Journal of Health Economics 30 (2011) 843–857

Contents lists available at ScienceDirect

Journal of Health Economics

journal homepage: www.elsevier.com/locate/econbase

The impact of Chernobyl on health and labour market performance

Hartmut Lehmann[a], Jonathan Wadsworth[b,*]

[a] Department of Economics, University of Bologna, IZA, Bonn; and DIW, Berlin, Germany
[b] Royal Holloway College, University of London, Egham, Centre for Economic Performance at the London School of Economics, CReAM and IZA, Bonn, Germany

ARTICLE INFO

Article history:
Received 28 June 2010
Received in revised form 30 June 2011
Accepted 13 July 2011
Available online 23 July 2011

JEL classification:
H00
J00

Keywords:
Chernobyl
Health
Labour Market performance

ABSTRACT

Using longitudinal data from Ukraine we examine the extent of any long-lasting effects of exposure to the Chernobyl disaster on the health and labour market performance of the adult workforce. Variation in the local area level of radiation fallout from the Chernobyl accident is considered as a random exogenous shock with which to try to establish its causal impact on poor health, labour force participation, hours worked and wages. There appears to be a significant positive association between local area-level radiation dosage and perception of poor health, though much weaker associations between local area-level dosage and other specific self-reported health conditions. There is also some evidence to suggest that those who lived in areas more exposed to Chernobyl-induced radiation have significantly lower levels of labour market performance 20 years on.

1. Introduction

On 26 April 1986, engineers at the Chernobyl[1] nuclear power plant in Ukraine began a series of tests on one of the reactors that lead to the world's worst civil nuclear disaster. The amount of radiation released as a result of the accident was far in excess of that released from the air bursts of the Hiroshima or Nagasaki atomic bombs, hitherto the focus of much research and knowledge about the effects of radiation fallout. Yet, while much has been written, and argued, about the medical and physical consequences of Chernobyl[2], less attention has been given to the social and economic consequences of the disaster, despite recent urgings along this line from the United Nations (UNDP, 2002). Fears of the consequences of a nuclear accident have surfaced again recently given the explosion and meltdown at the Fukushima nuclear power plant in Japan, following the 2011 earthquake and tsunami. While there are movements in many industrialised countries toward building a new generation of nuclear power facilities, some countries like Germany and Italy in response to Fukushima have decided to abandon nuclear energy production.[3] Given this heightened awareness of security, economic and health issues associated with nuclear energy, it seems timely and relevant to acquire knowledge of any long-term economic effects of such rare, low frequency events as an accident in a nuclear power plant.

Understanding the link between environmental shocks, health and economic performance and establishing an appropriate policy response is also helpful. Faced with a large-scale accident, state resources are almost certainly diverted away from other programmes in order to deal with the immediate consequences of the disaster and this may affect the future pattern of development and growth, even if mitigated by international aid. Equally, the subsequent performance of individuals may have been impaired directly in some way by the disaster. Investigating the relationship between this, health and economic performance then helps illuminate the costs of the accident.

There is also a growing literature concerned with the long-term consequences of environmental shocks on later health and other economic outcomes, summarised recently in Almond (2006) or Maccini and Yang (2009). The Chernobyl accident raises the issues of long latency of certain radiation-related conditions and poten-

* Corresponding author at: Economics Department, Royal Holloway College, University of London, Egham TW20 0EX, United Kingdom.
E-mail address: j.wadsworth@rhul.ac.uk (J. Wadsworth).

[1] "Chornobyl" in Ukrainian. Throughout the paper we employ the Russian transliteration "Chernobyl" since this form is predominantly used in the literature.

[2] For example, Chernobyl Forum (2005) puts the total number of cancer related deaths at 4000. Greenpeace (2006) cites a figure of around 90,000 cancer related deaths with an additional 100,000 from other radiation-related illnesses.

[3] The German government has tabled a law aimed at closing down all nuclear power plants by 2022. The Italian public in a recent referendum overwhelmingly reaffirmed its desire to do without nuclear power.

0167-6296/$ – see front matter © 2011 Elsevier B.V. All rights reserved.
doi:10.1016/j.jhealeco.2011.07.011

tial "at-risk" populations that can only be observed with data taken some years after the initial event. Health has also long been considered to be a potentially significant determinant of labour market outcomes, such as wages, hours of work and employment,[4] with much of the literature being concerned with the difficulty of establishing a causal link between health and performance.

In what follows, we examine the relationship between exposure to radiation as a result of the Chernobyl accident and both subsequent health and economic performance some 20 years later using longitudinal data on a representative sample of working age individuals from Ukraine. Since the intensity of radiation fallout was rather randomly distributed across Ukraine, given the prevailing wind patterns at the time and the fact that mobility was strictly controlled under the Soviet Union, we treat radiation exposure as an exogenous shock and look whether there is any association between the level of radiation dosage in the local area of residence at the time of the disaster and a variety of self-reported health and labour market measures some 17 years or more after the event.

One important existing study uses a similar exogenous source of environmental variation to identify causal effects. Almond et al. (2009) use regional variation in Chernobyl-related radiation dosage across Sweden to look at the differences in school outcomes at age 18, identifying an effect through differential exposure to the fallout of those who were *in utero* at the time of the accident. They find evidence indicating that cognitive ability of those *in utero* subject to higher doses of radiation may have been impaired as a result.

Our study takes individual-level longitudinal data to look for evidence of radiation associated longer-term effects on a variety of *health* and labour market outcomes across all ages living in the country at the source of the accident, where, arguably, awareness and the environmental legacy were most profound and where relatively high radiation levels affected a larger share of the population than any other country with the possible exception of Belarus. More than half of Ukrainian adults still appears to be concerned over the consequences of this event.[5] One in six prime-age Ukrainian adults also report being in poor health, a much higher figure than comparable estimates from many western industrialised countries.[6] Indeed, as Rahu (2003) notes, while the long latency period of many radiation-related illnesses means that it is important to take a long-run view of the consequences of the accident, equally Soviet secrecy about it and the lack of general awareness of the effects of radiation created a fertile ground for persistent fears and rumours attributing any health problem to Chernobyl. So perceptions may also have changed as a result of the accident. As such this paper can be seen as an attempt to identify a causal effect of the accident on both health outcomes and health perceptions while widening the study of Chernobyl's effect to other economic issues.

Unlike other related studies, we have access to longitudinal data on individuals that can facilitate identification of any causal examination of the effects of early shocks on later socio-economic achievement. Ukraine is fortunate in this regard since there is a panel data set, the Ukrainian Longitudinal Monitor Survey (ULMS), which has self-reported health and socio-economic data for a representative sample of individuals at, currently, three points in time, 2003, 2004 and 2007, which also allow us to establish the place of residence of respondents at the time of the Chernobyl accident. Since radiation dosage differed across local areas, we use this area variation as part of the identification process. The set of covariates allow us to control for a set of possible observable confounders. The longitudinal nature of the data allows us to control for unobserveable characteristics.

Other studies have looked at longer-term direct effects of environmental shocks on individual economic performance. Almond (2006) exploits the 1918 influenza epidemic to examine long run consequences for individual educational attainment and labour market performance using US census data. Meng and Qian (2006) and Chen and Zhou (2007) both use regional level variation in the 1959–61 Great Famine in China as an exogenous shock to identify different health effects on individual economic performance. Miguel and Roland (2006) look at how variation in area-level bombing in the Vietnam war, using distance from the 17th parallel as an instrument for the intensity of bombing, affected area-level consumption, literacy and economic performance 30 years on. Concerns over the exogeneity of any shock have been addressed by others analysing different events. Chay and Greenstone (2003) use the recession-induced variation in area level pollutants to try to identify the effects on child mortality. Maccini and Yang (2009) look at the consequences of geographical variation in early-life rainfall on the subsequent health and educational attainment of individuals across Indonesian birth cohorts.

One advantage of our approach is that we have information on an individual's settlement of residence in Ukraine around the time of the accident. There are no national surveys of individual measures of radiation dosage received, either perceived or realised, but it is possible to assign a settlement-level radiation dosage, based on monitoring data conducted by the authorities at the time of the accident and subsequently compiled by the European Commission (1998). We map this area-level radiation data to individual data to establish the association between dosage and the subsequent health of the adult workforce.

There was widespread variation in the amount of radiation areas received. Some areas in Ukraine received little more radiation then normal background levels, while other areas received more than ten times radiation than usual. The first step is to establish whether there is a link between local area level radiation dose received and the list of illnesses recorded in the ULMS. The second step is to see whether the radiation dose itself is associated with other observable socio-economic outcomes over the next 20 years. Finally we discuss whether local area level radiation dosage can be considered as an instrument for the effect of health on a range of labour market and income generating outcomes that are important for daily life in Ukraine. It has long been known that OLS estimation of the effects of poor health on economic performance would tend to be biased down if there is a negative correlation between unobservables that determine productivity at work and poor health.[7] Strauss and Thomas (1998) suggested that local environmental conditions can act as a potential instrument for health, since conditional on health, individual productivity and performance should not be affected by environmental conditions.

Our results show that there is a significant positive effect of residence in radiation affected areas at the time of the accident and self-assessed poor health. Adults living in areas considered to have received sufficiently high radiation fallout as to be monitored are up to 13 percentage points more likely to report being in poor health. However, there is a less obvious manifestation of such an

[4] See the references in Currie (2009), Lleras-Muney (2005), Currie and Madrian (1999), Strauss and Thomas (1998), Kahn (1998).

[5] The Ukrainian Longitudinal Monitoring Survey data used in this study show that in 2003, 58 percent of adults in the sample believed that their health or that of a family member had been affected by Chernobyl.

[6] Subject to the concerns that ordered responses on health questions may differ across populations (e.g. Lindeboom and van Doorslaer, 2004), the US National Health Interview Survey suggests that 3% of individuals aged 16 and over reported their health as "poor" in 2006. The 2006 Health Survey for England gives an estimate of 5%.

[7] This would be offset somewhat by any measurement error in the measure of health.