable to repay their alternative debt.

4.2 China's Lending Terms

Unlike the World Bank, China is not a unified creditor with a single framework that guides all credit activities. A formidable portion of China's loans are not undertaken through grants or government lending, but through state banking loans.[43] Such loans are not included in official reports of government debt. The Chinese lending network consists of state-owned policy banks, state-owned commercial banks, and state-owned enterprises (SOEs), each of whom has their own lending policies. Below is a summary of terms on loans from different Chinese lending institutions.[44]

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[41] Luca Bandiera and Vasileios Tsiropoulos, "A Framework to Assess Debt Sustainability and Fiscal Risks under the Belt and Road Initiative," *World Bank, Washington, DC EBooks*, June 17, 2019, https://doi.org/10.1596/1813-9450-8891, 24.
[42] Morris, Parks and Gardner, "Chinese and World Bank Lending Terms," 5.
[43] Ibid., 5.
[44] Ibid., 6.

1. China's Ministry of Commerce (MOFCOM) offers no-interest loans via "Economic and Technical Cooperation Agreements". Often, these are the first loans to be forgiven when a borrower experiences roadblocks in repayment.
2. Export-Import Bank of China (Exim Bank) offers concessional loans to government institutions. The difference between the central bank's benchmark rate and these loans is reimbursed by the Ministry of Finance. It also offers preferential export buyer's credits to government institutions that intend to buy Chinese exports, which have higher rates and shorter maturity and grace periods than the concessional loans it offers.
3. China Development Bank (CDB) and state-owned commercial banks (Bank of China, Industrial and Commercial Bank of China, China Construction Bank, and Agricultural Bank of China) provide non- and semi-concessional loans to government agencies and companies. This is because they maintain their own balance sheets and unlike the Exim bank, do not receive subsidies from the Ministry of Finance.

Morris et al.'s analysis shows that China's official lending is less concessional than the World Bank's and other Western and multilateral lenders.[45] The Chinese loan portfolio was approximately thirty percent less concessional than that of the World Bank, with interest rates nearly twice as high as the latter and average grace periods far longer on World Bank loans compared to Chinese ones.[46] However, as aforementioned, nearly all official Chinese loans have some elements of concessionality which make them more attractive compared to market sources of finance.[47]

4.3 Dealing with the Risk of Default

Chinese loan contracts have extensive repayment safeguards, more so than other lenders in the official credit market, which allows them to essentially obtain a guarantee of repayment from their borrowers.[48] These contracts contain distinctive provisions, including confidentiality undertakings regarding the terms of the contract, commitments to exclude Chinese lenders from

[45] Ibid., 17.
[46] Ibid., 13-14.
[47] For reasons of lack of reliable data, this paper does not analyse the terms on unofficial pledges and other unofficial loans by the Chinese government to debtor countries. However, it is not unreasonable to conclude that such loans, being under little scrutiny from the international community, would have less concessional terms than official loans.
[48] Anna Gelpern et al., "How China Lends: A Rare Look into 100 Debt Contracts with Foreign Governments," *Social Science Research Network*, May 6, 2021, https://doi.org/10.2139/ssrn.3840991, 8.

the Paris Club and other similar debt restructuring collectives, maintaining escrow accounts to secure debt repayment, and cross-default terms that would reinforce China's position in the borrower country.[49] Oftentimes, this means that the borrower country may be forced to sell off assets that are crucial to their country, which can give China incredible power over their internal affairs. For instance, Laos, a small neighbouring country to China, received a loan from China in 2016 worth $480 million to cover part of the funding required to build a railway line. In 2020, even before the railway began operations, Laos sold part of its energy grid for $600 million to China seeking debt relief in the face of bankruptcy.[50] This left the already vulnerable country, being one of the poorest countries in South-East Asia, further at risk. Such terms of Chinese lending back the borrower country into a corner, ensuring they remain further in debt to China.

Moreover, many Chinese state development loans require uncustomary forms of collateral. For instance, a Chinese debt contract with Venezuela requires the borrower to deposit foreign currency earned from selling oil into a Chinese bank account. The deal stated that the lender can immediately withdraw the amount from the account if a debt payment is missed.[51] Such provisions that demand earnings from sale of natural resources are becoming increasingly common in Chinese loan agreements, with the resource-backed model being a popular form of lending.

5. CHINESE VS. WESTERN AID POLICY

The West has been a primary source of foreign aid to developing countries in the form of bilateral as well as multilateral aid along with the World Bank or IMF. In fact, Europe has been the largest donor of Official Development Assistance, providing around 55.2% of global assistance followed by the USA at 23% . However, these forms of aid, tied to political conditionalities, impose an inherent top-down relationship with the recipient countries in terms

[49] Zainab Usman, "What Do We Know About Chinese Lending in Africa?," Carnegie Endowment for International Peace, June 2, 2021, https://carnegieendowment.org/2021/06/02/what-do-we-know-about-chinese-lending-in-africa-pub-84648.
[50] By Celia Hatton, "China: Big Spender or Loan Shark?," BBC News, September 29, 2021, https://www.bbc.com/news/world-asia-china-58679039.
[51] Steffanie G. Urbano, USAF, "Chinese Neocolonialism in Latin America - An Intelligence Assessment", *Journal of the Americas,* 3rd Ed., https://www.airuniversity.af.edu/Portals/10/JOTA/Journals/Volume%203%20Issue%203/03-Urbano_eng.pdf, 186.

of political interference and economic sanctions. China, a rising player in the foreign aid market, has also been accused of neocolonist behaviour towards other developing countries by intentionally lending to countries with a huge debt burden and subsequently taking control of their assets when they inevitably default. This was observed in the case of the seizure of the Hambantota port in Sri Lanka in 2017. Although both the West and China seem to exhibit neocolonial traits in their lending policy, several developing countries seem to view China as the "lesser evil". This is especially seen in the context of African countries - a huge recipient of foreign aid from the West as well as China.[52] This section aims to evaluate the development aid policy of both these lending giants in Africa and deduce the reasons behind why Africa prefers Chinese aid.

5.1 A Summary of Chinese Aid Policy in Africa

China offers interest-free loans as well as concessional loans to African countries in order to primarily fund infrastructure projects, followed by agriculture, mining and manufacturing projects. They also provide grants that are used to fund social welfare projects related to education and healthcare. The main advantage of Chinese loans is that they are largely free of political ties and are tagged with a "non interference" policy, typically staying out of the internal affairs of African countries.[53] China also stresses on more of a partnership relationship rather than a donor recipient relationship in its aid policy. This aim of equality and mutual benefit in partnership is further endorsed by China's South-South solidarity rhetoric.[54] A drawback of China's aid policy is its inherent lack of transparency - China opted out of international reporting systems such as the OECD's Creditor Reporting System and the International Aid Transparency Initiative[55] - and its natural resource-centric model. In this model, China offers loans backed by resources such as oil, cocoa beans, copper, etc., operating as in the Venezuela example. This system has allowed even highly debt-burdened but resource-rich countries such as Angola to obtain debt from China. The problem with these loans is that if there is a fluctuation in the

[52] Kucukbakkal, "The Real Intention of China in Africa: Comparison with the EU in the Light of Neo-Colonialism," *Charles University*, 2021., 32
[53] Ibid., 40
[54] Ibid.
[55] "China is investing in developing countries – what is it really up to?"

revenues of these resources, the country is under risk of default and further indebtedness. Moreover, due to the lack of transparency of China's investment, it is not entirely known whether the value of the infrastructural projects undertaken by China in Africa are commensurate with the earnings from resources obtained by them, leading to information asymmetry between the donor and recipient country.[56] It is seen that although China's ulterior motives behind lending to African countries remain undisclosed due to their lack of transparency, they do seem to aid the development of African countries in certain ways.

5.2 Western Aid Policy - A Summary

The Western Development policy in China is characterised by four main practices. The first is the imposition of political conditionalities in their aid policies. These mainly pertain to democracy, human rights, transparency and accountability. Violation of these policies can lead to suspension of aid received by borrower countries. These conditions not only cement an unbalanced power dynamic between the donor and recipient, but are also inconsistently imposed. European countries are seen to follow a selectivity approach in their implementation of political conditionalities. According to research conducted by Del Biondo (2015), out of ten African countries that were candidates for sanctions due to violation of political conditionalities between 2000-11, only seven countries were sanctioned, and the non-sanctioned ones were found to be strategically important countries for the European Union (82). While the West insists that it provides cash support rather than infrastructural support to emphasise the concept of "ownership" and enable the recipient to use it in ways that benefit them, it is a common perception that this is done to make it easier to impose political conditionalities.[57]

Secondly, the West is seen to invest in Africa primarily for its own benefit with very little interest in actually contributing towards African development. The USA is seen to invest a large amount of money (75% of FDI) purely in resources such as oil for its own benefit. China, on the other hand, invests 64% of its FDI in manufacturing and only 28% in natural resources. Western countries also tend to import raw materials rather than finished products from Africa and export

[56] "The Real Intention of China in Africa: Comparison with the EU in the Light of Neo-Colonialism," 2021., 24
[57] Ibid., 41

goods that are much more expensive than Chinese exports in return. Chinese investments are seen to aid Africa in increasing demand for their finished products rather than just raw materials. Moreover, Western countries are seen to practise protectionism that inhibits African exports especially in the field of agriculture, despite the establishment of free trade laws.[58]

The third characteristic of western aid is its need for transparency. For instance, the European Union along with the IMF required Angola to sign a deal regarding transparent economic management before providing it with aid.[59] This might discourage extremely debt burdened countries who have a greater chance of default and a greater incentive for moral hazard from borrowing from the West.

Fourthly, the Western aid policy is associated with a large amount of brain drain from African countries. Africans who migrate to receive education and training in the US tend to settle there rather than contribute to their own country's development. For instance, Ghana has lost 30 percent of the physicians educated within the country to countries like the US, UK, Canada, and Australia, countries which already have more than sufficient doctors, while Ghana suffers with only six doctors per 1000 people.[60] Thus, the Western aid policy is seen to use African resources to benefit its population while eroding the income and social welfare of the African continent.

5.3 Why Do African Countries Prefer Chinese Aid?

The summary of the literature on Chinese vs. Western aid policies in Africa tells us that China is preferred to the West as a creditor primarily because of freedom from political conditionalities. As a continent that has been colonised and exploited by the West in the past, Africans still feel strongly about the unbalanced power dynamic they share with the West, with countries like the US constantly interfering with African politics through its support or dissent against authoritarian regimes according to how it benefits. China's 'no interference policy' is a refreshing change to this Western interference. Moreover, due to the South-South solidarity and to the fact that China was itself once an underdeveloped country that rose from the shackles of

[58] Barry Sautman and Yan Hairong, "Friends and Interests: China's Distinctive Links with Africa," *African Studies Review* 50, no. 3 (December 1, 2007): 75–114, https://doi.org/10.1353/arw.2008.0014., 93
[59] "The Real Intention of China in Africa: Comparison with the EU in the Light of Neo-Colonialism," 2021., 34
[60] Sautman and Hairong, "Friends and Interests: China's Distinctive Links with Africa.", 92

underdevelopment without Western practices such as deregulation, privatisation and cuts in social expenditure, Africans tend to resonate more with the Chinese.[61]

Another major reason for African countries choosing China is its 'no transparency' requirement, whereby the recipient countries did not have to go through the process of excessive disclosures when obtaining a loan from China. After the 2008 global crisis, African countries suffered from a huge infrastructure deficit that hindered foreign investment due to an increase in the chances of adverse selection and moral hazard in extremely underdeveloped regions. For instance, given the dearth of sufficient funding and the economic slowdown, it was likely for companies to take loans that they wouldn't be able to pay back due to inadequate revenues. While the West set forth conditions of transparency to reduce the information asymmetry problem, China's 'no transparency' requirement provided a way out to these struggling African countries. China found a way to tackle the information asymmetry using lending practices like resource-backed loans and asset seizure.[62]

Plagued by present bias, African countries currently view minimal-conditionality Chinese investments as an attractive borrowing instrument without considering the potential long run negative implications of these borrowings, such as the aforementioned case of "asset stripping" in Laos.

6. ALTRUISM VS. GEOPOLITICAL INTERESTS

The West, along with certain sections of the population of developing countries, have been against China's lending policy and its potential ill effects on developing countries in the long run through its debt trap diplomacy - The New York Times coined the term 'rogue donor' for China in 2007 .[63] Some of their concerns are primarily driven by lack of available data on China's aid funding due to their aforementioned 'non-transparency' and 'no questions asked' policies. This section explores whether these concerns are warranted given China's aid policy implementation so far. It aims to analyse whether the investments predominantly aim to satisfy

[61] Ibid., 81.
[62] "The Real Intention of China in Africa: Comparison with the EU in the Light of Neo-Colonialism," 2021., 24
[63] Naím, "Opinion | Help Not Wanted."

Chinese geopolitical interests - an indication of debt trap diplomacy - or whether they actually help in local capacity building and development of transitioning economies.

Studies show that China exerts maximum influence on "vulnerable countries" that face the highest number of challenges in terms of mitigating economic and political risks. These vulnerabilities include fragile state institutions and weak civil society and provide China with the perfect opportunity to implement its 'no transparency' policy. This is because fragile state institutions do not have the ability to conduct robust due diligence and adequate investment screening. Weak regulatory bodies and institutions with uneven law-enforcement capabilities, or poor anti-corruption systems make it difficult for these countries to review executive or legislative decisions. This allows China to get away with its non-transparent investment practices along with its potential larger aim to spread Chinese influence among the local masses. In the absence of a strong civil society and an independent media to keep a check on such activities, China finds it even easier to exert its influence.[64] A prime example of a set of countries that face such a high degree of Chinese influence are in Latin America.

6.1 Looking through the lens of Latin America

With a large increase in investments in Latin America over the past decade, China has also exerted a high degree of economic and financial dominance and cultural influence over these countries. Venezuela has been victim to China's debt entrapment policy when it was unable to pay its outstanding debts to the Chinese Development Bank as a part of their previously mentioned crude oil-backed loan agreement, on account of political instabilities that existed within the nation during the Maduro regime. Due to its high indebtedness, Venezuela was forced to create the Anti-Blockade Law that allows foreign investments in previously State-owned infrastructure. This could potentially have a negative impact on local capacity-building, as the Chinese do not have the incentive to provide opportunities to the local workers and consider local interests, which would have ideally been the aim if infrastructural control still lay in the

[64] Deep Pal, "China's Influence in South Asia: Vulnerabilities and Resilience in Four Countries," Carnegie Endowment for International Peace, October 13, 2021. https://carnegieendowment.org/2021/10/13/china-s-influence-in-south-asia-vulnerabilities-and-resilience-in-four-countries-pub-85552.

hands of the State. Venezuela's socio-economic and political distress has thus cemented its dependence on China.[65]

China's disincentive to provide for local capacity building can be seen in its Mergers and Acquisitions policy. Chinese companies in Latin America are acquiring domestic industries and repopulating them with Chinese workers and management. For example, Chinese companies and banks together acquired an 83.6% stake in Peru's Luz del Sur, Peru's largest electricity company,[66] aiming to control the region's critical infrastructure through its own management and workers. The neglect of local labour is similar to the condition in Africa wherein China is more inclined towards employing Chinese workers rather than improving local employment and skill transfer through long-term training.[67]

Concerns are being raised about the increasing Chinese demand for South American raw materials and its imports of cheap manufactured goods - a potential for de-industrialisation in these countries. A similar fear is growing in the African continent with its rising demand for Chinese imports.[68] A study conducted to measure the relative export dependence of South American countries on China revealed that the higher the commodity dependence, the more vulnerable any exporter will be to a disruption of trade with China. The study found that Brazil, Argentina, Chile and Peru rely on Chinese demand more heavily than any other Western importer. Argentine soybean exports are among the most dependent on Chinese demand, which constitutes 83% of the share of its exports.[69] This commodity dependence adversely affected Argentina in 2009 when China cut off all imports of Argentinean soy in a bilateral trade dispute, affecting the local soybean industry significantly. China is thus able to leverage its position to its advantage in aid policies due to its dominant importer status.[70]

China's influence does not stop with its economic and financial manifestations. China also exerts a significant cultural influence on the local masses of Latin America and Chinese diaspora by establishing institutions that promote the pro-China discourse, the Chinese language

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[65] Urbano, "Chinese Neocolonialism in Latin America," 187.
[66] Ray, "2020: A Point of Inflection in the China-Latin America Relationship?," *Global Development Policy Center, BU*, 2021.
[67] "The Real Intention of China in Africa: Comparison with the EU in the Light of Neo-Colonialism," 2021., 41
[68] Alicia García-Herrero, Matt Ferchen, and Mario Nigrinis, "Evaluating Latin America's Commodity Dependence on China," *Social Science Research Network*, January 21, 2013, https://doi.org/10.2139/ssrn.2253159., 10
[69] Ibid.
[70] Ibid.

and culture. This is speculated to be a build up to China's aim of "One China" and global Chinese hegemony rather than aiming to educate the local population to contribute towards local development through these institutions.[71]

China also satisfies its political interests through more drastic measures. Recently, China targeted Paraguay, Taiwan's only remaining South American ally, with vaccine diplomacy, taking advantage of Paraguay's low vaccination rate and high number of COVID-19 cases. China continues to pressure Paraguay into not acknowledging Taiwan's sovereignty in exchange for vaccines and medical equipment. Thus, China might not be guided solely by its interest in the development of struggling economies but rather by its own geopolitical interests.[72]

While China's growing economic presence in South America has positively impacted development, scientific innovation, and Latin America's geo-political relevance to an extent, the long term implications of these policies might not be as shiny.[73] Attracted by the short-term rewards, Latin American countries show time-inconsistent preferences without considering the consequences in the long-run in terms of debt entrapment, commodity dependence, reduced local capacity building and Chinese hegemony. A major reason for this present bias could also be China's 'no questions' policy that makes it difficult to predict the long-term impacts of their aid policy.

6.2 'No Questions' Policy - Can it work against China ?

While China's 'no questions' policy with respect to its developmental aid has attracted several developing countries, it has received severe backlash from the West. Moreover, its increasing commercial interests in developing countries, especially in Africa, are making its investment policies more exploitative and disadvantageous for the recipient country. China's renewed exploitative interests are coming at a time of increased political liberalism, activism and space to express dissent against exploitative relations between Africa and other countries. This political awakening is enhanced by Chinese investments supporting the advancement in mass communication technology through the sale of cheap mobile phones that provide access to several social media platforms, thus providing the rising African liberal class a medium to

[71] Urbano, "Chinese Neocolonialism in Latin America," 193.
[72] Ibid., 194
[73] Ibid., 189

collectivise action and spread information. With the West positively influencing the educated class of Africans to adopt more democratic regimes, China might soon be victim to large-scale discord due to its investment policies that primarily deal with authoritarian African regimes. While its support of such regimes was initially seen in positive light in terms of its 'no interference' policy, increasing availability of information among the educated Africans is revealing the oppressive and undemocratic nature of both Chinese investments and the African regimes it associates with. Thus, China's contribution towards the development of infrastructure might be a barrier against its own practice of non-transparent investment policies in Africa.

7. DISCUSSION AND CONCLUSION

The issue of whether China's motives for investing in other countries arises from altruism or their geopolitical interests is a polarising debate. Studies either accept the view that China is engaging in neocolonial behaviour or conclude strongly against it. The existing literature is riddled with confirmation bias, as discussed earlier. This is unsurprising since China's motivations will remain unclear so long as there is lack of accurate data on their lending practices - until the day this changes, all opinions on this will remain speculative.

China's lending practices and the policies associated with borrowing from it can have far-reaching consequences for international finance. This is especially of consequence if China uses its lack of transparency as a strategy to pursue debt-trap diplomacy. The issue of information asymmetry arises on two counts - between the borrower nation and China regarding the terms and conditions of the loan, as well as China's secretive attitude towards its overseas investments. Credit-constrained countries disproportionately discount the future because they are desperate for funds and international institutions and Western countries have previously failed them, compelling them to accept loans with murky terms from China. Thus, there exists a unique problem - the onus of screening and monitoring unconventionally falls upon the debtor instead of the creditor, since the latter (China) has control over the implementation of the projects they fund. Combined with the fact that their motivations are undisclosed, it allows China to influence the borrower nation's culture, politics and economy. This is exacerbated in countries with weak legal, regulatory, and civic frameworks. This leads to an imbalanced power dynamic, the

implications of which are unclear at the outset but become apparent in the face of an extreme debt crisis.

This study concludes that despite a lack of decisive evidence, there exists a valid concern that the power that China wields through its lending practices extends beyond the debtor's financial capability to its sovereignty. The volume of China’s loans and the number of countries that are in its debt, combined with its dubious motives, indicates a threat of Chinese influence on a global scale. However, with increasing awareness of China’s suspicious lending practices among debtor countries and the international community at large, China may be faced with evolving public borrowing trends, and will be forced to reevaluate its foreign aid policies.

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Gender Penalty of First-Born Child on Female Labour Force Participation and Autonomy of Mothers in India

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Abstract

We focus on the differential impacts of the sex of the firstborn child on the FLFP of the mother. The rationale is that the sex of the first-born is random and from the second child onwards sex-selective abortions can occur. We hypothesize that if the mother's firstborn is female, her FLFP increases because she would be expected to "compensate" the female birth due to son preference. Likewise, her FLFP falls if she gives birth to a male firstborn as she would be expected to raise a healthy son. We also focus on the differential effect on the mother's autonomy both mobility and financial conditional on the birth of the preferred sex (male). We find that if the sex of the firstborn is male, the FLFP and autonomy decrease relative to a female firstborn in rural areas, while only the autonomy of the
mother decreases in urban areas.

JEL Classification - I14, J71, J13, J12,
Key Words - Female Labour Force Participation (LFP), Sex Ratio, Autonomy, India

1. INTRODUCTION

Economists have consistently tried to grapple with the low levels of Female Labour Force Participation (LFP) in India even in periods of economic growth and rising levels of education. (Afridi et al., 2020; Kansen and Pieters, 2015; Abraham et. al, 2017; Chatterjee and Sircar, 2021).[1]

We focus on the differential impacts of the sex of the first-born child on the FLFP of the mother. The rationale is that the sex of the first-born is random and from the second child onwards sex-selective abortions can take place (Jayachandran, 2001; Portner, 2014). We hypothesize that if the mother's first-born is female, her FLFP increases because she would be expected to "compensate" the female birth due to son preference. Likewise, her FLFP falls if she gives birth to a male first-born as she would be expected to raise a healthy son. We also focus on the differential effect on the mother's autonomy both mobility and financial conditional on the

[1] According to International Labour Organization (ILO), India's FLFP has dropped from a high of 32% in 2005 to 18% in 2020. This is alarmingly low when compared to other developing countries in Asia. "Labor Force Participation Rate, Female (% of Female Population Ages 15+) (Modeled ILO Estimate) - India," Data, https://data.worldbank.org/indicator/SL.TLF.CACT.FE.ZS?end=2020&locations=IN&start=2000.

birth of the preferred sex (male). Both these analyses are carried out separately for rural and urban areas. We find that if the sex of the first-born is male, the FLFP and autonomy decrease relative to a female first-born in rural areas, while only the autonomy of the mother decreases in urban areas.

The rest of the paper is organised as follows. Section 2 provides a brief literature review followed by Section 3 on data and the empirical strategy. Section 4 provides descriptive statistics. Section 5 discusses the results and robustness checks. Section 6 offers concluding comments.

2. LITERATURE REVIEW

Previous literature finds that a notion of women not "needing" to earn for the family is prevalent as family income levels increase. Arif et. al., 2002 ascertain that the economic participation of women is significantly influenced by factors like their age, education[2] and marital status. Similarly, Batool et al. 2019 find that household income, and the number of children appear to be negatively correlated with FLFP. The idea of the motherhood penalty has been explored by Bronars and Grogger, 1994; Angrist and Evans, 1998; and Deshpande and Singh, 2021. Additionally, Arif. et al. 2003, and Farid et al., 2009 highlight the impact of 0-5 aged children as a driving factor behind women dropping out.

Ichino et. al., 2014 observe that in the US, the UK, Sweden and Italy, women whose first-born are males are less likely to work and for a lesser number of hours than women with first-born females. This is an interesting observation because we would expect to see this in developing countries where the male child preference is high.

[2] As more women opt for higher education, their labour force participation decline.

We hypothesise that if the first-born child is a female, taking into account male preference for children, the mother would be expected to "compensate" for giving birth to a female child by working. However, if a male child is born, the mother would be expected to stay at home. Like Ichino et. al., 2014, we exploit the exogeneity in the sex of the first-born child as it is random. This paper contributes to the existing literature by evaluating the result obtained by Ichino et. al., 2014 using Indian data to explain the "compensation" channel to understand dropping FLFP.

This paper will also look at the impact of the sex of the first-born on the autonomy of a mother. There is rather low literature looking at the differential impacts of the sex of the first-born on the mother's autonomy but it highlights the importance of autonomy. There are improved benefits of the autonomy of the mother on the child's nutritional status (Grabowski and Self, 2013) and resource allocation within the family (Anderson and Eswaran, 2009). We hypothesize that male first-born children should lead to increased autonomy for the mother.

3. DATA AND EMPIRICAL STRATEGY

This paper uses the National Family Health Survey - Round 4 (NFHS 4) in 2015-16. For our analysis, we have merged the Individual (Women's) Recode and the Birth (Children's) Recode.

We use Linear Probability Model (LPM) to analyse the impact of the sex of the first-born on the outcome variables. We run separate regressions for the rural and urban samples in the dataset since the functional relationship between variables differs across rural and urban areas. There is vast heterogeneity that needs to be accounted for and splitting the sample will be cleaner for the analysis. This will also help us disaggregate the effect that we are trying to pick up. The sample is restricted to mothers who have given their first birth in the last 3 years (from the time of the survey).

Outcome Variables

We have three dependent variables of interest.

We measure the mother's FLFP by seeing whether she has worked in the last 12 months. This is constructed as a binary variable equalling 1 if the mother worked in the last 12 months, and 0 otherwise.

The mother's autonomy is categorised through two channels: first, is her autonomy over movement, whether she can decide where she wants to go outside of the house or is it dependent on a family member's permission. Second, whether she has control over her finances to use her wealth at her discretion or is it dependent on other members. The driving argument behind this is that increased autonomy would improve a mother's bargaining power within the family and take more independent decisions.

Autonomy over mobility is therefore a binary that has been constructed by using three different mobility autonomy indicators. It equals 1 if the mother is allowed to do at least one of these three things: visit a healthcare centre, visit the market and/or go outside the village, and equaling 0 otherwise.

Financial Autonomy is a binary variable which equals 1 if the mother has the autonomy to decide how to spend her earnings, and 0 if the decision lies with her husband/other family members.

Such diverse indicators of autonomy are chosen, and the driving idea behind this is that there is a possibility that a woman may have a certain type of autonomy over the other based on norms, preferences and priority of types of autonomy. Thus, to try and understand the biggest

and smallest of freedoms, we employ various indicators of mobility.

Independent variable

The independent variable of interest is the sex of the first-born child since the sex of the first-born child is randomised (Sharma and Rastogi, 2020). Thus, sex-selective abortions cannot take place for the first-born child. Literature has shown that sex-selective abortions can take place from the second child onwards (Jayachandran, 2014). We thus generate a binary variable *Male* which equals 1 when the first-born child is a male, and it equals zero when it is a female.

Controls

We control for the income of the family (through the wealth index), the education level of the mother, whether the household head is a female, whether the partner is working, if the respondent justifies domestic violence due to child neglect, the religion of the mother, whether the mother belongs to a historically marginalised community (SC/ST/OBC), the age gap between the couple, whether the child has received all five under-5 immunizations and finally, whether child is stunted (HAZ ratio).[3]

Fixed Effects

Additionally, we have included state-fixed effects to account for state-level time-invariant differences in norms and cultures which prevail and may influence the FLFP.

[3] Height cannot be reversed and thus captures the cumulative health effect. We make use of stunted, "the best anthropometric measure of net nutrition" as a measure of child health outcome (Jayachandran & Pande, 2015). An under-5 child is stunted if the child's HAZ ratio is 2 standard deviations below the WHO reference median. In our analysis, the variable "stunted" is coded as 1 if the child is stunted and 0 if the child is not. Complete immunization of the child and the HAZ ratio function as variables indicating whether the child is healthy or not. If the child is unhealthy, the mother may anyway stay at home to take care of the child and thus there may be an observed decline in her LFP.

The regression equations are as follows:

$$FLFP_{ihs} = \beta_0 + \beta_1 Male_{ihs} + \delta X_i + \alpha + \epsilon \quad – (A)$$

$$Mobility\ Autonomy_{ihs} = \beta_0 + \beta_1 Male_{ihs} + \delta X_i + \alpha + \epsilon \quad – (B)$$

$$Financial\ Autonomyy_{ihs} = \beta_0 + \beta_1 Male_{ihs} + \delta X_i + \alpha + \epsilon \quad – (C)$$

Where,

$FLFP_{ihs}$: FLFP of the mother *i* in household *h* in state *s*

$Mobility\ Autonomy_{ihs}$: autonomy of the mother over her mobility

$Financial\ Autonomy_{ihs}$: autonomy of the mother over her wealth

$Male_{ihs}$: sex of the first-born child (1, male; 0, female)

X_i : Control variables

α : state level fixed effects

ϵ : error term

4. DESCRIPTIVE STATISTICS

Summary statistics of the variables are included in ***Table 1*** *and 2*. The total number of women who have given birth to their first child within 3 years before the survey is 257,314.

Table 1 : Summary Statistics: Dependent Variables

Sex of the First-Born Child					
Variable	Female	Percent	Male	Percent	Total
Type of Residence					
Urban	28,827	11.2	27,705	10.8	56,532
Rural	104,255	40.5	96,527	37.5	200,782
Working Status of Mother					
No	17,284	38.5	16,429	36.6	33,713
Yes	5,923	13.2	5,273	11.7	11,196
Total	23,207	51.7	23,207	48.3	44,909
Mobility - Autonomy					
No	14,723	32.8	13,968	31.1	28,691
Yes	8,484	18.9	7,734	17.2	16,218
Total	23,207	51.7	21,702	48.3	44,909
Mobility - Finance					
No	801	10.4	805	10.5	1,606
Yes	3,255	42.4	2,816	36.7	6,071
Total	4,056	52.8	3,621	47.2	7,677

Table 2.1 : Summary Statistics: Controls

	Sex of the First-Born Child				
Wealth Index					
Poorest	41,301	16.1	38,046	14.8	79,347
Poorer	32,576	12.7	29,964	11.6	62,540
Middle	24,598	9.6	23,422	9.1	48,020
Richer	19,558	7.6	18,135	7.0	37,693
Richest	15,049	5.8	14,665	5.7	29,714
Total	133,082	51.7	124,232	48.3	257,314
Highest Education Level					
No Education	51,209	19.9	46,291	18.0	97,500
Primary	20,040	7.8	18,374	7.1	38,414
Secondary	52,154	20.3	49,890	19.4	102,044
Higher	9,679	3.8	9,677	3.8	19,356
Total	133,082	51.7	124,232	48.3	257,314
Sex of the Household Head					
Male	117,344	45.6	109,228	42.4	226,572
Female	15,738	6.1	15,004	5.8	30,742
Total	133,082	51.7	124,232	48.3	257,314
Working Status of Partner					
Not Working	1,238	2.8	1,194	2.7	2,432
Working	21,956	48.9	20,487	45.7	42,443
Total	23,194	51.7	21,681	48.3	44,875

Table 2.2 : Summary Statistics: Controls

Variable	Obs	Mean	Std. Dev.	Min	Max
Age Gap in Yrs (Father – Mother)					
Female First-Born	103,428	4.907	4.447	-33	75
Male First-Born	112,380	4.907	4.461	-33	75

Table 2.3 : Summary Statistics : Controls

Domestic Violence due to Child Neglect					
No	16,258	36.2	15,156	33.7	31,414
Yes	6,949	15.5	6,546	14.6	13,495
Total	23,207	51.7	21,702	48.3	44,909
Religion					
Hindu	92,653	36.0	84,240	32.7	176,893
Muslim	23,287	9.1	23,258	9.0	46,545
Christian	12,133	4.7	12,075	4.7	24,208
Other	5,009	1.9	4,659	1.8	9,668
Total	133,082	51.7	124,232	48.3	257,314
Belongs to Marginalized Communities					
No	22,623	9.2	21,159	8.6	43,782
Yes	105,171	42.6	98,023	39.7	203,194
Total	133,082	51.7	124,232	48.3	257,314
Child is Stunted					
No	88,542	34.4	81,097	31.5	169,639
Yes	44,540	17.3	43,135	16.8	87,675
Total	133,082	51.7	124,232	48.3	257,314
Fully Immunized					
No	120,320	46.8	112,528	43.7	232,848
Yes	12,762	5.0	11,704	4.5	24,466
Total	133,082	51.7	124,232	48.3	257,314

Type of residence

11.2% of total mothers in this sample live in urban areas with first-born females. 10.8% of mothers live in urban areas with first-born males. 40.5% of mothers live in rural areas with first-born females.

Mothers worked in the last 12 months

38.5% of mothers in the sample having first-born daughters haven't worked in the last 12 months, while 13.2% of mothers having first-born daughters have worked in the last 12 months. 36.6% of mothers (out of the total) having first-born sons haven't worked in the last 12 months, while 11.7% of mothers having first-born sons have worked in the last 12 months.

Mobility Autonomy

32.8% of mothers with first-born daughters and 31.1% having first-born sons do not have mobility autonomy, while 18.9% of mothers having first-born daughters and 17.2% of mothers having first-born sons have mobility autonomy.

Financial Autonomy

10.4% of mothers having first-born daughters and 10.5% having first-born sons do not have financial autonomy, while 42.4% of mothers having first-born daughters and 36.7% of mothers having first-born sons have financial autonomy.

5. RESULTS & ROBUSTNESS CHECKS

Referring to ***Table 3***, Columns (1) through (3) run the regressions given by equations (A) (B) and (C) respectively discussed in the empirical strategy section for the rural sample, and columns (4) through (6) run the regressions for urban sample. Row (1) across the table shows the beta coefficient corresponding to when the first-born child is a male.

Table 3 : Final Results including Controls

Final Results						
	(1)	(2)	(3)	(4)	(5)	(6)
		Rural Areas			Urban Areas	
	FLP of Mother	Mobility Autonomy	Financial Autonomy	FLP of Mother	Mobility Autonomy	Financial Autonomy
Sex of First-Born Child - Male	-0.0134***	-0.00407	-0.0246**	0.00801	-0.0255***	-0.0308
	(0.00478)	(0.00506)	(0.0104)	(0.00728)	(0.00948)	(0.0189)
Wealth Index						
Poor	-0.0522***	-0.0444***	0.0338**	-0.0190	0.0349	0.0177
	(0.00660)	(0.00679)	(0.0141)	(0.0216)	(0.0243)	(0.0407)
Middle	-0.0987***	-0.0407***	0.0160	-0.0787***	-0.00620	-0.159***
	(0.00756)	(0.00811)	(0.0189)	(0.0205)	(0.0238)	(0.0470)
Richer	-0.161***	-0.0167	0.0254	-0.0688***	-0.00800	0.0229
	(0.00914)	(0.0102)	(0.0253)	(0.0204)	(0.0236)	(0.0417)
Richest	-0.157***	0.00312	0.0603**	-0.113***	0.0152	-0.0224
	(0.0116)	(0.0134)	(0.0305)	(0.0211)	(0.0249)	(0.0461)
Educational Level						
Primary	-0.0428***	-0.0127	0.0314**	-0.0358**	-0.0346*	0.0487
	(0.00752)	(0.00784)	(0.0157)	(0.0144)	(0.0180)	(0.0340)
Secondary	-0.0686***	-0.0209***	0.0537***	-0.0572***	-0.0264*	-0.0139
	(0.00642)	(0.00674)	(0.0146)	(0.0118)	(0.0151)	(0.0330)
Higher	0.0274**	0.0792***	0.0913***	0.0416***	0.0780***	0.0605
	(0.0124)	(0.0136)	(0.0240)	(0.0156)	(0.0200)	(0.0384)
Female Household Head	-0.00410	0.105***	0.00380	-0.0163	0.0307**	0.0727***
	(0.00701)	(0.00789)	(0.0155)	(0.0109)	(0.0145)	(0.0246)
Partner Working	0.0193*	-0.00967	0.0128	-0.0372**	0.00539	0.0261
	(0.0109)	(0.0120)	(0.0258)	(0.0159)	(0.0188)	(0.0361)
Domestic Violence due to Child Neglect	0.0423***	0.00195	-0.0154	0.0273***	-0.0440***	-0.0642***
	(0.00545)	(0.00565)	(0.0117)	(0.00940)	(0.0117)	(0.0244)
Religion						
Muslim	-0.0485***	-0.0588***	-0.0976***	-0.0140	-0.0635***	-0.0908***
	(0.00717)	(0.00826)	(0.0222)	(0.00906)	(0.0121)	(0.0286)
Christian	0.0736***	0.0511***	-0.00209	0.135***	0.127***	0.00824
	(0.0154)	(0.0159)	(0.0237)	(0.0294)	(0.0308)	(0.0444)
Other	0.0312*	0.0476***	-0.0298	0.0211	0.0248	0.105**
	(0.0162)	(0.0169)	(0.0263)	(0.0237)	(0.0294)	(0.0417)
Marginalized status	0.0265***	0.00637	-0.0447**	0.0243***	-0.0284**	-0.0164
	(0.00642)	(0.00765)	(0.0182)	(0.00869)	(0.0125)	(0.0261)
Age Gap	-0.00241***	0.00103*	0.00599***	-0.000592	-0.00151	0.000761
	(0.000526)	(0.000557)	(0.00105)	(0.00101)	(0.00120)	(0.00198)
Child Stunting	0.0255***	-0.00257	-0.0211*	0.0185**	0.0109	0.00533
	(0.00514)	(0.00537)	(0.0110)	(0.00847)	(0.0109)	(0.0227)
Immunization Status	0.0333***	0.0134	0.0339**	0.0254*	0.00902	0.0639**
	(0.00827)	(0.00850)	(0.0159)	(0.0138)	(0.0175)	(0.0267)
_cons	0.268***	-0.0255	0.767***	0.134***	0.0954**	0.798***
	(0.0845)	(0.0596)	(0.0372)	(0.0319)	(0.0411)	(0.0681)
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
N	32479	32479	6099	9817	9817	1380
adj. R^2	0.082	0.085	0.058	0.047	0.091	0.123

Rural Areas

Mother's Labour Force Participation

The FLFP of the mother (or the probability of the mother having worked in the last 12 months) decreases by 1.34 percentage points when the first-born child is a son relative to when it's a daughter. This coefficient is significant at the 1% level of significance and is consistent with the results from Ichino et. al., 2014. As earlier discussed, we can observe the income effect in the labour force participation trends of mothers in rural areas. We can see that relative to the poorest households, as the income of the family increases, the probability of the mother has worked in the last 12 months decreases further when she has a son in comparison to when she births a daughter. Additionally, we see that as the education level of the mother increases, she is more likely to work (Abdulloev et. al, 2014). Relative to dominant caste mothers, the FLFP of mothers from historically marginalised communities is higher which is consistent with the results from Deshpande & Singh, 2021.

Mother's autonomy over her mobility & finance

The probability of the mother having autonomy over her mobility (where and when she goes) decreases by 0.4 percentage points when the first-born child is a son relative to a daughter. However, this coefficient is statistically insignificant. We can see that relative to the below primary level of education, mobility autonomy is the highest at higher levels of education, and the mother is more likely to have autonomy over her mobility when the household head is a female. The probability of the mother having complete autonomy over decisions regarding how to use her salary decreases by 2.4 percentage points when the first-born child is a son relative to a daughter. Relative to the poorest household, as the income of the family increases, the likelihood of the mother having autonomy over her finances increases as well. Financial autonomy further increases at higher levels of education.

Urban Areas

Mother's Labour Force Participation

In urban areas, the FLFP of the mother increases by 0.8 percentage points when the first-born child is a son relative to a daughter.[4] However, this result is statistically insignificant. Further, relative to the poorest household, the female labour force participation decreases as the income of the family increases. This is consistent with existing literature on the female labour force participation trends in urban areas where females in wealthier households are less likely to participate in the labour force (Deshpande & Singh, 2021).

Mother's autonomy over her mobility and finances

Similar to the rural areas, we find that in urban areas the probability of a mother's autonomy over her mobility decreases by 2.55 percentage points when the first-born child is a son relative to a daughter. This coefficient is statistically significant at the 1% level of significance. Likelihood of a mothers' autonomy over their mobility is greater at higher levels of education, and it decreases by 4.4 percentage points when the respondent justifies domestic violence due to child neglect (significant at 1% level of significance). However, when the household head is a female, the likelihood of the mother having autonomy over her mobility increases by 3.07 percentage points.

The probability of a mother having financial autonomy over decisions regarding how to spend her earnings (either through LFP or other sources of income) decreases by 3.08 percentage points when the first-born child is a son relative to a daughter (statistically insignificant).

The impact of having a first-born son relative to a first-born daughter on the FLFP,

[4] Previous research shows that after a male child's birth, the mother would have more possibilities to join (back) the workforce as having a male child first reduces fertility (Dahl and Moretti, 2008). When the mother births a first-born daughter, she would be expected to have more children thus increasing the time spent in pregnancies and reducing the mother's labour supply (Jayachandran and Kuziemko, 2011, Chun and Oh, 2002). Thus, while this coefficient is not consistent with our hypothesis, it is consistent with previous research which again highlights the preference for sons in families.

mobility autonomy and financial autonomy of the mother is negative for both rural and urban areas (with the exception of FLFP increasing in urban areas when the first-born child is a son). Even though some coefficients are statistically insignificant, the negative sign of the coefficients is consistent with our hypothesis that the mother is being expected to "compensate" for the birth of a female child by having to work. Moreover, if the firstborn is a male, she is expected to stay at home and take care of and bring up a healthy male child.

Robustness Check

To check the robustness of our results, we consider the regression equation A with two additional controls: the sex of the second-born child (which equals 1 when the sex of the born child is a male and 0 when female) and abortions (which equals 1 if the mother has had any abortions and 0 otherwise) to control for sex-selective abortions and births. The sample now considers mothers who have given birth to their first two children in the last three years. The primary reasoning behind this is that given that sex-selective abortions take place for the second-born onwards. Hence, we expand the analysis to see if the effect still holds when taking into account siblings and see if this effect still persists.

Table 4 : Robustness Check - Additional Controls

Robustness Check				
	(1)	(2)	(3)	(4)
	Rural Areas		Urban Areas	
	FLP of the Mother	FLP of the Mother	FLP of the Mother	FLP of the Mother
Sex of First-Born Child - Male	-0.0191*	-0.0372	-0.0119	-0.000426
	(0.00989)	(0.0380)	(0.0166)	(0.0353)
Sex of Second-Born Child - Male		0.102**		0.00307
		(0.0457)		(0.0572)
Abortions		0.115**		0.142**
		(0.0555)		(0.0584)
cons	0.243***	0.159	0.257***	-0.359**
	(0.0320)	(0.125)	(0.0700)	(0.174)
Controls from Final Table Included	Yes	Yes	Yes	Yes
Fixed Effects	Yes	Yes	Yes	Yes
N	6869	516	1567	163
adj. R^2	0.066	0.184	0.112	0.711

Standard errors in parentheses
* $p < .10$, ** $p < .05$, *** $p < .01$

From ***Table 4***, Columns (1) and (3) show the baseline regression A with controls for rural and urban areas respectively. In rural areas, when the first-born child is a son, the mother's FLFP decreases relative to when she has a first-born daughter (significant at 10% level). This decrease is observed in urban areas as well. Columns (2) and (4) include additional controls such as the sex of the second-born child and abortion dummy. We observe that the FLFP of the mother decreases i.e. the sign remains consistent in both urban and rural areas even now. While the latter three coefficients that we have discussed are statistically insignificant, the negative sign of the coefficients shows that our hypothesis that that the mother is being expected to "compensate" for the birth of a female child by having to work, holds here.

6. CONCLUSION

The phenomenon of dropping FLFP could be associated with socio-economic factors or a friction between supply and demand forces (Deshpande & Singh, 2021) or even rural-urban transitions (Neff et. al, 2012). We focus on understanding the impacts of fertility; more specifically the differential impacts of the sex of the first-born child. The hypothesis is built on the notion that patrilineal and patrilocal families would prefer sons over daughters and the added pressure of having a first-born as a male impacts the mother's autonomy and FLFP. We find that if the sex of the first-born is a male, the FLFP and autonomy (both mobility and financial) decrease relative to a female being the first-born. The results have also remained robust when taking into account possible sex-selective abortions and the sex of the second-born child as well.

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Exploring the relationship between domestic violence against mothers and their children's health outcomes

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Abstract

India-wide surveys show consistently increasing incidences of spousal violence. Research shows a strong association between domestic violence and women's health outcomes. The likelihood of a child having worse health outcomes is also higher amongst children whose mothers are victims of domestic violence. This paper explores the impact of domestic violence against mothers on the health outcomes of their first born child. We leverage NFHS-4 and use the implementation of the Protection of Women from Domestic Violence Act, 2005 as an instrumental variable in our regression analysis to remove endogeneity in the main relationship. We find a negative correlation between incidence of domestic violence and children's health outcomes. The results of this paper also imply that the Protection of Women from Domestic Violence Act, 2005 seems to be increasing the reporting of domestic violence.

JEL Classification: C36, I120, I140, J16, Y10

Keywords: Domestic Violence, Children's Health Outcomes, Birth Weight, Height For Age, Instrumental Variable, Protection of Women from Domestic Violence Act, 2005, Protection Officers, Household Dynamics

2. Introduction

Domestic violence is a pattern of behaviour in any relationship used to gain or maintain power and control over an intimate partner. The abuse can be physical, emotional, sexual, psychological, economic or threats that can influence another person[1]. While there is no gender-specific disposition of domestic violence victims, victims generally tend to be women[2]. Domestic violence represents an extreme form of control that husbands may use to hold their wives to preconceived gender roles[3].

In India, domestic violence is seen as a major threat to women's lives - historically being driven by the dowry system. Country-wide surveys show consistently increasing incidences of

[1] United Nations, "What is domestic abuse?
[2] Das, Anamika, and C. M. Lakshmana, "The Implementation of Domestic Violence Act in India: A State-Level Analysis"
[3] Stephenson, Rob, Michael A. Koenig, and Saifuddin Ahmed. "Domestic Violence and Contraceptive Adoption in Uttar Pradesh, India.", 75.

spousal violence - this trend is particularly seen in some regions. According to NFHS-5, states with the highest incidence of spousal violence are Karnataka, Bihar and Manipur[4].

Studies across the world, in countries such as Nicaragua, US, India and Bangladesh, show a higher incidence of low birth weight in newborn babies and deaths amongst pregnant women who are victims of domestic violence. A 2005 WHO study also showed a strong association between domestic violence and women's health. Further, studies found that the likelihood of a child being underweight, wasted, stunted or any combination of the three is higher among children whose mothers are domestic violence victims[5].

This paper aims to explore the impact of domestic violence against mothers on the health outcomes of their first born child. We do not include the other children as they might have worse health outcomes by virtue of being of a higher birth order or being born after a first-born son, biassing the main relationship. To assess this relationship, we leverage NFHS-4 and use the implementation of the Protection of Women from Domestic Violence Act, 2005 (referred to as 'The Act' henceforth) as an instrument to remove any endogeneity that may plague the main relationship. Accounting for relevant covariates also allows us to assess how these factors impact children's health outcomes in conjunction with domestic violence. Our preliminary hypothesis is that domestic violence against mothers plausibly causes worse health outcomes for children.

Upon employing a simple regression framework we find a statistically significant negative relationship between domestic violence and two indicators of child's health outcomes - height for age and birth weight. The negative impact is more pronounced for height for age as compared to birth weight. On employing a multiple regression framework with household and individual level controls, this negative correlation reduces, indicating that there are several factors correlated with incidence of domestic violence that impact a child's health outcomes. The results from the instrumental variable framework show a higher negative impact of domestic violence as compared to the OLS multiple regression framework in terms of magnitude.

[4] Suri , Shoba, Mona, and Debosmita Sarkar . "Domestic Violence and Women's Health in India : Insights from NFHS-4."
[5] Suri , Shoba, Mona, and Debosmita Sarkar . "Domestic Violence and Women's Health in India : Insights from NFHS-4."

However, this impact is statistically insignificant.

3. **Literature Review**

Research shows that child abuse is often found in cases of partner abuse and may occur during, before or after a pregnancy. A positive association between abuse during pregnancy and adverse pregnancy outcomes has also been found[6]. Domestic violence has a negative association with a couple's likelihood of adopting a modern method of contraception, and can be an important explanatory factor for unintended pregnancy[7]**.** Unintended pregnancies can lead to worse children's health outcomes, as a woman's body may not be prepared for pregnancy and prospective parents may not be capable of raising a child. A study done on NFHS-4 shows that incidence of any kind of domestic violence (verbal, mental, physical, economic and sexual) has significant effects on indicators of women's and children's health, care and nutrition[8]. Most studies assessing children of abused women report serious problems including increased anxiety and aggression. A cross sectional study conducted in Bihar found that those who experience physical and/or sexual domestic violence are significantly more likely to report miscarriage, stillbirth, and abortion as well as maternal health complications compared to women who had not faced such violence[9].

A study conducted in California most closely mimics the empirical strategy of this paper. The study employs an OLS regression model to test the effect of hospitalisation while pregnant on newborn health outcomes and then employs an instrumental variable (ratio of arrests for domestic violence to number of 911 calls reporting domestic violence in the previous year) to account for endogeneity. The paper found a negative relationship between violence during pregnancy and newborn health. It also finds that an increase in the probability of arrest for

[6] Morewitz, Stephen J, " Domestic violence and maternal and child health: new patterns of trauma, treatment, and criminal justice responses", 3.
[7] Stephenson, Rob, Michael A. Koenig, and Saifuddin Ahmed. "Domestic Violence and Contraceptive Adoption in Uttar Pradesh, India.", 82.
[8] Suri , Shoba, Mona, and Debosmita Sarkar . "Domestic Violence and Women's Health in India : Insights from NFHS-4."
[9] Dhar, Diva, Lotus McDougal, Katherine Hay, Yamini Atmavilas, Jay Silverman, Daniel Triplett, and Anita Raj, "Associations between intimate partner violence and reproductive and maternal health outcomes in Bihar, India: a cross-sectional study", 8

domestic violence reduces the number of pregnant women hospitalised because of an assault[10] .

Our paper adds to this field by studying not just the relationship between domestic violence and children's health outcomes but doing so in context of The Act. The question is policy relevant as the results can be used to inform laws regarding the safety of women and children and also ensure that there are safe, accessible avenues for victims to report violence. It could also provide insight into indirect factors affecting children's health outcomes as well as domestic violence, such as household income levels, and push for the implementation of more policies that target the improvement of such factors.

2.1 Protection of Women from Domestic Violence Act, 2005

The Act was passed in 2005 and came into effect in October 2006. The law for the first time recognized women's right to a violence free home. It is a civil law aimed at providing immediate support to women facing physical, sexual, verbal, emotional or economic domestic violence. No arrests can be made based on complaints filed under this law. The Act provides for the appointment of Protection Officers (POs) - who are the key implementing agencies of the Act. They are appointed to receive complaints from the victim/survivors and record reports apart from also providing information on legal rights, remedies and facilitating access to justice and support services. POs can pass protection orders in favour of the aggrieved, prohibiting the accused from inflicting any further violence on the aggrieved, freezing any assets, going to their workplace or attempting communication, amongst others. Breach of a protection order could result in imprisonment or fine[11].

Overall, implementation of the Act has been slow and uneven across states (Maharashtra had appointed over 3000 Protection Officers by 2012, West Bengal only had 20) .

4. Data

The data used in this paper is sourced from the Individual Recode dataset from the National Family Health Survey (NFHS-4) conducted over the years 2015-16. The NFHS is a

[10] Aizer, Anna, "Poverty, violence, and health the impact of domestic violence during pregnancy on newborn health", 535

[11] Indiankanoon, "The Protection of Women from Domestic Violence Act, 2005".

multi-round survey conducted in a representative sample of households throughout India and provides information on population, health and nutrition for India and each state and union territory. The dataset collected information from 601,509 households, 699,686 women and 103,525 men. The Individual Recode dataset has one record for every eligible woman and accounts for variables such as marriage and sexual activity, fertility preferences, family planning, women empowerment, domestic violence and anthropometry for children of interviewed women ("National Family Health Survey.").

The survey reports domestic violence of three types as dummy variables - less severe, severe and sexual. The primary independent variable used for this study is an index created as a summation of these three types of reported violence.

To measure children's health outcomes, we use height for age standard deviation as the first dependent variable. However, given that domestic violence during pregnancy is known to lead to adverse pregnancy outcomes due to the direct toll of abuse on the physical and mental health of the woman, we test whether domestic violence has a more pronounced impact on the child's neonatal health as compared to height for age. We hypothesise a greater impact because while height for age could be affected by other environmental factors, a woman's physical health and nutrition levels are the most crucial indicators of a child's neonatal well being. We test this impact by regressing a child's birth weight (an indicator of the child's neonatal health) on the domestic violence index. The covariates considered are expounded upon in the next section.

4. Empirical Strategy

To evaluate the impact that domestic violence may have on children's health outcomes, we begin by employing a simple regression model, with height for age and birth weight as the dependent variables and domestic violence index as the independent variable. This is delineated in equation (1):

$$y_{cihds} = \beta_0 + \beta_1 Domestic\,Violence\;Index_{ihds} + \epsilon_{cihds}$$

However, we theorise that there may be a myriad of other factors that significantly affect

this relationship, apart from the domestic violence index, that might impact children's health outcomes. These include age at marriage, age at first birth, household size, number of living children, woman's weight, wealth index, place of residence (rural or urban), whether the woman is currently working, has completed secondary education, whether her partner is currently working as well as her level of financial independence (whether the woman is involved in financial decision making in the household), and whether the child is a female. Not accounting for these factors might bias the β_1 coefficient in Equation (1). Thus, we build a Multiple Regression Model, characterised in Equation (2):

$$\begin{aligned} y_{cihds} = {} & \beta_0 + \beta_1 Domestic\ Violence\ Index_{ihds} + \beta_2 Age\ at\ Marriage_{ihds} + \\ & \beta_3 Age\ at\ First\ Birth_{ihds} + \beta_4 Household\ Size_{hds} + \beta_5 Number\ of\ Living\ Children_{ihds} + \\ & \beta_6 Woman's\ Weight_{ihds} + \beta_7 Wealth\ Index_{hds} + \beta_8 Urban_{ds} + \\ & \beta_9 Woman\ Currently\ Working_{ihds} + \beta_{10} Woman\ Completed\ Secondary\ Education_{ihds} \\ & + \beta_{11} Partner\ Completed\ Secondary\ Education_{ihds} + \beta_{12} Financial\ Independence_{ihds} + \\ & \beta_{13} Child\ is\ Female_{cihds} + \epsilon_{cihds} \end{aligned}$$

We expound on our empirical strategy by explaining the expected directionality of some of the relationships between the covariates and independent and dependent variables considered.

A priori, we hypothesise a negative relationship between the **wealth index and domestic violence index**, i.e., being from a low income household will increase chances of being a victim of domestic violence. Gender norms, gender pay gap and unequal access to public services contribute to a woman's disadvantaged position in the economy[12]. These factors are exacerbated when women are from low income households - women are less likely to be educated and are dependent on their husband, with lesser options outside of their marriage as compared to women from high income households. This creates a power imbalance and increases the propensity for women to experience domestic violence. We hypothesise a positive relationship between children's health outcomes and wealth index. Richer households will be able to better provide for their children's health needs, by virtue of having better access to care and nutrition and probably

[12] Reis, "Domestic Abuse Is an Economic Issue – for Its Victims and for Society."

also being more educated about children's health compared to poorer households.

The relationship between **financial independence and domestic violence** incidence is ambiguous. The relationship may be negative through the following channel: more independence could lead to lesser domestic violence incidence, as greater financial independence could mean that the woman has more economic options outside her marriage. Greater financial independence could lead to greater autonomy and bargaining power within the household, help reduce or reverse the power imbalance between the husband and wife and provide the woman with more control over her household, reducing domestic violence incidence. One could also argue a positive relationship. Women with greater financial independence might face backlash from husbands who feel inadequate that they are not the sole providers of the household, as conventionally dictated by society. Alternatively, women with greater financial independence may be more willing to answer surveys truthfully and report violence than those who are afraid of greater backlash. We estimate a positive relationship between children's health and their mother's financial independence. Research shows that mothers spend more on their children than their fathers do[13]. In that vein, more financial independence for the mother should imply that they have a greater say in their children's health expenditure and will also be willing to spend more on their well being, leading to better health outcomes for them.

We hypothesise a negative relationship between domestic violence and level of education. Essentially, a woman being more educated should reduce the probability of domestic violence occurrence. Prior literature finds that in India, couples with higher educated wives are less likely to experience less severe and severe violence compared to low educated couples. Further, equally highly educated couples revealed the lowest likelihood of experiencing any type of domestic violence, connoting that the partner's level of education also plays a role in this relationship[14]. However, it must be noted that this negative relationship might be underestimated - i.e. it is possible that less educated women are less likely to truthfully report domestic violence as compared to those with more education. The relationship between a mother's education and children's health outcomes is intuitively positive. Educated mothers might have more bargaining power within the household, enabling them to take better care of their child, consequently

[13] Zelizer, "The Gender of Money"
[14] Rapp, Daniel, Beate Zoch, M. Mobarak H. Khan, Thorsten Pollmann, and Alexander Krämer, "Association between gap in spousal education and domestic violence in India and Bangladesh."

improving their health outcomes. Additionally, educated mothers will also have greater knowledge about how best to take care of their child compared to a less educated mother, thus ensuring that the child receives adequate care.

Our third specification includes fixed effects at the individual level such as relationship with household heads and religion which are unlikely to change in the short run. We include the relationship with the household head as a proxy for women's autonomy within the household. We hypothesise that women who are the wives of household heads might have a greater autonomy in decision making regarding their child's nutritional needs as compared to a daughter in law and might also face lower abuse considering their status within the household[15]. We include women's religion as previous literature shows it to be correlated with domestic violence and child's health outcomes. For instance, Muslim children are likely to have better health outcomes than those of Hindus[16].

In our fourth specification, we conduct heterogeneity tests to see whether the impact of domestic violence on child's health outcomes has differential impacts across women's education and household income levels.

Summary Statistics

	mean	sd	min	max
Height for Age	-1.915845	.9666248	-4.18	1.29
Birth Weight	2.825551	.5692009	1.3	4.5
Domestic Violence Index	.4270674	.7516783	0	3
Age at Marriage	18.57754	3.952486	10	35
Age at First Birth	20.5546	3.800384	13	36
Household Size	5.791607	2.629463	2	25
Number of Living Children	1.746378	1.650001	0	9
Woman's Weight	50.78852	11.0627	30	85
Wealth Index	2.978762	1.386907	1	5
Woman Completed Secondary Education	.5928945	.4912952	0	1
Partner Completed Secondary Education	.6544212	.4755592	0	1
Woman Currently Working	.2340643	.4234143	0	1
Urban	.2926098	.4549611	0	1
Child is Female	.4166892	.493011	0	1
Observations	699686			

Summary Statistics of the dependent and independent variables used in the research process using the Individual Recode of NFHS-4 data.

5. RESULTS

[15] Carlson, Gwen J., Katarzyna Kordas, and Laura E. Murray-Kolb, "Associations between women's autonomy and child nutritional status: a review of the literature.", 4

[16] Geruso, Michael, and Dean Spears, "Neighbourhood sanitation and infant mortality", 1.

Using Height for Age as the Outcome Variable

Table 1: OLS Regression Results

	(1) Basic Specification	(2) With Controls	(3) Fixed Effects	(4) Heterogeneity Test
Domestic Violence Index	-0.112***	-0.0276***	-0.0286***	-0.0234
	(0.00508)	(0.00895)	(0.00898)	(0.0189)
Age at Marriage		-0.00112	-0.000349	-0.000402
		(0.00352)	(0.00347)	(0.00347)
Age at First Birth		0.00219	0.00208	0.00204
		(0.00355)	(0.00341)	(0.00341)
Household Size		0.0184***	0.0113**	0.0114**
		(0.00432)	(0.00526)	(0.00526)
Number of Living Children		-0.0216***	-0.0144**	-0.0144**
		(0.00667)	(0.00732)	(0.00732)
Woman's Weight		0.0374***	0.0372***	0.0372***
		(0.000850)	(0.000810)	(0.000810)
Wealth Index		0.0249***	0.0156**	0.0152*
		(0.00789)	(0.00788)	(0.00896)
Urban		-0.101***	-0.0949***	-0.0948***
		(0.0197)	(0.0195)	(0.0195)
Woman Currently Working		-0.0126	-0.00971	-0.00994
		(0.0178)	(0.0181)	(0.0181)
Woman Completed Secondary Education		0.00898	0.0191	0.0286
		(0.0195)	(0.0196)	(0.0230)
Partner Completed Secondary Education		0.0360**	0.0414**	0.0416**
		(0.0178)	(0.0178)	(0.0178)
Financial Independence		-0.0464**	-0.0386*	-0.0390*
		(0.0200)	(0.0200)	(0.0200)
Child is Female		-0.0135	-0.0123	-0.0128
		(0.0150)	(0.0149)	(0.0149)
Wealth Index * Domestic Violence Index				0.000169
				(0.00785)
Education * Violence				-0.0172
				(0.0215)
Observations	64894	13767	13767	13767
Fixed Effects	No	No	Yes	Yes
Adjusted R-squared	0.00754	0.184	0.189	0.189

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01
Testing the relationship between Domestic Violence Index and Height for Age using OLS regressions
where (1) is the basic specification without controls, (2) includes controls but not fixed effects
(3) includes fixed effects of religion and relationship with household head
(4) includes heterogeneity tests of domestic violence with income and education

(1) In the simple regression model, the main relationship is statistically significant and negative. An increase in the index of domestic violence by one decreases the child's height for age by 0.112 standard deviations. This makes sense intuitively - a woman who experiences a higher level of domestic violence is less likely to have the emotional and physical well being to take good care of her child. Moreover, a woman who experiences domestic violence and ill treatment within the household might be more likely to have inadequate autonomy to make decisions regarding the distribution of household resources towards food[17]**.** Considering that mothers are usually the primary caregivers and have a higher knowledge of the nutritional benefits for their child, this lack of autonomy might contribute to lower health outcomes of her child[18]. Existing literature also tells us that

[17] Tenkorang, Eric Y, "Women's Autonomy and Intimate Partner Violence in Ghana", 56.
[18] Mehrotra, Santosh, "Child malnutrition and gender discrimination in South Asia", 913.

domestic violence is more prevalent in households belonging to lower wealth quintiles and poor education backgrounds. These households are also less likely to be able to provide their children with adequate nutrition and healthcare, further contributing to the negative impact of domestic violence on child's health outcomes[19].

(2) In order to partial out the effects of other factors contributing to the main relationship, the second specification employs a multiple regression model including these factors as controls. As hypothesised, upon addition, the negative impact of domestic violence on height for age reduces. Omitting controls was causing an overestimate of the negative impact of domestic violence. On testing bilateral relationships between these variables, it is seen that a woman facing a higher level of domestic violence is also more likely to have a greater number of living children, lower weight reflecting worse health outcomes, is more likely to belong to a poorer background and be with a less educated partner. These factors contribute to the negative impact of domestic violence on child's health outcomes, which is consistent with existing literature. A family with more living children is likely to have worse health outcomes for each child due to less time and resources incurred on each child. Children belonging to richer families are more likely to have better access to nutrition and healthcare consequently exhibiting better health outcomes and children belonging to women with lower weight (nutritional status) are likely to have worse health outcomes. On controlling for these factors, we see that the impact of facing domestic violence on the child's height for age is not as pronounced as in the basic specification. While the negative relationship between a woman's financial independence and height for age is not consistent with our *a priori* hypothesis, this could potentially be attributed to self-reported financial independence being an inaccurate measure of a woman's decision-making autonomy within the household. Moreover, even if the woman has greater financial independence, if the household income is primarily the man's, he might choose to spend less of it on the child as compared to what a woman would.

[19] Pearce, Anna, Ruth Dundas, Margaret Whitehead, and David Taylor-Robinson, "Pathways to inequalities in child health", 3

(3) On adding aforementioned **individual fixed effects**, the negative impact of domestic violence on child's height for age remains similar to specification (2), reflecting that these factors may not greatly contribute to the main relationship.

(4) The fourth specification employs **heterogeneity tests** to check whether there is a differential impact of domestic violence on a child's height for age across education levels and wealth classes. We see no statistically significant differential impact, contrary to expectations and previous literature. However, this result may be a function of the large number of missing observations within the dataset and its self-reported nature, which might skew results due to misreporting. For instance, poorer households might be underreporting domestic violence incidence due to greater inhibition of being alienated from their family as compared to richer women who might be more comfortable doing so. Thus, the results might not depict a significant differential impact (i.e. a higher negative impact for poorer households and those with lower education) despite there being one in reality.

Using Birth Weight as the Outcome Variable

Table 2: OLS Regression Results

	(1) Basic Specification	(2) With Controls	(3) Fixed Effects	(4) Heterogeneity Tests
Domestic Violence Index	-0.0193***	-0.00661	-0.00313	-0.0202
	(0.00579)	(0.0122)	(0.0120)	(0.0241)
Age at Marriage		0.0183***	0.0133***	0.0134***
		(0.00455)	(0.00463)	(0.00464)
Age at First Birth		-0.0141***	-0.0117***	-0.0116***
		(0.00432)	(0.00450)	(0.00450)
Household Size		0.00563	0.00398	0.00383
		(0.00487)	(0.00688)	(0.00688)
Number of Living Children		0.0130	0.00948	0.00985
		(0.00944)	(0.0102)	(0.0102)
Woman's Weight		0.00618***	0.00611***	0.00611***
		(0.00106)	(0.00102)	(0.00102)
Wealth Index		0.00949	0.0120	0.00615
		(0.0104)	(0.0103)	(0.0115)
Urban		0.0171	0.0130	0.0142
		(0.0261)	(0.0256)	(0.0256)
Woman Currently Working		-0.0820***	-0.0825***	-0.0816***
		(0.0224)	(0.0223)	(0.0223)
Woman Completed Secondary Education		0.0791***	0.0644**	0.0770***
		(0.0255)	(0.0251)	(0.0295)
Partner Completed Secondary Education		0.00122	-0.00104	-0.000467
		(0.0244)	(0.0241)	(0.0241)
Financial Independence		0.0474*	0.0385	0.0381
		(0.0250)	(0.0248)	(0.0248)
Child is Female		-0.0710***	-0.0749***	-0.0749***
		(0.0190)	(0.0189)	(0.0189)
Wealth Index * Domestic Violence Index				0.0123
				(0.0109)
Education * Violence				-0.0233
				(0.0274)
Observations	19750	3418	3418	3418
Fixed Effects	No	No	Yes	Yes
Adjusted R-squared	0.000604	0.0459	0.0640	0.0643

Standard errors in parentheses

* p<0.10, ** p<0.05, *** p<0.01

Testing the relationship between Domestic Violence Index and Birthweight using OLS regressions

where (1) is the basic specification without controls, (2) includes controls but not fixed effects

(3) includes fixed effects of religion and relationship with household head

(4) includes heterogeneity tests of domestic violence with income and education

Contrary to our preliminary hypothesis we see that domestic violence against women has a lower negative impact on their child's birth weight as compared to their height for age. In fact, this impact becomes insignificant once individual household level controls are added to the specification. This might indicate that domestic violence has more of an emotional toll on women that affect their ability to take care of the nutritional needs of their children post birth, thus negatively affecting their postnatal health outcomes more than neonatal outcomes which is primarily impacted by the woman's physical health outcomes. However, the NFHS dataset has several missing values for birth weight thus reducing the sample size by a large margin. This could contribute to inaccurate results, underestimating the negative impact of domestic violence

on birth weight.

Endogeneity Problem :

Our OLS specifications suffer from endogeneity, impeding us from establishing a causal relationship between domestic violence and child's health outcomes, largely due to the self-reported nature of the dataset. Self-reported domestic violence could lead to a **misclassification bias** because women might not truthfully report their exposure to domestic violence to present the more socially desirable answer and paint their partner in good light. They may also underreport out of fear of being alienated from their family and further ill-treated in case their answers are publicised. Further, the specification also suffers from a **survivor bias** in the case of health outcomes of children. We only consider the health outcomes of children who survived the neonatal stage, not those who died at or prior to birth. Given that domestic violence has been linked to adverse pregnancy outcomes, these children, had they survived, might have had worse health outcomes. Further, they might have also belonged to mothers who faced higher levels of domestic violence thus leading to a severe underestimate of the negative impact of domestic violence on child's health outcomes.

Endogeneity could also result from omitted factors such as household **history and perception of domestic violence**. For instance, women belonging to households with a greater history of domestic violence might be more emotionally tolerant and be able to take better care of their children despite abuse. These women might skew the results leading to an underestimation of the negative impact of domestic violence.

Children's genetic health problems could cause a sample bias. The sample may consist of children who display worse health outcomes due to genetic or external factors, despite domestic violence incidence. Such observations could overestimate the negative impact of domestic violence.

There is also a chance of a recall bias. Recall bias is a systematic error that occurs when respondents do not remember previous events or experiences accurately, or omit details. It has been found that 'undesirable habits' tend to be underreported and pre-existing beliefs might also

impact recall of past events[20]. Given this, there is a high chance of this bias in our data, due to the sensitivity of domestic violence.

Instrumental Variable

To account for endogeneity, we employ a control function approach wherein we exploit the Act to perform an instrumental variable specification. The instrumental variable used is the number of POs assigned to a state as a fraction of the state's population. This instrument is relevant because it is extremely likely that the introduction of POs in states has a causal impact on self-reported domestic violence incidence either by decreasing the incidence of domestic violence (negative impact) or by increasing the confidence of women to be able to report these cases (positive impact on self reporting). The instrument is unlikely to affect a child's health outcome through channels other than domestic violence, satisfying instrumental endogeneity. However, to ensure that program implementation was exogenous, we perform a robustness check, the results of which are shown in table 4.

Equations of Interest :

First Stage Regression:

$$DomesticViolenceIndex_{ihds} = \alpha_0 + \alpha_1 Proportion\ of\ Protection\ Officers_s + \alpha_2 Statewise\ PCI_s + \gamma X_{ihds} + v_{ihds}$$

Second Stage Regression:

$$y_{cihds} = \beta_0 + \beta_1 Domestic\ \widehat{Violence}\ Index_{ihds} + \eta X_{ihds} + \zeta Statewise\ PCI + u_{cihds}$$

Where X represents the controls from the OLS specification and state wise per capita income accounts for endogeneity in program implementation. This is to control for the possibility that more developed states received earlier and better implementation of the program,

[20] Catalog of Bias

Table 3: Instrumental Variable Regression Results (Height For Age)

	(1) Stage 1	(2) Stage 2
Propportion of Protection Officers	2456.5***	
	(863.9)	
Age at Marriage	0.00126	-0.000340
	(0.00325)	(0.00359)
Age at First Birth	-0.0112***	0.00130
	(0.00322)	(0.00523)
Household Size	0.000508	0.0113**
	(0.00499)	(0.00520)
Number of Living Children	0.0169**	-0.0131
	(0.00705)	(0.00886)
Woman's Weight	-0.00145*	0.0371***
	(0.000743)	(0.000977)
Wealth Index	-0.0775***	0.0103
	(0.00751)	(0.0256)
Urban	0.0684***	-0.0894***
	(0.0182)	(0.0292)
Woman Currently Working	0.00275	-0.0105
	(0.0178)	(0.0179)
Woman Completed Secondary Education	-0.0827***	0.0126
	(0.0186)	(0.0348)
Partner Completed Secondary Education	-0.0692***	0.0369
	(0.0176)	(0.0304)
Financial Independence	-0.176***	-0.0512
	(0.0213)	(0.0624)
Child is Female	0.0101	-0.0117
	(0.0142)	(0.0154)
Statewise Per Capita Income	-0.000000304**	-0.000000159
	(0.000000135)	(0.000000172)
Domestic Violence Index		-0.0991
		(0.332)
Observations	13767	13767
Adjusted R-squared		0.172

Standard errors in parentheses

* p<0.10, ** p<0.05, *** p<0.01

Instrumental Variable regressions with Proportion of Protection Officers as the instrument.

Controls include (1) religion and (2) relationship with household head fixed effects

(1) From the first stage of the 2SLS regression specification, it is observed that the proportion of POs has a positive impact on self-reported domestic violence index and this impact is statistically significant. This may be due to increased awareness and confidence among women to report abuse post the implementation of the Act as they have a system to protect them if they are ill-treated for exposing abusers.

However, while interpreting the results, it is important to keep in mind that the instrument is weak (F statistic = 8.14). An increase in the proportion of protection officers by .0001 (2500% of the mean) increases the degree of self reported domestic violence only by 0.2 (50% of the mean). The low degree of correlation between the instrument and variable of interest implies that if the instrument does not satisfy the exogeneity

condition, there is a possibility of observing largely biassed estimates. Although we hypothesise that the instrument does not suffer from endogeneity and employ robustness checks to ensure the same, it is difficult to accurately test for zero exogeneity.

In the second stage of the 2SLS regression with child's height for age as the outcome variable, we observe that the negative impact of domestic violence becomes insignificant. While this could be a result of the other controls correlated with domestic violence having a higher impact on a child's health outcome, it could also be a function of the instrument being weak - inflating the standard error or having an endogeneity bias which cannot be accurately tested for. Thus, the statistical significance of this impact should be interpreted with caution.

Table 4: Instrumental Variable Regression Results (Birth Weight)

	(1)	(2)
	Stage 1	Stage 2
Propportion of Protection Officers	3591.3*	
	(1987.4)	
Age at Marriage	0.00363	0.0138***
	(0.00629)	(0.00490)
Age at First Birth	-0.0212***	-0.0154
	(0.00616)	(0.00951)
Household Size	-0.0169*	0.000930
	(0.00950)	(0.00907)
Number of Living Children	0.0412***	0.0166
	(0.0157)	(0.0192)
Woman's Weight	-0.00172	0.00582***
	(0.00133)	(0.00129)
Wealth Index	-0.0795***	-0.00104
	(0.0144)	(0.0313)
Urban	0.0532	0.0219
	(0.0345)	(0.0333)
Woman Currently Working	-0.0316	-0.0886***
	(0.0341)	(0.0264)
Woman Completed Secondary Education	-0.0647*	0.0524
	(0.0373)	(0.0383)
Partner Completed Secondary Education	-0.0591	-0.0116
	(0.0374)	(0.0350)
Financial Independence	-0.202***	0.00250
	(0.0406)	(0.0845)
Statewise Per Capita Income	7.37e-09	-4.36e-08
	(0.000000257)	(0.000000189)
Domestic Violence Index		-0.177
		(0.392)
Observations	3418	3418
Adjusted R-squared		-0.0242

Standard errors in parentheses

* p<0.10, ** p<0.05, *** p<0.01

Instrumental Variable regressions with Proportion of Protection Officers as the instrument. Controls include (1) religion and (2) relationship with household head fixed effects

We observe similar results on using the instrumental variable model to check the impact of domestic violence on a child's birth weight. While the effect of proportion of protection officers on domestic violence has a more pronounced but less significant positive impact on self reported domestic violence, the negative impact of domestic violence on birth weight is also statistically insignificant although greater in magnitude as that of height for age. However, the results of this specification suffer from the problem of restricted sample size to a greater extent than the previous specification, further inflating the standard error.

Robustness Checks

Table 5: Robustness Check Results

	(1) Domestic Violence Index
Proportion of Protection Officers	-5751.0***
	(646.3)
Age at Marriage	-0.00954***
	(0.00332)
Age at First Birth	-0.00528*
	(0.00316)
Household Size	-0.00741
	(0.00461)
Number of Living Children	0.0242***
	(0.00610)
Woman's Weight	-0.00259***
	(0.000609)
Wealth Index	-0.0710***
	(0.00712)
Urban	0.132***
	(0.0160)
Woman Currently Working	-0.0190
	(0.0215)
Woman Completed Secondary Education	-0.122***
	(0.0186)
Partner Completed Secondary Education	-0.0585***
	(0.0164)
Financial Independence	-0.00888
	(0.0189)
Child is Female	0.000341
	(0.0131)
Statewise Per Capita Income	-0.00000113***
	(0.000000153)
Observations	16804
Adjusted R-squared	0.0833

Standard errors in parentheses

* p<0.10, ** p<0.05, *** p<0.01

Robustness Check to see whether there is a positive correlation between Domestic Violence Index and Proportion of Protection Officers.

Proportion of Protection Officers is calculated as the Number of Protection Officers in a State divided by its population as of 2011.

Although the proportion of POs might seem like a relevant instrument that satisfies instrumental exogeneity, there is a possibility that the implementation of the Act was not entirely exogenous, affecting the exogeneity of the instrument. It is possible that the program, which was implemented in a staggered manner[21], was better implemented in states that already had a high incidence of domestic violence (leading to reverse causality) or in more developed states. In order to control for the latter issue, the instrumental variable specification controls for per capita income of each state according to the 2011 census. Further, to ensure that the program implementation did not have a positive relationship with pre-existing higher incidence of self reported domestic violence, we test the effect of proportion of POs on self-reported domestic violence in 2005 using NFHS-3 data. We see that the correlation between the proportion of POs and domestic violence is in fact negative, thus confirming that the Act was not endogenous to the high incidence of domestic violence pre-existing in the state.

6. Conclusion

This paper aimed to study the relationship between domestic violence on mothers and their children's health outcomes. We found there to be a negative relationship between the two, implying that higher incidence of domestic violence on mothers has an adverse effect on her children's health outcomes. Although this negative impact is statistically insignificant, this could be attributed to the large number of missing observations, weak instrument and the risk of potential endogeneity in the instrument.

While some limitations have been addressed along with the endogeneity problem, that list is non-exhaustive. Firstly, the external validity of this paper can be contested. While NFHS is nationally representative, given the complex demographic and societal structure of the Indian population, the results of this paper may not be applicable to other countries and populations.

The paper also suffers from the omitted variable bias. An important factor to look at in this regard is the way in which we quantify a woman's autonomy and bargaining power in the household - financial independence may not be a completely accurate indicator of these

[21] Das, Anamika, and C. M. Lakshmana, "The Implementation of Domestic Violence Act in India: A State-Level Analysis", 9.

measures, as larger factors such as acceptability of domestic violence in the household/community might overshadow financial independence and reverse its relationship with the independent and dependent variable.

While the survey measures the incidence of domestic violence, the variable does not have a time dimension, i.e. we do not know how long ago and how often the woman has faced abuse. Having access to this data would help in gaining a nuanced understanding of the main relationship, as the health outcomes for a child whose mother continues to face domestic violence regularly might be different to those for a child whose mother no longer faces domestic violence/does not face it regularly.

The NFHS dataset also suffers from some major problems. There is a large incidence of missing data across several variables, which reduces our sample size and the general applicability of this study. The magnitude of missing data also prevented us from using controls such as whether the partner consumes alcohol - which is an important factor to consider given the relationship we are studying. Secondly, a lengthier questionnaire could lead to poorer quality of data, and given the length of the NFHS survey (the women's questionnaire has 1,139 questions), we may suffer from poor quality of data.

We have tried to address as many of these concerns through our usage of the instrumental variable - the implementation of the Protection of Women from Domestic Violence Act, 2005. However, this instrument can also suffer from problems. Given the dearth of information about the Act, especially with regards to its implementation, we are unable to ratify how exogenous its implementation is. While we tried to control for whether developed states had better implementation, state wise per capita income may not be an entirely accurate measure of development as economic development may not be the main indicator considered while measuring how developed a state was at the time of implementation. For example, some states might have been more socially or politically active, which could influence the speed of implementation of the Act. Moreover, we also suffer from the problem of employing a weak instrument.

Overall, while the estimates may not be entirely impactful (due to some degree of statistical insignificance), it still provides important information about the impact of domestic

violence on children's health. In a country like India, which is still rooted in the patriarchy, women who are victims of domestic violence continue to be stigmatised and made to feel unsafe in their own home. This study also shows how this violation of human rights also has damaging long term impacts on those caught in the crossfire of this abuse.

Further research should employ more comprehensive health and violence related data in order to determine a more robust relationship between domestic violence on mothers and their children's health outcomes. The focus should be on employing non self-reported data, so as to increase its accuracy. Given the severe restrictions on movement put in place by the Coronavirus lockdowns in 2020, researchers should also look into whether there was an increase in domestic violence incidence over the lockdown period.

The results of this paper imply that the Act does seem to be increasing the reporting of domestic violence. However while increased reporting is no doubt a feat, our data does not provide any evidence of the Act actually reducing domestic violence. One explanation for this could be due to the Act being a civil law and not a criminal law. This implies that the Act can only support women who report crime, but cannot make any arrests until a protection order is breached. However, the institution of a protection order against the husband might in fact lead to a more unsafe environment for the wife, subjecting her to the risk of more harm. Thus, from a policy standpoint, the Act should be reexamined to ensure that it is not only meeting its objectives, but also doing so in a more effective and safe manner.

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Effect of IGMSY on the Untargeted Siblings

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Abstract

Infant mortality is a serious concern in India to combat which vaccination plays a crucial role. Indira Gandhi Matritva Sahyog Yojna (IGMSY), a conditional cash transfer scheme attempts to address this. Making use of the pilot implementation of this scheme as a natural experiment, we employ a difference-in-difference strategy using the NFHS-4 to find the intention to treat estimate of IGMSY on the immunization rates of untargeted younger siblings whose elder siblings were exposed to the program. Firstly, we find no significant increase in immunization on the targeted children because of IGMSY. Secondly, we find that there has been no spillover except for the polio vaccine among the untargeted siblings. Thirdly, there is a positive differential impact on unexposed siblings receiving BCG vaccine relative to the targeted siblings. To sum up, the findings that emerge from this study show evidence of some spillover although with insufficient behavioural change.

JEL Classifications: I18, I12, H51, H53

Keywords: child health, immunization, India, spillover, conditional cash transfer, maternity support

1. Introduction

Amidst rapid economic growth in India since the 1980s, India struggled with extreme cases of infant mortality and contributed to a third of the global infant deaths in the start of the 21st century. The development of vaccines against disease is among the most important scientific achievements. The value of the low hanging fruit — vaccination — on health cannot be exaggerated enough. Besides access to safe water, nothing else has been able to impact mortality to the extent vaccination has.[1] Despite having the Universal Immunization Program (UIP) which provides child immunization at zero cost, India's vaccination rate is amongst the lowest globally.[2] Few of the problems in the low immunization are distance to the immunization facilities, fear of side effects and high opportunity costs for the mother. In response to this, India

[1] Stanley A Plotkin & Edward A. Mortimer, *Vaccines (*Philadelphia, PA: Saunders, 1988), quoted in Charlene M C Rodrigues and Stanley A Plotkin, "Impact of Vaccines; Health, Economic and Social Perspectives," *Frontiers in microbiology* (Frontiers Media S.A., July 14, 2020), accessed December, 2020, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7371956/

[2] Nijika Shrivastwa, Brenda W. Gillespie, Giselle E. Kolenic, James M. Lepkowski, & Mathew L. Boulton, "Predictors of Vaccination in India for Children Aged 12-36 Months", *American Journal of Preventive Medicine*, *49*(6) (2015), accessed December, 2020, https://doi.org/10.1016/j.amepre.2015.05.008

began exploring conditional cash transfer programs (CCTs) like Indira Gandhi Maternity Support Scheme (IGMSY) to incentivize healthy behaviors of pregnant mothers.

Under such schemes, individuals are required to fulfill certain requirements to avail the cash transfers from the government. Since these transfers are temporary and restricted to a certain period, we may observe immediate change. However, CCT aims to make people realise the benefits of utilising the facilities during the intervention and thus change behaviour positively in the long run, even in the absence of the intervention. The important question is, what happens when the incentive is stopped? Will those who received such monetary incentives change their behaviour when the transfer halts? The long-term benefit of CCT and its cost effectiveness could come into question.

These questions push for the need to understand the spillover effect of CCTs and to understand to what extent has the CCT benefited the children whose parents once received such incentive, but not anymore. Taking advantage of the restricted eligibility of IGMSY, upto the second born children, and its implementation in 52 pilot districts, we exploit the difference in differences strategy to find the impact of the scheme on the untargeted siblings. Specifically, using NFHS 4 we attempt to find the intention to treat estimate of IGMSY on the immunization rates of untargeted younger siblings whose elder siblings were exposed to the program.

Firstly, we find that the IGMSY has had no statistically significant impact on the targeted children in contrast to the finding of the existing literature although most coefficients are positive.[3] Second, we find that there is no significant difference in the immunization rates of the untargeted siblings (third and higher order) relative to those in the control group except for vaccination against polio for which the probability that the untargeted siblings receive *OPV 3* increases by 3.7 percentage points as a result of IGMSY. Further we find that the third and higher order children relative to second order children are 3.3 percentage points more likely to receive *BCG* vaccination. However, for all other vaccines, the differential impact of the IGMSY on the third and higher order children relative to second born children is statistically

[3] Paula Von Haaren, & Stefan Klonner,"Lessons learned? Intended and unintended effects of India's second-generation maternal cash transfer scheme", *Health Economics (United Kingdom), 30*(10) (2021) accessed December, 2020, https://doi.org/10.1002/hec.4390

insignificant. Since we first found that the targeted children up to the second born had not been impacted by the program, this implies that there is no spillover effect either on DPT 3 and Measles. However, for BCG and OPV 3 there is a possible spillover that is evident. These indicate that families focus more on immediate and temporary relief and do not alter their behavior sufficiently by linking transfers to incentives for investments in human capital. A careful construction of the policy is required to gain long term and a sustainable change in the attitudes of people towards essential requirements for building human capital. This also requires imparting information to the people.

To the best of our knowledge, the spillover effect of IGMSY has not been studied for vaccination though for other CCTs it has been.[4] Therefore, ours is an attempt to add to the existing stream of knowledge on the evidence of behavioral responses evident in those beyond the target of the intervention.

The paper is structured as the following. We start off with reviewing the literature d to the empirical analysis where we discuss the data and empirical strategy. The next section presents the results and test for the parallel trends assumption followed by which is the discussion and conclusion.

2. Literature Review

Our paper is most closely related to Harren and Klonner where they exploit IGMSY's geographically targeted pilot phase as a natural experiment and use NFHS-4 to estimate its effects by a matched-pair differences-in-differences approach. They find a positive effect on infant immunization as well as long-term health care utilization.[5] Additionally, in the state of Bihar, delayed payments of IGMSY improved the child's WAZ score.[6]

[4]Sakshi Jain, "Own and Spillover Effects of a Conditional Cash Transfer Program Targeting Young Girls: Evidence from India", *ProQuest Dissertations and Theses, May*, (2018), accessed December, 2020

[5] PaulaVon Haaren, & Stefan Klonner, "Lessons learned? Intended and unintended effects of India's second-generation maternal cash transfer scheme", *Health Economics (United Kingdom)*, *30*(10) (2021), accessed December, 2020, https://doi.org/10.1002/hec.4390

[6] Prabhat Ghosh & Anjini Kochar, "Do welfare programs work in weak states? Why? Evidence from a maternity support program in India", *Journal of Development Economics*, *134* (2018), accessed December, 2020, https://doi.org/10.1016/j.jdeveco.2018.05.008

Many researchers have found a positive effect of conditional transfers in inducing a structural change in their practices. Lagarde et al. assesses the effectiveness of CCT in improving access to care and health outcomes, in particular for poorer populations in low and middle income countries.[7] They find that several CCT programs provided strong evidence of a positive impact on the use of health services, nutritional status, and health outcomes. Thus, CCTs are a viable measure to bring out a change. This idea is further supported in the paper by Kanika and Aishwarya where they highlight that there is a positive effect of the scheme on the HAZ score and significantly negative for neonatal mortality[8]. This is an important result because in contrast to the other results finding no effect of maternity support CCTs on the child health outcomes, this paper finds a positive effect and highlights how the institutional factors that are responsible for the supply of healthcare impacts the effect of the program in itself. This is the main takeaway from this paper.

More than just focusing on positive impacts on immediate outcomes which might merely signal a temporary effect, it is equally important to measure and identify any structural change in the behavior that might be taking place due to the scheme. In a study that evaluates the delayed benefits of parent focused intervention on the unintended siblings, it finds positive results, indicating that the intervention led to a sustainable change in the parent's practices.[9] Ruggiero et al. measures the impact of a responsive parenting initiative on the maternal feeding practices towards the second born children also finds a positive spillover.[10] Hence, following the same idea, we try to identify this exact impact of IGMSY on the behavior of the mother with regards to the child belonging to the third or higher birth order.

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[7] Mylene Lagarde, Andy Haines, & Natasha Palmer, "The impact of conditional cash transfers on health outcomes and use of health services in low and middle income countries", In *Cochrane Database of Systematic Reviews* (Issue 4) (2009), accessed December, 2020, https://doi.org/10.1002/14651858.CD008137

[8] Kekre, Aishwarya, Mahajan, Kanika. "Maternity support and child health: Un-intended gendered effects." *Journal of Comparative Economics* (2023).

[9] Victoria Seitz, & Nancy H. Apfel, "Parent-focused Intervention: Diffusion Effects on Siblings", *Child Development*, *65*(2) (1994), accessed December, 2020, https://doi.org/10.1111/j.1467-8624.1994.tb00776.x

[10] Carla F Ruggiero, Emily E Hohman, Leann. L Birch, Ian M Paul, & Jennifer S Savage, "The Intervention Nurses Start Infants Growing on Healthy Trajectories (INSIGHT) responsive parenting intervention for firstborns impacts feeding of second born", *American Journal of Clinical Nutrition*, *111*(1), (2020), accessed December, 2020 https://doi.org/10.1093/ajcn/nqz277

3. Background of Scheme

To overcome the shortcomings of the Janani Suraksha Yojana, Indira Gandhi Matritva Sahyog Yojana (IGMSY), a conditional cash transfer scheme was launched by the central government of India in April 2011. It aimed to improve the maternal and child health along with bringing structural and behavioral changes.[11] Funded by the National Government via the state and district branches of the ICDS, Rs 4000 were transferred to the bank account of the mothers who were older than 18 years until 2013 and Rs 6000 from 2013. This allowance was paid in three installments – in the last trimester, after 3 months and 6 months of birth. The minimum requirement was to get the child immunized with at least 3 vaccines– one dose of BCG, Polio and DPT. Additionally, the mother was provided with iron and folic acid tablets and were expected to attend at least 4 nutrition and health counseling sessions.

This scheme was targeted and implemented only in 52 districts in India. These districts were chosen as a representative sample of the country. They employed a stratified sampling method where they first divided the districts into high, medium, and low based on health and development indicators. After this, they picked 11 districts from the low and high category and 26 districts from the medium category. The remaining 4 districts were selected from the UTs.

We use 2012 as the intervention period for the analysis because the amount of funds expended by state governments in 2011 was only half of what was spent in 2012. This suggests that the program was up and running only in the second half of the financial year 2011-2012.[12]

In 2017, this scheme was renamed as the Prime Minister's Reverence for Maternity Scheme (PMMVY) which was then passed in all districts throughout the country. The cash transfer was reduced to Rs. 5000 and the first born were the only beneficiaries.

[11] PaulaVon Haaren, & Stefan Klonner, "Lessons learned? Intended and unintended effects of India's second-generation maternal cash transfer scheme", *Health Economics (United Kingdom)*, *30*(10) (2021), accessed December, 2020, https://doi.org/10.1002/hec.4390

[12] PaulaVon Haaren, & Stefan Klonner, "Lessons learned? Intended and unintended effects of India's second-generation maternal cash transfer scheme", *Health Economics (United Kingdom)*, *30*(10) (2021), accessed December, 2020, https://doi.org/10.1002/hec.4390

4. Empirical Analysis

4.1 Data

We have used the National Family Health Survey round 4 data collected in 2015-2016 to measure the spillover effects of the scheme. We make use of the child dataset consisting of data on children under the age of 5. We restrict our sample to only alive children and to families that have at least three children to allow us to study the impact on the non-targeted children who should be of birth order three and above.[13] Also, beneficiary mothers of the IGMSY scheme need to be at least 19 years old, therefore we restrict to mothers who are at least 19 years old at the birth of the respective child. We additionally retain individuals for whom we have data on all the controls and for whom at least data on one of the outcome variables is available.

The primary outcome variables we are interested in is the immunization status of the mandatory vaccines in IGMSY, namely, *BCG*, DPT, and Polio.[14] We also look at *Measles* to see how the uptake of a vaccine not covered by the scheme is affected, which is a spillover in itself. For *DPT 3* and *OPV 3* we look only at whether the child has received the third dose since it is complete only after receiving three doses, for the others it is just a single shot. These are all defined as binary variables, taking the value 1 if the child received the respective vaccine and 0 otherwise. We further have an overall vaccination coverage variable, *Complete* which takes the value 1 if all the 4 vaccines have been received and 0 otherwise. We present the average vaccination rates in the treatment and control group in Table 1 before the implementation of the program i.e. children born before 2012. Except for BCG, we find that there is statistically significant difference between the two groups prior to the intervention.

Table 1: Balance Check

	Control Observation	Pilot Observation	Control Mean	Pilot Mean	P-value

[13] Since third and higher order children constitute the untargeted sample, and because the focus of the analysis is to examine if there has been any effect on the untargeted sample, this restriction is important. Our main results on Table 2 and 3 are robust to the inclusion of number of children born as a control.

[14] "Ministry of Women and Child Development, G. of I" *Implementation guidelines of Indira Gandhi Matritva Sahyog Yojana(IGMSY)-- a conditional maternity benefit scheme*. (2011)

BCG	46211	3204	.8734933	.8817104	.1752624
DPT 3	46211	3204	.7298912	.7849563	9.20e-12
OPV 3	46211	3204	.639826	.6972534	5.22e-11
Measles	46211	3204	.7947242	.8083645	.0640936
Complete	46211	3204	.5342018	.6104869	5.30e-17

4.2 Empirical Strategy

Had individuals who received the program been selected randomly, it would have been easier to estimate the treatment effect using a simple model by comparing the differential outcomes of the treated relative to the control group. Any difference other than the treatment effect would have been random and therefore the causal identification would have been simple. However, this is not possible given that the government has implemented this policy. Further, even though a few pilot districts have been chosen to receive the treatment, and they were chosen to be representative of the of the country they were not completely random as demonstrated in Table 1. It is very likely that the current treatment group which is better than the control group will continue in a similar trend even if the program in truth had no impact. The difference between the two groups will persist and therefore, it would be a mistake to not account for this initial difference when we estimate the effect of the program. Also, it would be naive to just compare the outcome of the treated group before and after the implementation as for the above said reason, it could be capturing the general progress with time.

Assuming that both the groups would have moved parallelly in the absences of the program, we account for these by employing a difference in differences strategy to identify the intention to treat (ITT) estimate. We estimate the effect of the program by looking at two variations: the first is a cohort variation which looks at the difference between the exposed and unexposed cohort based on the year of birth and the second difference is to compare them between the pilot and control districts. Additionally, since we have no information on the actual

uptake of the program, we compare eligible children in general, therefore it is an ITT estimate rather than average treatment effect, which is however valuable from a policy point of view.

The first model we use estimates the effect of the program on the targeted children, up to second order births. This replicates the results of Von & Klonner, however, with slight modification.[15]

$$Y_{isy} = \alpha_0 + \alpha_1 ExposedCohort_{isy} + \alpha_2 PilotDistrict_{isy} + \alpha_3 ExposedCohort_{isy} * PilotDistrict_{isy} + \alpha X_{isy} + \gamma_s + \delta_y + u_{isy} \quad (1)$$

Equation 1 aims to find out the ITT estimate of the IGMSY program for an individual *i* from state *s* born in year *y*. *ExposedCohort* takes the value 1 if the child was born after the program was implemented, which we take as 2012 and 0 if earlier. As aforementioned, IGMSY is implemented only in 52 pilot districts across India. Therefore, the variable *PilotDistrict* takes the value 1 for the said 52 districts and 0 for all other districts. α_3 gives the ITT estimates of the IGMSY program. This gives us the causal impact of the program and a statistically significant positive coefficient will indicate that the program led to an increase in the vaccination of children.

X is a set of individual and household level covariates we include to increase the precision of our results and to avoid omitted variable bias. The age of the child, the birth order and sex of the child are included as individual level controls. The mother's education, mother's age and square of age, wealth index of the family, dummy for lower cast, religion and rural dummy comprise the household level control. Third we include village level control which is the proportion of children in the village who have received at a minimum of 4 ANC visits as per the WHO recommendation (2016). Further, we control for the proportion of children in the village who received postnatal check-up. These are highly correlated with the program impact, as a part of these are conditions of the CCT and also regular medical visits can increase awareness and

[15] PaulaVon Haaren, & Stefan Klonner, "Lessons learned? Intended and unintended effects of India's second-generation maternal cash transfer scheme", *Health Economics (United Kingdom)*, *30*(10) (2021), accessed December, 2020, https://doi.org/10.1002/hec.4390

importance of immunization and hence affect the vaccination. Since both these correlations exist, we control for this to avoid bias. Since different states have different policies in place, we use state fixed effects to control for this state level unobservable variation. Additionally, since nationwide policy or the economic position of the country in each year can affect the immunization rate, we also include birth year fixed effects. Finally, we cluster the standard errors within districts to avoid standard errors to be correlated within the districts.

In addition to the method of the existing literature, we impose a birth order restriction[16]. Since only the first and the second born are eligible for the CCT, we restrict our analysis to those of birth order 2 and below. Furthermore, in contrast to the base paper's approach to look only at a subset of the pilot and control districts selected by a subjective matching technique, we look at the entire sample. However, we present both results to see the comparability of our results with that of the existing literature.

The primary objective of our paper is to study the impact of the program on untargeted siblings. The first model provides us with insight on the effect on the targeted children which we believe might also translate to effect on the untargeted sibling. To identify this spillover, we use a second approach.

4.3.1 Spillover Estimation

To estimate the spillover, the unintended effect of the IGMSY program on non-eligible siblings, we measure the effect of older siblings in a household being exposed to the program on the third and higher order (younger) children who will never be eligible for the program. We use the estimation equation 2:

$$Y_{isy} = \beta_0 + \beta_1 ExposedHH_{isy} + \beta_2 PilotDistrict_{isy} + \beta_3 ExposedHH_{isy} * PilotDistrict_{isy} + \beta X_{isy} + \gamma_s + \delta_y + v_{isy} \quad (2)$$

[16] PaulaVon Haaren, & Stefan Klonner, "Lessons learned? Intended and unintended effects of India's second-generation maternal cash transfer scheme", *Health Economics (United Kingdom)*, *30*(10) (2021), accessed December, 2020, https://doi.org/10.1002/hec.4390

ExposedHH takes the value 1 if the child belongs to a family that has had at least one first or second born in or after 2012, which means at least one of the siblings were exposed to the program. It takes the value 0 if no first or second born in the family was born after 2012. In this way, this variable captures the family's exposure to the program. This specification is restricted to children of birth order above 2. Using this approach, we compare untargeted children whose siblings were exposed to the program within each district and second compare pilot and control districts. This estimates the treatment effect on the unexposed sibling, the spillover.

Moreover, if we find significant results, then this would imply that there has been a spillover. That is, untargeted siblings from pilot districts is better than their counterparts in control districts. To test these results further, we use a third model to estimate the differential impact of the program on the exposed (targeted) and unexposed sibling (untargeted). We use the equation 3 to estimate this:

$$\begin{aligned} Y_{isy} = {} & \Pi_0 + \Pi_1 ExposedHH_{isy} + \Pi_2 PilotDistrict_{isy} + \Pi_3 ThirdSibling_{isy} \\ & + \Pi_4 ExposedHH_{isy} * PilotDistrict_{iys} + \Pi_5 ExposedHH_{isy} \\ & * ThirdSibling_{isy} + \Pi_6 PilotDistrict_{isy} * ThirdSibling_{isy} \\ & + \Pi_7 ExposedHH_{isy} * PilotDistrict_{isy} * ThirdSibling_{isy} + \Pi X_{isy} \\ & + \gamma_s + \delta_y + w_{isy} \end{aligned} \qquad (3)$$

ThirdSibling takes the value 1 if the child is of third and higher order born and 0 if they are the second born. There is no restriction imposed in this, since, it gives a differential treatment effect on a third order child relative to the second order child. If we find through equation 1 that there is a positive treatment effect, and then if we observe a statistically significant positive coefficient using equation 3, this implies that the IGMSY program has a spillover effect as the third child relative to the second becomes more likely to receive the vaccination. Even if it is not significant it implies that there has been a spillover which is why the second and the third children are not statistically different when exposed to the program. Had there been no spillover, they would be statistically different and negatively correlated—third born should be less likely to receive vaccination.

5. Results

Table 2, columns 6-10, shows when we look at the sub-sample of 70 districts following Von & Klonner, the complete vaccination coefficient is positive and very close to their finding.[17] The probability that the targeted children are *Completely* immunized increases by 5.08 percentage points (ppt) and the probability that they receive *DPT 3* increases by 3.37 ppt. Both are significant at the 5 % level. But, extending this to the entire sample does not produce significant results. When focusing on the full sample, we see that the IGMSY had no statistically significant impact on the targeted children. The point estimates tell that there has been an increase in the immunization because of the CCT, but this is not statistically significant. Therefore, IGMSY has had null effect on the targeted children, for those of birth order 2 or below.

Table 2: Effect of IGMSY on exposed cohorts born before 2013 and birth order less than or equal to 2

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	BCG	DPT 3	OPV 3	Measles	Complete	BCG	DPT 3	OPV 3	Measles	Complete
Exposed Cohort x Pilot	-0.00628	0.00361	0.00144	0.00591	0.00389	0.00454	0.0337**	0.0244	0.0177	0.0508**
	(0.00743)	(0.0118)	(0.0128)	(0.0113)	(0.0156)	(0.0120)	(0.0169)	(0.0204)	(0.0146)	(0.0232)
Observations	92008	92008	92008	92008	92008	8994	8994	8994	8994	8994
Mean of Dep. Variable	0.906	0.790	0.708	0.835	0.615	0.905	0.821	0.740	0.839	0.656
SD	0.291	0.407	0.455	0.371	0.486	0.293	0.383	0.439	0.367	0.475
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sample restriction	Full Sample	Full Sample	Full Sample	Full Sample	Full Sample	Sub-Sample	Sub-Sample	Sub-Sample	Sub-Sample	Sub-Sample

Standard errors in parentheses

[17] PaulaVon Haaren, & Stefan Klonner, "Lessons learned? Intended and unintended effects of India's second-generation maternal cash transfer scheme", *Health Economics (United Kingdom)*, *30*(10) (2021), accessed December, 2020, https://doi.org/10.1002/hec.4390

This finding contrasts with Von & Klonner, due to difference in methodology.[18] We look at all the districts disregarding the different policies implemented in each state and we restrict our focus to the targeted children. Since we use state-fixed effects the first concern is addressed, and our findings must be robust to the second restriction. Also, the very first finding that the program did not impact even the targeted children could be because, it is even more likely that the CCT did not reach the neediest among the eligible children as the program is estimated to have reached only 50-60% of the target population [19]. Additional constraints in accessing the program would have existed, therefore the ITT estimate is not significant.

Table 3 explores whether IGMSY had any diffusion effect on the third and higher order children—effect of the CCT on exposed households for third and higher order children. We find that IGMSY causes the probability that the untargeted siblings to receive *OPV 3* to increases by 3.66 ppt relative to their counterparts in the control districts. This result is statistically significant at the 10% level. One major achievement of India through the UIP has been to eliminate polio by 2014. It is possible that the great focus given on Polio might have additionally contributed to the effect which's intensification happened through years of effort started in 1995 with the Pulse Polio Immunization program.[20] No other coefficients are significant, although the point estimates for *BCG* and *DPT 3* are positive. Given that all but the *OPV 3* is insignificant, we conclude that there has been no spillover except for *OPV 3*.[21]

[18] PaulaVon Haaren, & Stefan Klonner, "Lessons learned? Intended and unintended effects of India's second-generation maternal cash transfer scheme", *Health Economics (United Kingdom)*, *30*(10) (2021), accessed December, 2020, https://doi.org/10.1002/hec.4390

[19]Falcao V. L, Khanuja J., Matharu S., Nehra S., and Sinha D. "Report on the study of the Indira Gandhi Matritva Sahyog Yojana." *Centre for Equity Studies (New Delhi)* (2015). Accessed December, 2020

[20] "NHP". *Pulse Polio Programme: National Health Portal of India* (2015). Pulse Polio Programme. Retrieved January 22, 2022, accessed December, 2020, https://www.nhp.gov.in/pulse-polio-programme_pg

[21] In Table A1 and A2, we also report the impact of IGMSY on the earlier dosages of DPT and OPV. There is no impact of earlier does of DPT and OPV among the targeted children. We do find a positive spillover in OPV 2. Since, receiving all the dosages are important to receive the CCT, and given that coefficient on OPV 2 and OPV 3 are of the same magnitude it seems that at least for it is not the case that the null results are being driven by the belief that there is just diminishing returns to dosages.

Table 3: Effect of IGMSY on exposed households for third and higher order children

	(1) BCG	(2) DPT 3	(3) OPV 3	(4) Measles	(5) Complete
Exposed HH x Pilot	0.0194	0.0174	0.0366*	-0.00249	-0.0130
	(0.0164)	(0.0222)	(0.0207)	(0.0227)	(0.0222)
Observations	75443	75443	75443	75443	75443
Mean of Dep. Variable	0.833	0.623	0.587	0.624	0.432
SD	0.373	0.485	0.492	0.484	0.495
State FE	Yes	Yes	Yes	Yes	Yes
Birth Year FE	Yes	Yes	Yes	Yes	Yes
Sample restriction	Full Sample	Full Sample	Full Sample	Full Sample	Full Sample

Standard errors in parentheses

Note: The outcome variables, BCG and Measles taking the value 1 if the child received the respective vaccine and 0 otherwise. DPT 3 and OPV 3 taking the value 1 if the child received the third dose of the respective vaccine and 0 otherwise. Complete takes the value 1 if all the 4 vaccines have been received and 0 otherwise. Exposed HH takes the value 1 if the child belongs to a family that has had at least one first or second born in or after 2012, which means at least one of the siblings were exposed to the program. It takes the value 0 if no first or second born in the family was born after 2012. Pilot takes the value 1 for 52 pilot districts and 0 for all other districts. We control for the sex of the child, birth order, mother's age, mother education level, marital status, dummy for rural, dummy for lower caste, 6 categories of religion, wealth index and as village level controls, proportion of children who received postnatal and antenatal care in the village. We include state and birth year fixed effects and cluster the standard errors within districts. This specification is restricted to children of birth order above 2.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Additionally, observing negative insignificant results for *Measles* is a concern because it is administered after a minimum 6 months after birth for which period IGMSY does not apply. Therefore, had there been a change in the general perception of parents, we would have expected to see significant results or a positive coefficient for Measles, which we do not observe. This highlights how the monetary aspect is the driving force for increased immunization.

Table 4 presents results on the differential impact of IGMSY on third and higher order and second born children. We find that relative to second born children the probability that a third born is vaccinated with *BCG* vaccine increases by 3.28 ppt because of the CCT. This is significant at the 10% level. It is possible that what the CCT could not achieve for the second born targeted child is achieved for untargeted children because of diffusion. In Table 2 from point estimates, the targeted children had a statistically significant negative coefficient. Also, *BCG* had a positive, but insignificant coefficient in Table 3, these combined could be because of some positive spillover. In terms of *OPV 3*, from table 2 and 3 the point estimates were positive

and in Table 3 it was significant. Combining these it might be possible that there is some spillover in *OPV 3* as well.

Table 4: Differential impact of IGMSY on exposed households

	(1) BCG	(2) DPT 3	(3) OPV 3	(4) Measles	(5) Complete
Exposed HH x Pilot x Third Order	0.0328*	0.00749	0.0337	-0.00306	-0.00271
	(0.0167)	(0.0225)	(0.0240)	(0.0217)	(0.0250)
Observations	146684	146684	146684	146684	146684
Mean of Dep. Variable	0.865	0.667	0.618	0.658	0.469
SD	0.342	0.471	0.486	0.474	0.499
State FE	Yes	Yes	Yes	Yes	Yes
Birth Year FE	Yes	Yes	Yes	Yes	Yes
Sample restriction	Full Sample	Full Sample	Full Sample	Full Sample	Full Sample

Standard errors in parentheses

Note: The outcome variables, BCG and Measles taking the value 1 if the child received the respective vaccine and 0 otherwise. DPT 3 and OPV 3 taking the value 1 if the child received the third dose of the respective vaccine and 0 otherwise. Complete takes the value 1 if all the 4 vaccines have been received and 0 otherwise. Exposed HH takes the value 1 if the child belongs to a family that has had at least one first or second born in or after 2012, which means at least one of the siblings were exposed to the program. It takes the value 0 if no first or second born in the family was born after 2012. Pilot takes the value 1 for 52 pilot districts and 0 for all other districts. ThirdSibling takes the value 1 if the child is of third and higher order born and 0 if they are the second born. We control for the sex of the child, birth order, mother's age, mother education level, marital status, dummy for rural, dummy for lower caste, 6 categories of religion, wealth index and as village level controls, proportion of children who received postnatal and antenatal care in the village. We include state and birth year fixed effects and cluster the standard errors within districts.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The coefficients on other vaccines are insignificant, implying that there has been no spillover in terms of DPT 3 and Measles vaccination as there is no statistically significant difference between second and third born children. Given that our first regression found no treatment effect on the targeted children, this is to say that neither is there any effect on the untargeted. Hence, there has been no spillover in DPT 3 and Measles.

5.1 Channel

The hypothesized spillover effect can come about through two channels, namely behavioural change, or the income channel. The CCT incentivizes the increased vaccination rate of the targeted children, but the effect also diffuses to the untargeted younger siblings. One of the conditions for the transfer is to attend a minimum of 4 nutritional and health counseling sessions.

Mothers are made aware about the value of immunization which will make them willingly choose to immunize their children even without incentives. As Von & Klonner suggests, those parents were more likely to make use of medical facilities because of the CCT.[22] This additionally is likely to translate to improvements in the outcomes of the third and higher order children as well, as the mothers are already frequenting the health facilities. As discussed earlier, intervention in the parenting of firstborn children, leads to improved intake of vegetables in the second born[23]. Similar diffusion is documented by Seitz and Apfel (1994) which suggests that positive parental changes can contribute to indirect effects through diffusion of the effect to all the children of a parent.[24]

A second conjectured channel is an income channel. If the finding by Von & Klonner that women seek health facilities more frequently because of the CCT is true, then this could translate to better health outcomes of the family.[25] This could improve the ability to work and thus affect income positively. Thereby, the higher order children could be exposed to better family conditions thus leading to an increase in the immunization. When families move out of straightened circumstances, they would be more able to focus on the health needs of the child, like immunization, than when in dire situations. Study by Adebowale et al. in Nigeria confirms this channel by finding that child immunization is higher among rich than poor women.[26]

Furthermore, the beneficiaries received a sum of Rs 4000 until 2013 and Rs 6000 after 2013. Although this might seem too little to be saved and preserved for the future, if those families were on the threshold of poverty trap, even this small amount could help them escape the trap and increase income. Evidence from Bangladesh revealed that those with very low assets

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[22] PaulaVon Haaren, & Stefan Klonner, "Lessons learned? Intended and unintended effects of India's second-generation maternal cash transfer scheme", *Health Economics (United Kingdom)*, *30*(10) (2021), accessed December, 2020, https://doi.org/10.1002/hec.4390

[23] Carla F Ruggiero, Emily E Hohman, Leann. L Birch, Ian M Paul, & Jennifer S Savage, "The Intervention Nurses Start Infants Growing on Healthy Trajectories (INSIGHT) responsive parenting intervention for firstborns impacts feeding of second born", *American Journal of Clinical Nutrition*, *111*(1) (2020), accessed December, 2020, https://doi.org/10.1093/ajcn/nqz277

[24]Victoria Seitz, & Nancy H. Apfel, "Parent-focused Intervention: Diffusion Effects on Siblings", *Child Development*, *65*(2) (1994), accessed December, 2020, https://doi.org/10.1111/j.1467-8624.1994.tb00776.x

[25] PaulaVon Haaren, & Stefan Klonner, "Lessons learned? Intended and unintended effects of India's second-generation maternal cash transfer scheme", *Health Economics (United Kingdom)*, *30*(10) (2021), accessed December, 2020, https://doi.org/10.1002/hec.4390

[26] Ayo Adebowale, Taiwo Obembe, & Eniola Bamgboye, "Relationship between household wealth and childhood immunization in core-North Nigeria". *African Health Sciences*, *19*(1) (2019), accessed December, 2020, https://doi.org/10.4314/ahs.v19i1.33

at baseline could not benefit from the transfer of livestock and escape poverty trap. Those who were beyond the threshold yet poor could transition to productive occupations and rise consumption, relative to those below.[27] The increased income could affect children even through this mechanism. We nevertheless cannot identify which of the mechanism is driving the result.

5.2 Heterogeneity

In order to evaluate the heterogenous impact of the program, we look at how the impact is different for rich and the poor people. We define poor to be a dummy which takes the value 1 if the wealth index of the family lies in the bottom 49.23%, which is to say they are the categorized poorest or poor based on their wealth index. It takes the value 0 they lie above the median value and are regarded as rich. We estimate the same three equations again by imposing a sample restriction and looking at impact on the rich and poor separately. The sample means for the poor children indicated on table 5[28] shows clearly that the poor children have a lower chance of being vaccinated as compared to children from rich families. However, given that none of the coefficients are significant, which is consistent with the previous results we can say that IGMSY has had null effect on the targeted children, for those of birth order 2 or below. Nevertheless, it is interesting to observe that the poor children have positive coefficients on all, but *BCG* as opposed to the rich who have a positive coefficient only for *Measles*, signaling benefit for the poor most.

Turning to the spillover effect, table 6 presents the results of the effect of the CCT on exposed households for third and higher order children separately for the rich and poor. While none of the coefficients for the poor children were significant though they are positive, for the rich we see that the probability that the untargeted siblings from rich families receive *OPV 3* increases by 6.48 percentage points as a result of the program relative to their counterparts in the control districts. This result is statistically significant at the 5% level, which means that there could have been a spillover, which is why the third order children exposed to the program through their siblings are different from those not. Here we see spillover in rich families but not in poor families.

[27] Clare Balboni, Oriana Bandiera, Robin Burgess, Maitreesh Ghatak, & Anton Heil, ”Why Do People Stay Poor”? *The Quarterly Journal of Economics* (2021), accessed December, 2020, https://doi.org/doi.org/10.1093/qje/qjab045
[28] Tables 5-7 are in the Appendix.

Finally, in table 7 we look at the differential impact of IGMSY on third and higher order and second born children. As was the case before, the significant improvement in BCG vaccination is driven by the impact on poor families where we find that relative to second born children the probability that a third born is vaccinated with *BCG* vaccine increases by 5.86 percentage points as a result of the CCT in poor households. This is statistically significant at the 5 % level and thus we can say that there could have been some positive externality on BCG vaccine in poor households, which however IGMSY could not achieve in the targeted children. *BCG* had a positive, but insignificant coefficients in table 2 and table 3 and these results could be because of some positive spillover in the poor families.

5.3 Parallel Trends

We test parallel trends assumption by taking a fake intervention period as 1998. Using the NFHS round 2 data conducted in the year 1998-1999 we repeat the same analysis using this data. Data on 20 of the 52 pilot districts is not available in the NFHS 2 which is a major difference as opposed to NFHS 4. Table 8 is a test for the parallel trends assumption corresponding to Table 2. Firstly, none of the coefficients are positive statistically significant. However, Measles vaccination has a negative significant coefficient which fails to satisfy our parallel trends assumption. Nevertheless, since it is negative, it means that the exposed group has a lower probability of receiving the vaccination. So, it was not a pre-positive trend that existed earlier which is being reflected now. In Tables 9 and 10, we still see no significant coefficients, therefore, pre-trends are not a major concern, and the parallel trends assumption holds.

Table 8: Parallel trends test: Effect of IGMSY on exposed cohorts born before 1999 and birth order less than or equal to 2

	(1)	(2)	(3)	(4)	(5)
	BCG	DPT 3	OPV 3	Measles	Complete
Exposed Cohort x Pilot	-0.0228	-0.00473	0.00186	-0.00625	0.00789
	(0.0181)	(0.0189)	(0.0234)	(0.0245)	(0.0257)
Observations	20371	20362	20369	20372	20372
Mean of Dep. Variable	0.795	0.607	0.609	0.495	0.403
SD	0.404	0.488	0.488	0.500	0.491
State FE	Yes	Yes	Yes	Yes	Yes
Birth Year FE	Yes	Yes	Yes	Yes	Yes
Sample restriction	Full Sample	Full Sample	Full Sample	Full Sample	Full Sample

Standard errors in parentheses

Note: The outcome variables, BCG and Measles taking the value 1 if the child received the respective vaccine and 0 otherwise. DPT 3 and OPV 3 taking the value 1 if the child received the third dose of the respective vaccine and 0 otherwise. Complete takes the value 1 if all the 4 vaccines have been received and 0 otherwise. Exposed Cohort takes the value 1 if the child was born in or after 1998 and 0 if earlier. Pilot takes the value 1 for 32 pilot districts and 0 for all other districts. We control for the sex of the child, birth order, mother's age, mother education level, marital status, dummy for rural, dummy for lower caste, 6 categories of religion, wealth index and as village level controls, proportion of children who received postnatal and antenatal care in the village. We include state and birth year fixed effects and cluster the standard errors within districts.

$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

Table 9: Parallel trends test: Effect of IGMSY on exposed households for third and higher order children

	(1)	(2)	(3)	(4)	(5)
	BCG	DPT 3	OPV 3	Measles	Complete
Exposed HH x Pilot	-0.0161	-0.0295	0.0113	-0.172*	-0.0512
	(0.0994)	(0.113)	(0.111)	(0.104)	(0.104)
Observations	19298	19292	19294	19293	19300
Mean of Dep. Variable	0.593	0.392	0.448	0.323	0.238
SD	0.491	0.488	0.497	0.468	0.426
State FE	Yes	Yes	Yes	Yes	Yes
Birth Year FE	Yes	Yes	Yes	Yes	Yes
Sample restriction	Full Sample	Full Sample	Full Sample	Full Sample	Full Sample

Standard errors in parentheses

Note: The outcome variables, BCG and Measles taking the value 1 if the child received the respective vaccine and 0 otherwise. DPT 3 and OPV 3 taking the value 1 if the child received the third dose of the respective vaccine and 0 otherwise. Complete takes the value 1 if all the 4 vaccines have been received and 0 otherwise. Exposed HH takes the value 1 if the child belongs to a family that has had at least one first or second born in or after 1998, which means at least one of the siblings were exposed to the program. It takes the value 0 if no first or second born in the family was born after 1998. Pilot takes the value 1 for 32 pilot districts and 0 for all other districts. We control for the sex of the child, birth order, mother's age, mother education level, marital status, dummy for rural, dummy for lower caste, 6 categories of religion, wealth index and as village level controls, proportion of children who received postnatal and antenatal care in the village. We include state and birth year fixed effects and cluster the standard errors within districts. This specification is restricted to children of birth order above 2.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 10: Parallel trends test: Differential impact of IGMSY on exposed households

	(1) BCG	(2) DPT 3	(3) OPV 3	(4) Measles	(5) Complete
Exposed HH x Pilot x Third Order	0.00595	-0.0402	-0.0162	-0.174	-0.0746
	(0.103)	(0.117)	(0.113)	(0.120)	(0.121)
Observations	29976	29969	29971	29972	29979
Mean of Dep. Variable	0.656	0.458	0.498	0.378	0.289
SD	0.475	0.498	0.500	0.485	0.453
State FE	Yes	Yes	Yes	Yes	Yes
Birth Year FE	Yes	Yes	Yes	Yes	Yes
Sample restriction	Full Sample	Full Sample	Full Sample	Full Sample	Full Sample

Standard errors in parentheses

Note: The outcome variables, BCG and Measles taking the value 1 if the child received the respective vaccine and 0 otherwise. DPT 3 and OPV 3 taking the value 1 if the child received the third dose of the respective vaccine and 0 otherwise. Complete takes the value 1 if all the 4 vaccines have been received and 0 otherwise. Exposed HH takes the value 1 if the child belongs to a family that has had at least one first or second born in or after 1998, which means at least one of the siblings were exposed to the program. It takes the value 0 if no first or second born in the family was born after 1998. Pilot takes the value 1 for 32 pilot districts and 0 for all other districts. ThirdSibling takes the value 1 if the child is of third and higher order born and 0 if they are the second born. We control for the sex of the child, birth order, mother's age, mother education level, marital status, dummy for rural, dummy for lower caste, 6 categories of religion, wealth index and as village level controls, proportion of children who received postnatal and antenatal care in the village. We include state and birth year fixed effects and cluster the standard errors within districts.

$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

We repeat the same parallel trends assumption check on the heterogeneity test. The results are reported in Tables 11, 12 and 13 (which can be found in the Appendix). We see that in the case of children from poor families, there is a clear pre-trend. But as was the case before, the coefficients are negative and statistically significant. This leads to the conclusion that the exposed group has a lower probability of receiving the vaccination for children from poor families. Therefore, we can once again confirm that it was not a pre-positive trend that existed which is being reflected now.

6. Conclusion

The IGMSY was introduced mainly to encourage behavioural practices that are beneficial to the child and the mother both in short and long term. However, after conducting a causal analysis, it was found that this scheme was able to induce a long-term behavioural change only for *BCG* and *OPV 3*. The complete vaccination stage is not impacted. This shows how money motivates a

certain action and the inability of CCT to promote behavioural change including make parents internalize the benefits of vaccination.

Our work is not without its limitations. When testing the validity of the parallel trends assumptions, we encounter data related limitations. We compute the wealth index in NFHS 2 due to inability merge the wealth index file provided by DHS. Secondly, NFHS 2 does not cover all the 640 districts that are considered in NFHS 4. Firstly in 2001 there were only 585 districts in total and secondly, NFHS 2 did not collect data from all districts and the sample for state is small, thus making the estimates for individual districts of any state less reliable (NFHS-2 1999). This can affect the validity of the parallel trends assumption.

After accounting for the said drawbacks, future studies can focus on other aspects that this scheme impacts. Disadvantaged groups—children female and low caste—might be benefited most from the impact of the program. The well-off group is likely to be availing these services even in the absence of an incentive. For instance, son-preference leads to poor health outcomes of daughters who are neglected. Such an incentive can benefit those on the margin more significantly. Moreover, the scheme ensures that under-supply of services like immunization does not occur, therefore there can also be an increase in health care use in general regardless of the transfer. These areas can be explored in greater detail and studied further.

The findings that emerge from this study show evidence of some spillover although insufficient behavioural change is also evident. With further analysis on the most impacted group, the pan-India project should expend funds in the right direction through appropriate measures that will foster behavioural change. It is now imperative to speed up the development in terms of child immunization and for long-term sustainability.

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Appendix

Table A1: Effect of IGMSY on exposed cohorts born before 2013 and birth order less than or equal to 2

	(1)	(2)	(3)	(4)	(5)
	DPT 1	DPT 2	OPV 0	OPV 1	OPV 2
Exposed Cohort # Pilot	-0.00774	0.00124	-0.0108	-0.00136	0.00143
	(0.0106)	(0.0111)	(0.0116)	(0.00852)	(0.0104)
Observations	92008	92008	92008	92008	92008
Mean of Dep. Variable	0.886	0.853	0.749	0.889	0.849
SD	0.318	0.354	0.434	0.314	0.358
State FE	Yes	Yes	Yes	Yes	Yes
Birth Year FE	Yes	Yes	Yes	Yes	Yes
Sample restriction	Full Sample	Full Sample	Full Sample	Full Sample	Full Sample

Standard errors in parentheses

Note: The outcome variables DPT 1, 2 and OPV 0, 1 and 2 take the value 1 if the child received the 0^{th}, first and second dose of the respective vaccine and 0 otherwise. Exposed Cohort takes the value 1 if the child was born in or after 2012 and 0 if earlier. Pilot takes the value 1 for 52 pilot districts and 0 for all other districts. We control for

the sex of the child, birth order, mother's age, mother education level, marital status, dummy for rural, dummy for lower caste, 6 categories of religion, wealth index and as village level controls, proportion of children who received postnatal and antenatal care in the village. We include state and birth year fixed effects and cluster the standard errors within districts.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A2: Effect of IGMSY on exposed households for third and higher order children

	(1)	(2)	(3)	(4)	(5)
	DPT 1	DPT 2	OPV 0	OPV 1	OPV 2
Exposed HH x Pilot	0.00534	0.00787	0.0224	0.0205	0.0348*
	(0.0237)	(0.0276)	(0.0156)	(0.0172)	(0.0193)
Observations	75445	75445	75445	75445	75445
Mean of Dep. Variable	0.778	0.716	0.634	0.807	0.736
SD	0.415	0.451	0.482	0.395	0.441
State FE	Yes	Yes	Yes	Yes	Yes
Birth Year FE	Yes	Yes	Yes	Yes	Yes
Sample restriction	Full Sample	Full Sample	Full Sample	Full Sample	Full Sample

Standard errors in parentheses

Note: The outcome variables DPT 1, 2 and OPV 0, 1 and 2 take the value 1 if the child received the 0^{th}, first and second dose of the respective vaccine and 0 otherwise. Exposed HH takes the value 1 if the child belongs to a family that has had at least one first or second born in or after 2012, which means at least one of the siblings were exposed to the program. It takes the value 0 if no first or second born in the family was born after 2012. Pilot takes the value 1 for 52 pilot districts and 0 for all other districts. We control for the sex of the child, birth order, mother's age, mother education level, marital status, dummy for rural, dummy for lower caste, 6 categories of religion, wealth index and as village level controls, proportion of children who received postnatal and antenatal care in the village. We include state and birth year fixed

effects and cluster the standard errors within districts. This specification is restricted to children of birth order above 2.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Heterogeneity by Wealth- Effect of IGMSY on exposed cohorts born before 2013 and birth order less than or equal to 2

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	BCG	DPT 3	OPV 3	Measles	Complete	BCG	DPT 3	OPV 3	Measles	Complete
Exposed Cohort x Pilot	-0.00810	0.0189	0.0176	0.0103	0.0342	-0.00770	-0.00751	-0.0100	0.000605	-0.0160
	(0.0142)	(0.0212)	(0.0194)	(0.0184)	(0.0211)	(0.00740)	(0.0121)	(0.0155)	(0.0131)	(0.0189)
Observations	37964	37964	37964	37964	37964	54043	54043	54043	54043	54043
Mean of Dep. Variable	0.875	0.729	0.655	0.785	0.546	0.929	0.833	0.744	0.871	0.664
SD	0.331	0.445	0.475	0.411	0.498	0.258	0.373	0.436	0.335	0.472
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Sample restriction	Poor	Poor	Poor	Poor	Poor	Rich	Rich	Rich	Rich	Rich

Standard errors in parentheses

Note: The outcome variables, BCG and Measles taking the value 1 if the child received the respective vaccine and 0 otherwise. DPT 3 and OPV 3 taking the value 1 if the child received the third dose of the respective vaccine and 0 otherwise. Complete takes the value 1 if all the 4 vaccines have been received and 0 otherwise. Exposed Cohort takes the value 1 if the child was born in or after 2012 and 0 if earlier. Pilot takes the value 1 for 52 pilot districts and 0 for all other districts. We control for the sex of the child, birth order, mother's age, mother education level, marital status, dummy for rural, dummy for lower caste, 6 categories of religion, wealth index and as village level controls, proportion of children who received postnatal and antenatal care in the village. We include state and birth year fixed effects and cluster the standard errors within districts.

$p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Heterogeneity by Wealth- Effect of IGMSY on exposed households for third and higher order children

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	BCG	DPT 3	OPV 3	Measles	Complete	BCG	DPT 3	OPV 3	Measles	Complete
Exposed HH x Pilot	0.0213	0.0184	0.0149	0.0247	-0.00540	0.00995	0.0129	0.0648**	-0.0417	-0.0228
	(0.0254)	(0.0266)	(0.0241)	(0.0268)	(0.0248)	(0.0188)	(0.0313)	(0.0311)	(0.0300)	(0.0316)
Observations	49398	49398	49398	49398	49398	26044	26044	26044	26044	26044
Mean of Dep. Variable	0.809	0.589	0.557	0.597	0.400	0.879	0.689	0.642	0.677	0.493
SD	0.393	0.492	0.497	0.491	0.490	0.326	0.463	0.479	0.468	0.500
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sample restriction	Poor	Poor	Poor	Poor	Poor	Rich	Rich	Rich	Rich	Rich

Standard errors in parentheses

Note: The outcome variables, BCG and Measles taking the value 1 if the child received the respective vaccine and 0 otherwise. DPT 3 and OPV 3 taking the value 1 if the child received the third dose of the respective vaccine and 0 otherwise. Complete takes the value 1 if all the 4 vaccines have been received and 0 otherwise. Exposed HH takes the value 1 if the child belongs to a family that has had at least one first or second born in or after 2012, which means at least one of the siblings were exposed to the program. It takes the value 0 if no first or second born in the family was born after 2012. Pilot takes the value 1 for 52 pilot districts and 0 for all other districts. We control for the sex of the child, birth order, mother's age, mother education level, marital status, dummy for rural, dummy for lower caste, 6 categories of religion, wealth index and as village level controls, proportion of children who received postnatal and antenatal care in the village. We include state and birth year fixed effects and cluster the standard errors within districts. This specification is restricted to children of birth order above 2.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Heterogeneity by Wealth- Differential impact of IGMSY on exposed households

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	BCG	DPT 3	OPV 3	Measles	Complete	BCG	DPT 3	OPV 3	Measles	Complete
Exposed HH x Pilot x Third Order	0.0586**	0.00904	0.0263	0.0261	0.00526	0.00797	-0.000878	0.0509	-0.0462	-0.0174
	(0.0288)	(0.0345)	(0.0325)	(0.0305)	(0.0352)	(0.0214)	(0.0307)	(0.0309)	(0.0291)	(0.0307)
Observations	80929	80929	80929	80929	80929	65754	65754	65754	65754	65754
Mean of Dep. Variable	0.831	0.616	0.575	0.619	0.421	0.906	0.730	0.672	0.707	0.529
SD	0.375	0.486	0.494	0.486	0.494	0.292	0.444	0.469	0.455	0.499
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sample restriction	Poor	Poor	Poor	Poor	Poor	Rich	Rich	Rich	Rich	Rich

Standard errors in parentheses

Note: The outcome variables, BCG and Measles taking the value 1 if the child received the respective vaccine and 0 otherwise. DPT 3 and OPV 3 taking the value 1 if the child received the third dose of the respective vaccine and 0 otherwise. Complete takes the value 1 if all the 4 vaccines have been received and 0 otherwise. Exposed HH takes the value 1 if the child belongs to a family that has had at least one first or second born in or after 2012, which means at least one of the siblings were exposed to the program. It takes the value 0 if no first or second born in the family was born after 2012. Pilot takes the value 1 for 52 pilot districts and 0 for all other districts. ThirdSibling takes the value 1 if the child is of third and higher order born and 0 if they are the second born. We control for the sex of the child, birth order, mother's age, mother education level, marital status, dummy for rural, dummy for lower caste, 6 categories of religion, wealth index and as village level controls, proportion of children who received postnatal and antenatal care in the village. We include state and birth year fixed effects and cluster the standard errors within districts.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 11: Parallel trends test: Heterogeneity by Wealth- Effect of IGMSY on exposed cohorts born before 1998 and birth order less than or equal to 2

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	BCG	DPT 3	OPV 3	Measles	Complete	BCG	DPT 3	OPV 3	Measles	Complete
Exposed Cohort x Pilot	-0.0185	0.0245	-0.0116	0.0317	0.0226	-0.0287	-0.0269	0.00358	-0.0372	-0.00967
	(0.0363)	(0.0324)	(0.0360)	(0.0416)	(0.0384)	(0.0224)	(0.0284)	(0.0307)	(0.0241)	(0.0239)
Observations	6431	6430	6431	6432	6432	13940	13932	13938	13940	13940
Mean of Dep. Variable	0.630	0.430	0.477	0.341	0.265	0.871	0.689	0.670	0.567	0.467
SD	0.483	0.495	0.500	0.474	0.442	0.335	0.463	0.470	0.496	0.499
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Sample restriction	Poor	Poor	Poor	Poor	Poor	Rich	Rich	Rich	Rich	Rich

Standard errors in parentheses

Note: The outcome variables, BCG and Measles taking the value 1 if the child received the respective vaccine and 0 otherwise. DPT 3 and OPV 3 taking the value 1 if the child received the third dose of the respective vaccine and 0 otherwise. Complete takes the value 1 if all the 4 vaccines have been received and 0 otherwise. Exposed Cohort takes the value 1 if the child was born in or after 1998 and 0 if earlier. Pilot takes the value 1 for 32 pilot districts and 0 for all other districts. We control for the sex of the child, birth order, mother's age, mother education level, marital status, dummy for rural, dummy for lower caste, 6 categories of religion, wealth index and as village level controls, proportion of children who received postnatal and antenatal care in the village. We include state and birth year fixed effects and cluster the standard errors within districts.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 12: Parallel trends test: Heterogeneity by Wealth- Effect of IGMSY on exposed households for third and higher order children

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	BCG	DPT 3	OPV 3	Measles	Complete	BCG	DPT 3	OPV 3	Measles	Complete
Exposed HH x Pilot	-0.304	-0.375***	-0.347***	-0.216***	-0.127**	0.0970	0.120	0.162	-0.151	-0.00440
	(0.199)	(0.0828)	(0.0698)	(0.0706)	(0.0567)	(0.121)	(0.147)	(0.139)	(0.141)	(0.142)
Observations	10233	10232	10231	10231	10235	9065	9060	9063	9062	9065
Mean of Dep. Variable	0.480	0.291	0.372	0.224	0.155	0.720	0.507	0.534	0.436	0.332
SD	0.500	0.454	0.483	0.417	0.362	0.449	0.500	0.499	0.496	0.471
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sample restriction	Poor	Poor	Poor	Poor	Poor	Rich	Rich	Rich	Rich	Rich

Standard errors in parentheses

Note: The outcome variables, BCG and Measles taking the value 1 if the child received the respective vaccine and 0 otherwise. DPT 3 and OPV 3 taking the value 1 if the child received the third dose of the respective vaccine and 0 otherwise. Complete takes the value 1 if all the 4 vaccines have been received and 0 otherwise. Exposed HH takes the value 1 if the child belongs to a family that has had at least one first or second born in or after 1998, which means at least one of the siblings were exposed to the program. It takes the value 0 if no first or second born in the family was born after 1998. Pilot takes the value 1 for 32 pilot districts and 0 for all other districts. We control for the sex of the child, birth order, mother's age, mother education level, marital status, dummy for rural, dummy for lower caste, 6 categories of religion, wealth index and as village level controls, proportion of children who received postnatal and antenatal care in the village. We include state and birth year fixed effects and cluster the standard errors within districts. This specification is restricted to children of birth order above 2.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 13: Parallel trends test: Heterogeneity by Wealth- Differential impact of IGMSY on exposed households

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	BCG	DPT 3	OPV 3	Measles	Complete	BCG	DPT 3	OPV 3	Measles	Complete
Exposed HH x Pilot x Third Order	-0.276	-0.440***	-0.343***	-0.266***	-0.198***	0.116	0.145	0.116	-0.124	-0.00347
	(0.184)	(0.0901)	(0.0924)	(0.0900)	(0.0743)	(0.130)	(0.155)	(0.145)	(0.162)	(0.165)
Observations	13948	13947	13947	13947	13951	16028	16022	16024	16025	16028
Mean of Dep. Variable	0.514	0.323	0.397	0.251	0.181	0.779	0.576	0.586	0.487	0.383
SD	0.500	0.468	0.489	0.434	0.385	0.415	0.494	0.493	0.500	0.486
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sample restriction	Poor	Poor	Poor	Poor	Poor	Rich	Rich	Rich	Rich	Rich

Standard errors in parentheses

Note: The outcome variables, BCG and Measles taking the value 1 if the child received the respective vaccine and 0 otherwise. DPT 3 and OPV 3 taking the value 1 if the child received the third dose of the respective vaccine and 0 otherwise. Complete takes the value 1 if all the 4 vaccines have been received and 0 otherwise. Exposed HH takes the value 1 if the child belongs to a family that has had at least one first or second born in or after 1998, which means at least one of the siblings were exposed to the program. It takes the value 0 if no first or second born in the family was born after 1998. Pilot takes the value 1 for 32 pilot districts and 0 for all other districts. ThirdSibling takes the value 1 if the child is of third and higher order born and 0 if they are the second born. We control for the sex of the child, birth order, mother's age, mother education level, marital status, dummy for rural, dummy for lower caste, 6 categories of religion, wealth index and as village level controls, proportion of children who received postnatal and antenatal care in the village. We include state and birth year fixed effects and cluster the standard errors within districts.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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