HEALTH AND QUALITY IN WORK

Impact of Macroeconomic Factors on Mortality in Europe and the OECD

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Executive Summary

Study aims

The general purpose of this study was to determine whether measures of the "quality of working life" give us appropriate indications of the physical and mental health of working populations in European and other industrialised countries.

Much of the work of this study included a substantial review of the epidemiological literature pertaining to risks which bear on physical and emotional health of workers. This yielded a number of outstanding risk factors, including (1) failure to modernise (i.e., inconsistent with scientific evidence) ergonomics, equipment, physical plant and emissions control technology, so as to minimise accidental injury and disability, and chemical and other toxins and carcinogens; (2) lack of worker autonomy (including very minimal control of the work process and insufficient intellectual complexity of tasks); (3) lack of adherence to standard health and safety regulations as might occur in shadow economy employment; (4) major disruption of career, including unemployment, income loss, and underemployment; and (5) wage and job status differentials that segregate employees by factors that may not be associated with productivity – namely, gender and age. The last topic is often referred to in the economic literature under the heading of economic inequality.

Methods

Having identified traditional individual-level epidemiologic risk factors to health, the question became whether such measures, seen in the behaviour of individuals and firms, could also be measured at the macro or national level of societal functioning. Four such macroeconomic factors were identified: real GDP per capita, proportion of the working population that are self-employed, relative size of the shadow economy in ratio to the GDP, and the extent of income inequality as judged by the Gini index of income concentration.

The research issue was whether these macroeconomic factors, occasionally supplemented by more traditional epidemiological risk factors, could account for levels and changes in mortality rates for major causes of death in samples of European, other OECD and even larger numbers of countries. Data are extracted from the databanks of Eurostat, WHO, ILO, World Bank, and FAO. Multi-variable cross-sectional regression, pooled cross-sectional time-series and time-series analyses were used for statistical data analysis.

Main findings

The main findings of this study represent four discoveries.

1. Most prominent is that the size of the real GDP per capita is the most important factor in distinguishing national mortality rates, in working-age populations of industrialised countries. This discovery is not only important because of its predictive power. Its newness relates to the fact that, while it is generally accepted that national wealth per capita is important to the health of developing country populations, there is hardly any

indication in the epidemiological literature that enhanced GDP per capita would improve the health of industrialised societies. Indeed, the consensus of the literature is that, after a certain minimal threshold of per capita income (affecting nutrition, sanitation, housing, transportation, primary health care), the effect of increased economic growth has no additional beneficial impact on survival rates in industrialised nations. The evidence of this study is that these mainstream assumptions are fundamentally in error.

2. While worker autonomy has been a principal theme in the epidemiological literature on occupational stress, this study notes for the first time, that, when self-employment (or small firm employment) is taken as a national indicator, it has an important effect on mortality reduction.

3. While economists have generally felt that employment in the shadow economy deprives the government of taxes, it is seen to add to workers' income and to national wealth. It is clear, however, from this study that the magnitude of the shadow economy has a substantial damaging impact on the health of working age populations.

4. The debate over the potential impact of income inequality on national health levels has been very intense over the past two decades. The most recent epidemiological evidence has tended to show that the influence of the Gini index may be minimal, if it exists at all. The present study, in contrast, shows that income inequality is indeed damaging to working-age population health, but is particularly intense for males under 45 and female populations at all ages.

Specific findings

1. The principal model with four variables, real GDP per capita, self-employment, shadow economy and income inequality account for approximately 80 percent of the variance in age-adjusted mortality among 31 Western and Eastern European and other OECD countries. Accounting for other major epidemiological risk factors, such as per capita alcohol and carbohydrate consumption can raise the explained variance to around 90 percent.

2. GDP per capita in purchasing power parity is clearly the most important factor in explaining differential mortality rates. This can be seen, on a cross-sectional basis among all study samples (24, 31, 38 and 46 countries), total mortality and virtually all major causes of death. The great explanatory strength for mortality in the 15-64 group can also be seen dramatically in time-series analysis. Graphically presented regression models show the extremely consistent inverse relationship between the trend in GDP per capita and that in 15-64 age-adjusted mortality for all European countries. Indeed, where GDP growth trends have been relatively absent, such as in Poland and Hungary, there is also an absence of decline in age-adjusted mortality.

3. In addition, time-series models of the effect of historical changes in GDP per capita have been developed, using the Error-Correction Method, for the G7 countries (Canada, France, (West) Germany, Italy, Japan, United Kingdom, United States). These models show that the impact of GDP per capita is moderated, over time, in an interactive relation with the size of the unemployment rate.

4. The economic models were successfully tested in total age-adjusted mortality for the 15-64 population and an additional nine specific causes of death: cardiovascular, malignancies, total accidents, non-motor-vehicle accidents, motor-vehicle accidents, accidental poisoning, cirrhosis of liver, suicide and homicide.

Methodological and policy implications

1. It is feasible to identify macroeconomic indicators at the national level which can be used to describe several of the main factors which predict mortality rates in the working-age population in European countries and the remainder of the OECD.

2. While, to a large extent, it is feasible to utilise mortality rates, including by major causes of death, as measures of population health (or damage to health) associated with the economic environment, it is not yet feasible to utilise measures of the incidence or prevalence of disease or disability for these purposes.

3. Given the importance of the four main macroeconomic variables in mortality prediction, systematic attempts to evaluate the efficacy of legislative health and safety standards for national populations, must in some manner, control, adjust, or otherwise account for the effects of GDP per capita, employee autonomy, shadow economy activity and wage/status inequality.

4. Since GDP per capita is the main predictor of health (via low mortality rates) in the working population, it is evident that the European Commission is correct in emphasising international economic competitiveness, with an eye toward improved GDP per capita as a principal policy goal. This study indicates that this economic policy goal is also intrinsic to the improvement of health.

5. This study provides additional evidence that employee autonomy, the presence of relatively small firms and entrepreneurship should be encouraged in the early 21st Century economy. It is a key factor in predicting improvements in national health.

6. The shadow economy is not only a problem because it deprives governments of revenue required to support education, health care and social welfare. In itself, the extent of the shadow economy, with its lack of health and safety standards, appears to have a pronounced effect on diminishing the health of working people. National health policy would thus require efforts to minimise the size of this portion of the national economy.

7. The international epidemiological debate over whether income inequality has a damaging effect on population health is, to some degree, resolved by the data of this study. It has been found that particularly among younger males (under 45) and females of all ages, that income inequality, measured by the Gini index, is an important factor in increasing their mortality rates. The importance of the Gini index is not seen when one looks at total mortality ages 15-64, largely because males in the ages of 45-54 and 55-64, with relatively high mortality, do not display this relationship. This “uncovering” of the importance of income inequality of younger men and all age-groups of women points to the potential importance of policy action to minimise wage and job status differentials based solely on the grounds of gender and age.

According to the study, the strongest influences on the health of employees concern economic development (which positively influences the economic and technological capacity of firms to implement high standards of health and safety policies), minimization of bureaucratic control and the shadow economy and reductions of major sources of income inequality.

Countries show various standards in their respective health and safety policies and have different means of financing the implementation and monitoring thereof. In order to derive conclusions on the effectiveness of different approaches to occupational health and safety policies, further research is recommended to analyse the impact of (properly enforced) health and safety policies on employee longevity in the context of specific economic and cultural changes.

Synthèse

Objectifs de l'étude

L'objectif principal de cette étude était de déterminer si l'évaluation de la « qualité de vie au travail » nous donne des indications appropriées sur la santé physique et mentale des populations actives en Europe et dans d'autres pays industrialisés.

L'examen approfondi de la littérature épidémiologique relative aux risques encourus par la santé physique et mentale des travailleurs, constitue l'essentiel du travail de cette étude. Plusieurs facteurs de risque marquants se dégagent de cet examen dont (1) l'incapacité à moderniser (c'est-à-dire en contradiction avec la preuve scientifique) l'ergonomie, l'équipement, les installations matérielles et la technologie de contrôle des émissions, afin de minimiser les blessures accidentelles, l'invalidité, les toxines chimiques et autres ainsi que les facteurs cancérigènes ; (2) le manque d'autonomie des travailleurs (y compris un contrôle tout à fait minime du processus de travail et une complexité intellectuelle insuffisante des tâches) ; (3) le manque d'observation des réglementations en matière de santé et de sécurité tel qu'il peut se produire dans les emplois de l'économie souterraine ; (4) des fractures majeures dans le déroulement de carrière, y compris le chômage, la perte de revenus, et le sous-emploi ; et (5) des hiérarchies salariales et des différences de statut d'emploi qui catégorisent les employés selon des facteurs qui peuvent ne pas être associés à la productivité, à savoir le sexe et l'âge. En littérature économique, il est souvent fait référence à ce dernier point sous le terme d'inégalités économiques.

Méthodes

Ayant identifié les facteurs de risque épidémiologiques traditionnels pour la santé au niveau individuel, la question s'est alors posée de savoir si de telles mesures, effectuées sur le comportement des individus et des entreprises pouvaient également être appliquées à un niveau plus global ou national du fonctionnement sociétal. Quatre de ces facteurs macroéconomiques ont été identifiés : le PIB réel par habitant, la proportion de travailleurs indépendants dans la population active, la part relative de l'économie souterraine dans le PIB, et l'ampleur des inégalités salariales calculées par rapport à l'indice de Gini de concentration des revenus.

L'objet de la recherche était de déterminer si ces facteurs macroéconomiques, accompagnés occasionnellement de facteurs de risque épidémiologiques plus traditionnels, pouvaient expliquer les niveaux et les modifications des taux de mortalité dûs aux causes principales de décès dans des échantillons de pays européens, d'autres pays de l'OCDE et même dans un plus grand nombre de pays. Les données ont été extraites des banques de données d'Eurostat, de l'OMS, du BIT, de la Banque mondiale et de la FAO. Pour l'analyse des données statistiques, des analyses de régression multi-variables transversales, des analyses de séries chronologiques transversales combinées et des analyses chronologiques ont été utilisées.

Résultats principaux

Les résultats principaux de cette étude s'articulent en quatre découvertes:

1. La plus frappante est que le niveau du PIB réel par habitant est le facteur le plus important pour distinguer les taux de mortalité nationaux parmi les populations actives des pays industrialisés. Cette découverte n'est pas uniquement importante du fait de son pouvoir de prévision. Sa nouveauté est liée au fait que, alors qu'il est généralement admis que la santé publique par habitant est importante pour la santé des populations des pays en voie de développement, il n'existe que de rares indications en littérature épidémiologique qui mettent en avant le fait que le PIB par habitant pourrait améliorer la santé dans les sociétés industrialisées. En effet, il est admis dans la littérature que, dès qu'un certain seuil minimal de revenus par habitant (touchant l'alimentation, le système sanitaire, le logement, les transports, les soins de santé primaires) est franchi, les effets d'une croissance économique accrue n'ont pas de répercussions bénéfiques supplémentaires sur les taux de survie dans les nations industrialisées. Cette étude prouve que ces hypothèses dominantes sont foncièrement erronées.

2. Alors que l'autonomie des travailleurs a été l'un des thèmes principaux dans la littérature épidémiologique sur le stress occupationnel, cette étude note pour la première fois que lorsque le travail indépendant (ou le travail dans une petite entreprise) est pris comme indicateur national, il a un effet important sur la réduction de la mortalité.

3. Alors qu'en général, les économistes ont l'impression que le travail dans l'économie souterraine prive le gouvernement de revenus fiscaux, il semble être un plus pour les revenus des travailleurs et la prospérité nationale. Il est toutefois clair, sur la base de cette étude, que l'ampleur de l'économie souterraine a un impact préjudiciable substantiel sur la santé des populations en âge de travailler.

4. Au cours des deux dernières décennies, le débat sur l'impact potentiel des inégalités de revenus sur les niveaux de santé publique a été très intense. La preuve épidémiologique la plus récente tend à montrer que l'influence de l'indice de Gini peut être minime voire inexistante. Par contraste, l'étude actuelle montre que les inégalités de revenus sont effectivement nuisibles à la santé de la population en âge de travailler, mais qu'elles le sont tout particulièrement pour les hommes de moins de 45 ans et les femmes de tous âges.

Résultats particuliers

1. Le modèle principal a quatre variables: le PIB réel par habitant, le travail indépendant, l'économie souterraine et les inégalités de revenus sont responsables de près de 80% des variations de la mortalité ajustées par âge dans les 31 pays de l'Europe de l'Est et de l'Ouest ainsi que dans d'autres pays de l'OCDE. Quant aux trois autres principaux facteurs de risques épidémiologiques, tels que la consommation d'alcool et de glucides par habitant, ils peuvent augmenter les variations expliquées de près de 90%.

2. Le PIB par habitant dans la parité de pouvoir d'achat est clairement le facteur le plus important pour expliquer les variations de taux de mortalité. On peut le constater sur une

base transversale dans tous les échantillons de l'étude (24, 31, 38 et 46 pays), la mortalité totale et virtuellement toutes les causes principales de décès. La grande force explicative de la mortalité dans le groupe des 15 à 64 ans peut également être visualisée clairement dans l'analyse chronologique. Les modèles de régression représentés graphiquement, illustrent la relation inverse extrêmement constante entre le PIB par habitant et la mortalité ajustée par âge chez les 15 à 64 ans dans tous les pays européens. En effet, là où les tendances croissantes de PIB ont été relativement absentes, comme en Pologne ou en Hongrie, il n'y a pas de déclin de la mortalité ajustée par âge.

3. De plus, des modèles chronologiques portant sur l'effet des changements historiques sur le PIB par habitant ont été développés, en utilisant une méthode de correction des erreurs, pour les pays du G7 (Canada, France, Allemagne (de l'Ouest), Italie, Japon, Royaume-Uni, Etats-Unis). Ces modèles montrent que l'impact du PIB par habitant est modéré dans le temps, dans une relation interactive avec le niveau du taux de chômage.

4. Les modèles économiques ont été testés avec succès sur la mortalité ajustée totale par âge pour la population des 15 à 64 ans ainsi que neuf causes de décès spécifiques supplémentaires : origine cardiovasculaire, cancers, totalité des accidents, accidents hors circulation, accidents de la circulation, empoisonnement accidentel, cirrhose du foie, suicide et homicide.

Implications méthodologiques et politiques

1. Au niveau national, des indicateurs macroéconomiques peuvent être identifiés pour décrire plusieurs facteurs principaux de prévision des taux de mortalité dans la population en âge de travailler dans les pays européens et dans le reste de l'OCDE.

2. Alors qu'il est possible dans une large mesure d'utiliser les taux de mortalité, incluant les causes principales de décès, comme mesure de la mortalité de la population (ou des dommages à la santé) associée à l'environnement économique, il n'est cependant pas possible d'utiliser des mesures de l'incidence ou de la prévalence de maladies ou de handicaps dans ce but.

3. Etant donné l'importance des quatre principales variables macroéconomiques dans la prévision de la mortalité, des tentatives systématiques d'évaluation de l'efficacité des normes législatives de santé et de sécurité pour les populations nationales doivent d'une certaine façon contrôler, ajuster ou prendre en compte les effets du PIB par habitant, de l'autonomie des employés, des activités économiques souterraines et des inégalités de salaires et de statuts.

4. Le PIB par habitant étant le principal facteur de prévision de santé (par le biais des taux de mortalité bas) dans la population active, il va de soi que la Commission européenne ait raison de mettre l'accent sur la compétitivité économique internationale, en se fixant comme objectif politique principal l'amélioration du PIB par habitant. Cette étude montre que cet objectif politique économique est également un facteur intrinsèque de l'amélioration de la santé.

5. Cette étude fournit une preuve supplémentaire que l'autonomie des employés, la présence d'entreprises relativement petites et l'entreprenariat devraient être encouragés dans l'économie du 21ème siècle. C'est un facteur essentiel pour la prévision de l'amélioration de la santé publique.

6. L'économie souterraine n'est pas un problème uniquement parce qu'elle prive les gouvernements de revenus nécessaires pour subvenir à l'éducation, aux soins de santé et à l'aide sociale. En soi, l'ampleur de l'économie souterraine, avec ses lacunes en termes de normes de santé et de sécurité, semble avoir un effet marqué sur la baisse de l'état de santé des personnes actives. Ainsi, une politique de santé publique devrait s'efforcer d'en minimiser la part dans l'économie nationale.

7. Le débat international épidémiologique sur l'effet néfaste des inégalités salariales pour la santé de la population est clos, dans une certaine mesure, par les données de cette étude. Il a été démontré que, particulièrement parmi les hommes jeunes (moins de 45 ans) et les femmes de tous âges, les inégalités salariales, mesurées par l'indice de Gini, sont un facteur important d'augmentation du taux de mortalité. L'importance de l'indice de Gini n'est pas notable lorsque l'on observe la mortalité totale des 15 à 64 ans, essentiellement parce que les hommes de 45 à 54 ans et de 55 à 64 ans, avec leur taux de mortalité relativement élevé, n'illustrent pas cette relation. Cette « découverte » de l'importance de l'inégalité de revenus des jeunes hommes et des femmes de tous les groupes d'âge, met en évidence l'importance potentielle de l'action politique pour minimiser les différences de statut salarial et d'emploi basées uniquement sur des motivations de sexe et d'âge.

Selon l'étude, les plus fortes influences sur la santé des employés sont exercées par le développement économique (qui influence de manière positive la capacité économique et technologique des entreprises à mettre en œuvre des normes élevées de politiques de santé et de sécurité), la minimisation du contrôle bureaucratique ainsi que sur l'économie souterraine et la réduction des sources principales d'inégalité salariale.

Les pays ont différentes normes dans leurs politiques de santé et de sécurité respectives et ils ont différents moyens de mise en œuvre financière et de contrôle de ces politiques. Afin de tirer des conclusions sur l'efficacité des différentes approches de politiques de santé au travail et de sécurité, d'autres recherches seraient souhaitables pour analyser l'impact des politiques de santé et de sécurité (correctement mises en œuvre) sur la longévité des employés dans le contexte de changements économiques et culturels spécifiques.

Zusammenfassung und Bemerkungen

Ziele der Studie

Das allgemeine Ziel dieser Studie war es festzustellen, ob Messungen der Qualität des Arbeitslebens uns entsprechende Hinweise auf die körperliche und geistige Gesundheit der arbeitenden Bevölkerung in den europäischen und anderen Industriestaaten geben.

Ein Großteil der Arbeit dieser Studie umfasste eine wesentliche Evaluation der epidemiologischen Literatur über Risiken, die die körperliche und seelische Gesundheit von Arbeitnehmern betreffen. Diese Evaluation ergab eine Anzahl von auffallenden Risikofaktoren, darunter die Unterlassung der Modernisierung (d.h. unvereinbar mit wissenschaftlichen Belegen) der Ergonomie, der Büroausstattung, der Anlagen- und Emissionskontrollentechnologie zur Verringerung der Gefahr von Verletzungen und Behinderungen, sowie von chemischen und anderen Toxinen und Karzinogenen; (2) Mangel an Autonomie der Arbeitnehmer (einschließlich einer sehr kleinen Kontrolle der Arbeitsabläufe und einer unzulänglichen Anzahl von Aufgaben von intellektueller Komplexität); (3) mangelnde Befolgung von allgemeinen Gesundheits- und Sicherheitsvorschriften, wie es in der Beschäftigung im Rahmen der Schattenwirtschaft vorkommen könnte; (4) eine bedeutende Unterbrechung der Karriere, einschließlich Arbeitslosigkeit, Einkommensverlust und Unterbeschäftigung, und (5) Lohn- und Statusunterschiede, die die Arbeitnehmer durch Faktoren isolieren, die nicht unbedingt etwas mit Produktivität zu tun haben – nämlich Geschlecht und Alter. Auf das letzte Thema wird in der Wirtschaftsliteratur oft unter der Überschrift der wirtschaftlichen Ungleichheit verwiesen.

Methoden

Nachdem die üblichen individuellen epidemiologischen Risikofaktoren in Bezug auf die Gesundheit identifiziert worden waren, kam die Frage auf, ob solche Größen, die man in dem Verhalten von Einzelpersonen und Firmen festgestellt hat, auch auf der Makro- oder nationalen Ebene des gesellschaftlichen Miteinanders gemessen werden können. Es wurden vier solcher makroökonomischen Faktoren identifiziert: das reale Pro-Kopf-Bruttoinlandsprodukt, der Anteil der arbeitenden Bevölkerung, die selbstständig tätig ist, die relative Größe der Schattenwirtschaft im Verhältnis zum BIP, sowie das Ausmaß der Einkommensungleichheit gemessen durch den Ginikoeffizienten im Bezug auf die Einkommenskonzentration.

Gegenstand der Untersuchung war, ob diese makroökonomischen Faktoren, gelegentlich ergänzt durch weitere herkömmliche epidemiologische Risikofaktoren, für die Höhe und Abweichungen der Sterberaten in Bezug auf die Haupttodesursachen, gemessen an ausgewählten Ländergruppen aus den europäischen, anderen OECD- und auch weiteren Ländern, verantwortlich sein können. Die Daten stammen aus den Datenbanken von Eurostat, der WHO, der ILO, der Weltbank und der FAO. Die statistische Datenanalyse erfolgte unter Verwendung von multiplen Querschnittsregressionen, gepoolten Querschnitts- und Zeitreihenregressionen und Zeitreihenanalysen.

Hauptergebnisse

Die Hauptergebnisse dieser Studie bestehen aus vier Entdeckungen.

1. Die markanteste Entdeckung ist, dass die Höhe des realen Pro-Kopf-BIP der wichtigste Faktor bei der Unterscheidung von nationalen Sterberaten in Bezug auf die Bevölkerung im arbeitsfähigen Alter der Industrieländer ist. Diese Entdeckung ist nicht nur wegen ihrer Voraussagekraft wichtig. Die Neuheit liegt darin, dass es in der epidemiologischen Literatur kaum einen Hinweis darauf gibt, dass ein erhöhtes Pro-Kopf-BIP die Gesundheit der Gesellschaften in den Industrieländern verbessern würde, wogegen es allgemein bekannt ist, dass das Pro-Kopf-Volksvermögen wichtig für die Gesundheit der Bevölkerung in den Entwicklungsländern ist. In der Tat stimmt die Literatur dahingehend überein, dass, nachdem ein Minimumschwellenwert des Pro-Kopf-Einkommens erreicht wurde (mit Auswirkungen auf die Ernährung, die Hygiene, das Wohnen, das Transportwesen und die medizinische Grundversorgung), die Ergebnisse eines höheren Wirtschaftswachstums keinerlei zusätzliche nutzbringende Auswirkungen auf die statistischen Überlebensraten in den Industriestaaten hat. Diese Studie beweist, dass diese Annahmen im Wesentlichen falsch sind.

2. Obwohl die Autonomie des Arbeitnehmers eines der Hauptthemen in der epidemiologischen Literatur in Bezug auf Stress im Berufsleben ist, hat diese Studie zum ersten Mal festgestellt, dass, wenn die Selbstständigkeit (oder eine Anstellung in einer kleinen Firma) als nationaler Indikator genommen wird, sie eine große Auswirkung auf die Verringerung der Mortalitätsrate hat.

3. Während Wirtschaftswissenschaftler im Allgemeinen davon ausgehen, dass eine Anstellung in der Schattenwirtschaft der Regierung Steuern vorenthält, so verschafft sie den Arbeitnehmern dennoch ein Einkommen und trägt damit auch zum Volksvermögen bei. Diese Studie zeigt dennoch klar auf, dass das Ausmaß der Schattenwirtschaft schädigende Auswirkungen auf die Gesundheit der Bevölkerung im arbeitsfähigen Alter hat.

4. In den letzten zwei Jahrzehnten wurden die möglichen Auswirkungen der Einkommensungleichheit auf den nationalen Gesundheitszustand intensiv diskutiert. Der jüngste epidemiologische Beleg versuchte aufzuzeigen, dass der Einfluss des Ginikoeffizienten, wenn überhaupt, minimal ist. Im Gegensatz dazu zeigt diese Studie auf, dass die Einkommensungleichheit tatsächlich schädigende Auswirkungen auf die Gesundheit der Bevölkerung im arbeitsfähigen Alter hat. Besonders schädigend wirkt sie sich auf die Gesundheit der männlichen Bevölkerung unter 45 und auf die weibliche Bevölkerung in allen Altersgruppen aus.

Spezifische Ergebnisse

1. Das Hauptmodell mit den vier Variablen reales Pro-Kopf-BIP, Selbstständigkeit, Schattenwirtschaft und Einkommensungleichheit erklärt ungefähr 80 Prozent der Varianz in der altersbereinigten Mortalitätsrate in 31 west- und osteuropäischen und anderen OECD-Ländern. Die erklärte Varianz kann auf ungefähr 90 Prozent steigen, wenn man

andere wichtige epidemiologische Risikofaktoren wie z.B. den Pro-Kopf-Alkohol- und Kohlenhydratkonsum mit berücksichtigt.

2. Das Pro-Kopf-BIP, ausgedrückt in Kaufkraftparitäten, ist definitiv der wichtigste Faktor, um die unterschiedlichen Mortalitätsraten zu erklären. Das kann auf einer Querschnittsbasis für alle Beispiele dieser Studie (24, 31, 38 und 46 Länder) festgestellt werden und zwar in Bezug auf die Gesamtmortalität und nahezu alle Haupttodesursachen. Die bedeutende Erklärungskraft für die Mortalitätsrate in der Altersgruppe der 15-64-jährigen kann auch sehr gut anhand der Zeitreihenanalyse festgestellt werden. Grafisch dargestellte Regressionsmodelle zeigen sehr konsistent die umgekehrte Beziehung zwischen der Entwicklung des Pro-Kopf-BIP und der Entwicklung der altersbereinigten Mortalität der Altersgruppe der 15 bis 64-jährigen in allen europäischen Ländern. In der Tat gibt es in Ländern, wie z.B. Polen und Ungarn, in denen kaum eine Wachstumstendenz des BIP vorhanden ist, auch kaum eine Abnahme der altersbereinigten Mortalitätsrate.

3. Des Weiteren wurden Zeitreihenmodelle über die Auswirkungen von geschichtlichen Veränderungen des Pro-Kopf-BIP unter Verwendung der Fehlerkorrekturmethode für die G7-Staaten (Kanada, Frankreich, (West) Deutschland, Italien, Japan, das Vereinigte Königreich, die Vereinigten Staaten) entwickelt. Diese Modelle zeigen, dass die Auswirkungen des Pro-Kopf-BIP mittelmäßig sind, aber in interaktiver Beziehung mit der Höhe der Arbeitslosenquote stehen.

4. Die Wirtschaftsmodelle wurden erfolgreich in Bezug auf die altersbereinigte Gesamtmortalität für die Bevölkerungsgruppe der 15-64-jährigen überprüft, sowie unter Berücksichtigung von neun spezifischen Todesursachen: kardiovaskuläre Erkrankungen, bösartige Tumore, Gesamtanzahl der Unfälle, Nicht-Verkehrsunfälle, Verkehrsunfälle, unbeabsichtigte Vergiftungen, Leberzirrhose, Selbstmord und Mord.

Methodologische und politische Auswirkungen

1. Es ist möglich, makroökonomische Indikatoren auf nationaler Ebene zu identifizieren, die verwendet werden können, um einige der Hauptfaktoren zu beschreiben, die die Mortalitätsrate der Bevölkerung im arbeitsfähigen Alter in den europäischen Ländern und den restlichen OECD-Ländern voraussagen.

2. Obwohl es weitgehend möglich ist, Mortalitätsraten, unter Einbeziehung der Haupttodesursachen, als Maß für die Gesundheit einer Bevölkerung (oder für den Schaden, der der Gesundheit zugefügt wird) zu verwenden und dies auch in Verbindung mit dem wirtschaftlichen Umfeld, ist es noch nicht möglich die Inzidenz oder Prävalenz von Krankheiten oder Behinderungen zu diesem Zweck anzuwenden.

3. Angesichts der Wichtigkeit dieser vier makroökonomischen Variablen bezüglich der Vorhersage der Mortalitätsrate müssen systematische Versuche, die Wirksamkeit der gesetzlichen Gesundheits- und Sicherheitsstandards für nationale Bevölkerungen zu bewerten in gewisser Weise auch die Auswirkungen des Pro-Kopf-BIP, der Autonomie der Arbeitnehmer, der Aktivitäten der Schattenwirtschaft und der Lohn-/Statusungleichheit kontrollieren, anpassen oder anders berücksichtigen.

4. Da das Pro-Kopf-BIP die wichtigste Wirkungsvariable in Bezug auf Gesundheit (über niedrige Mortalitätsraten) der arbeitenden Bevölkerung ist, ist es offensichtlich, dass die Europäische Kommission Recht hat, auf die internationale wirtschaftliche Wettbewerbsfähigkeit Wert zu legen, und dies mit einem besondern Augenmerk auf ein verbessertes Pro-Kopf-BIP als politisches Hauptziel. Diese Studie zeigt, dass dieses wirtschaftspolitische Ziel wesentlich für die Verbesserung der Gesundheit ist.

5. Diese Studie liefert zusätzliche Beweise, dass die Autonomie der Arbeitnehmer, das Vorhandensein von relativ kleinen Firmen und Unternehmertum in der Wirtschaft des frühen 21. Jahrhunderts gefördert werden sollten. Dieses sind Schlüsselfaktoren in der Vorhersage einer Verbesserung im Bereich der nationalen Gesundheit.

6. Die Schattenwirtschaft ist nicht nur ein Problem, weil sie der Regierung Einkünfte vorenthält, die für die Unterstützung der Bildung, des Gesundheitswesens und der Sozialfürsorge wichtig sind. An sich scheint das Ausmaß der Schattenwirtschaft mit ihrem Mangel an Gesundheits- und Sicherheitsstandards die Gesundheit der arbeitenden Bevölkerung zu verschlechtern. Nationale Gesundheitspolitik macht Anstrengungen erforderlich den Anteil der Schattenwirtschaft an der nationalen Wirtschaft zu verringern.

7. Die internationale epidemiologische Diskussion über die Frage, ob die Einkommensungleichheit schädigende Auswirkungen auf die Gesundheit der Bevölkerung hat, wird bis zu einem bestimmten Ausmaß durch die Ergebnisse dieser Studie beantwortet. Es wurde herausgefunden, dass insbesondere unter jüngeren Männern (unter 45) und Frauen aller Altersgruppen die Einkommensungleichheit, gemessen am Ginikoeffizienten, ein wichtiger Faktor für den Anstieg ihrer Mortalitätsraten ist. Die Wichtigkeit des Ginikoeffizienten fällt nicht auf, wenn man sich die Gesamtmortalität für die Altersgruppe der 15-64-jährigen ansieht, hauptsächlich weil Männer zwischen 45-54 und 55-64 mit einer relativ hohen Mortalitätsrate diesen Bezug nicht zeigen. Diese “Aufdeckung” der Bedeutung der Einkommensungleichheit für jüngere Männer und Frauen aller Altersgruppen zeugt von der potentiellen Wichtigkeit politischer Maßnahmen, um die Unterschiede in Einkommen und Status, die nur auf Geschlecht und Alter basieren, zu minimieren.

Gemäß dieser Studie betreffen die stärksten Einflüsse auf die Gesundheit von Arbeitnehmern die wirtschaftliche Entwicklung (die das wirtschaftliche und technologische Vermögen von Firmen, hohe Gesundheitsstandards und Sicherheitspolitiken umzusetzen, positiv beeinflussen), die Minimierung der bürokratischen Kontrolle und der Schattenwirtschaft, sowie einer Reduzierung der Hauptquellen für Einkommensungleichheiten.

Die Länder haben verschiedene Standards in Bezug auf ihre Gesundheits- und Sicherheitspolitiken und haben unterschiedliche Möglichkeiten, deren Umsetzung und Überwachung zu finanzieren. Damit man Schlussfolgerungen über die Wirksamkeit der verschiedenen Vorgehensweisen in Bezug auf die Gesundheits- und Sicherheitspolitiken im Arbeitsleben ziehen kann, müssen weitere Forschungen betrieben werden, um den Einfluss der (richtig umgesetzten) Gesundheits- und Sicherheitspolitiken auf die Langlebigkeit des

Arbeitnehmers unter Berücksichtigung von spezifischen wirtschaftlichen und kulturellen Abweichungen zu analysieren.

Summary

Objective

The objective of this research has been to delineate and test an approach to occupational health that relies on macroeconomic and labour market indicators as principal determinants of the health and longevity of the working age populations in selected industrialised countries. These countries include the 15 “old” European Union member states, the 10 “new” member states, the 3 Candidate Countries of Bulgaria, Romania and Turkey and the 10 remaining OECD countries including the United States, Canada and Japan, as well as Australia and New Zealand. In addition, for more extensive testing of the main hypotheses, over a wider international range, we included several CIS countries including Russia, the Ukraine and Georgia in specified samples. To test the final limits of the generalisability of our model to all countries which possess the relevant data through international databanks, we explored the impact of the main economic indicators to mortality in 46 countries.

Principal occupational health outcomes

We have departed from the more traditional view of occupational health which classically includes “occupational” illnesses, diseases and mortality. These have conventionally involved work accidents, environmental toxins in the workplace and industrial diseases. We have taken the view in this study that all major health problems affecting the working-age population are potentially subject to industrial/occupational characteristics of work. These potential health outcomes, therefore, include not only work accidents and industrial toxins, but the entire range of work stress-related illnesses and sources of mortality. They concern especially work-related problems involving psychological stress and therefore, potentially, involve the principal chronic diseases, including the cardiovascular diseases and, theoretically, certain types of malignancy as well as liver cirrhosis. In addition, work-related psychological stress is understood to influence depression and aggressive mood, which can therefore deleteriously influence suicide, homicide, work accidents and motor-vehicle accidents.

When this project was initially proposed, the intention was to research the outcomes of ill health in the working-age population involving total mortality, cardiovascular illness and work accidents. As the project developed, it became clear that, theoretically, it would be important to examine other potentially serious work-related outcomes of psychological stress. Furthermore, after intensive study of the availability of non-fatal work-related accidents for European Union countries, it was found that it would not be possible to obtain a coherent set of data with consistent definitions of “reported” accidents. The decision was therefore to use only “hard” mortality data (i.e., no subjective health reports) in our multi-country analysis.

We have performed an extensive analysis of European Statistics on Accidents at Work (ESAW) and its United States counterpart occupational injury surveillance system, the US Census of Fatal Occupational Injuries (CFOI). The primary difficulty with the use of these databases for epidemiological analysis is that different countries use different financial and non-wage incentive systems in order to induce the injured to report their accidents. Thus,

while some consistency exists within the reporting systems of individual countries, it is not possible to assume that the data of different countries have a similar meaning (i.e., are “harmonised”). Further, we have evidence (see section 4: Accidents at Work) that the differential national incentive systems make for lack of comparability of accident/injury rates (including fatal accidents at work) among countries. We have therefore been unable to utilize accident morbidity data in the present analysis, yet we are very appreciative of the efforts of the principal statistical organizations like Eurostat in making considerable progress in harmonizing the country-specific data on accident morbidity and fatalities.

Our theoretical framework focussed on the risk factors that are potentially most important to the health of the working population. At the individual firm level, these substantially involved traditional matters of “safety” which include ergonomic (i.e., man-machine interaction) factors and the control of environmental, and especially chemical, toxins at the workplace. While the industrialised countries typically have developed very elaborate legal foundations for worker health and safety monitoring and controls, it is the implementation of those surveillance and control procedures which is equally critical. Implementation, moreover, requires the financial investment in ergonomically and toxicologically safe engineering procedures. This, in turn, is facilitated by a sufficiently robust economy that will help such investments to take place.

Further, it is important to recognise that the safety standards themselves are a by-product not only of government, industrial, union and scientific expert consensus, but also the development of occupational health sciences (especially epidemiological sciences) and their diffusion within the scientific, management and employee populations. The development and diffusion of such sciences again depend on investments in ‘human factors’ research, university and government research and research and development within industry. Such investments will, once again, require a sufficiently robust economy to enable such investments. Indeed, we can say that, overall, the modernisation of industry which is the basis of productivity, will, to a large extent, require enhanced health and safety standards. It can then be said that health and safety levels in the workplace are very largely a by-product of overall investment in the modernisation of industry and productivity enhancement.

At the same time, enhancement of equipment, the physical work environment and the structure of work procedures are not the only determinants of the health of employees. There is abundant evidence that work stress and the mental health of workers are of importance in determining their physiological health and proneness to the consequences of depression and frustration. The research literature describes the connection between work stress and cardiovascular disease as well as accidents and even damage to immune system functioning which has implications for the common infections of ‘colds’ and viruses. Moreover, psychological stress and depression arising from work are also known to increase levels of pathological use of tobacco and alcohol and possibly of high consumption of carbohydrates and fats as stress-coping devices. They also are known to increase the actual and subjective sense of fatigue which, in turn, tends to lead to diminution in mental concentration, exercise and mobility generally. These coping responses to stress, anxiety and depression resulting in elevated levels of consumption of tobacco, alcohol, carbohydrates, fats and reduction in exercise levels are, as is well known, major risk factors to the modern chronic diseases involving cardiovascular disturbances, diabetes, a variety of malignancies and cirrhosis of liver.

Tests of principal hypotheses

This study began with the idea of examining indicators of health across industrialized countries in relation to well established epidemiological risks, or predictors. The aim was to observe, first of all, whether the standard risks to damaged occupational health could be observed at the international level, and therefore be used to explain policy differences in the behaviour of nations, that would influence their occupational health levels. A related aim was to examine, specifically, to what degree standard macroeconomic and labour market policy indicators were related to significant occupational health risks and thus to national mortality differentials. At the individual level of epidemiological analysis, several types of risk factors have been identified: (1) socio-economic status, including educational level, occupational skill level and income level (2) extent of social relations, (3) socio-economic features of the workplace, including: extent of autonomy, or control, by employees over work processes; length of work time (including work-life balance), extent of remuneration, including wages and non-wage benefits, job stability, career continuity and development; (4) physical features of the workplace, including: ergonomics, health and safety hazards, temperature and overall climate control, (5) external factors of "lifestyle," including non-work stressors, high consumption of alcohol, tobacco and animal fats, and low exercise levels.

In this study, we attempted to model age-adjusted mortality rates for the major causes of death, as they vary among industrialized countries. This means, ideally, to try to include, in a single model, as many of the appropriate risk factors as would impinge on a given type of mortality (e.g. mortality due to industrial accidents) as it varies among countries.

Our principal methodology consisted of the use of standard multi-variable regression analysis including the use of a maximal group of epidemiological risk (and benefit) factors as joint predictors of (age-adjusted) mortality rate variation among countries for the years 1995-2000. Different groupings of countries were analysed in separate samples: (1) EU member states (including those in Eastern and Western Europe), (2) EU member states plus additional OECD countries, (3) EU member states plus additional OECD countries and several CIS countries. The resulting cross-sectional regression models were then further tested, where feasible with the use of pooled cross-sectional time-series techniques (involving random effects models). A second procedure involved standard time-series analysis of total and cardiovascular mortality among working populations in the seven largest economies. This procedure especially involved GDP per capita and the unemployment rate, as cumulative predictors over 0-10 years, of the age-adjusted mortality rates in each country.

Socio-economic variables that showed statistical significance in prediction of mortality rates included income and educational level (especially secondary-level education, but not a scaled version of occupational skill level). Higher income, wages and benefits were consistently associated with lower mortality rates for nearly all causes of death. Autonomy of worker status indicated by the extent of self-employment was also importantly related to lower mortality rates. Rates of alcohol consumption, tobacco consumption, carbohydrate and (occasionally) animal fat consumption were related to higher mortality rates (especially total, cardiovascular and malignancies), but were relatively minor contributors to the overall statistical explanation of variation in mortality rates for the majority of causes of death.

A principal aim of this research was to observe whether key macroeconomic and labour market factors were influential in explaining mortality variance across countries in the working population. Our study found that these factors were, in fact, the most important sources of mortality variation. An explanation of the potential effects on health of these major factors concerns much of the remainder of this report.

Principal macroeconomic risk factors

It is apparent that the key macroeconomic indicator which should theoretically influence health and safety monitoring and enforcement is GDP per capita. The reason is that per capita GDP measures overall national income and is thus the basis for potential financing by industry as a whole, specific firms and national governments of the development and diffusion of new technologies supporting employee health – and thus contributing to national productivity. As indicated above, equally important is the potential, via GDP growth, for investment in those sciences and education of the working population which will be the basis for sophisticated utilisation of more highly productive technology.

From the work-stress viewpoint, GDP per capita represents the capacity for employees to earn both direct incomes and non-wage benefits. The latter include unemployment insurance, health and disability insurance and pensions. The increase of GDP per capita points to the potential of the economy to increase social mobility and thus (1) not only elevate the social status of workers but, through that greater elevation of status, (2) provide further motivation and incentive for high productivity work and greater life satisfaction. With respect to income it should also be recalled that greater levels of economic resources permit individual employees to obtain goods and services in accordance with their life preferences which will depend on personal values. Moreover, increasing economic resources not only permit greater satisfaction with respect to an arbitrary set of preferences (on any particular occasion), but permit the individual greater advancement in those areas to which he or she has strong interests and is committed over the life course. Finally, in modern philosophy of ethics, individual happiness is not only dependent on daily pleasures and comforts, but on the achievement of the most important things in life, involving both career and family. It is clear that growth provides the basis for enhanced levels of achievement in most areas of human endeavour and also provides the increasing diversity of occupations in which individual workers can express their talents and commitments.

It can be successfully argued that not only are health and safety at work enhanced by economic growth, but the other principal areas of job quality, identified by the European Commission, are similarly enriched. These include (1) intrinsic job quality (including job satisfaction), (2) investment in skills, life-long learning and career development, (3) flexibility and security (including access to employment and social protection systems), (4) work organisation and work-life balance (including hours worked and the incorporation of family and leisure elements within employment policy), (5) diversity and non-discrimination based on increasing diversity of occupations in cosmopolitan/urban settings, and (6) overall work performance, especially emphasising labour productivity.

Clearly, GDP per capita is the outstanding factor that, theoretically, should influence overall quality of working life, as well as health and safety at work, in order to produce lower illness

and mortality rates among the working population in nearly all areas of physical and mental health and diminished mortality rates. This general hypothesis, though plausible and indeed logical, is not the reigning hypothesis in the social epidemiology of occupational health. Rather, over the last 15 years, the dominant thesis in research literature has been that to the extent that a country is characterised by high levels of income inequality, illness and mortality rates will be higher. Within this hypothetical framework the issue of overall GDP per capita and economic growth has been essentially discarded. The principal findings of this study, however, indicate that GDP per capita, and economic growth overall, are indeed the most important sources of the health of the working population.

The second most important factor that is found to beneficially influence mortality rates across countries among the working population is the extent to which there is self-employment (and additionally family employment) among the working population (in contrast to wage and salary employment). The principal literatures governing the original hypothesis are prominent within the management sciences, industrial psychology and sociology, as well as epidemiology. The key issue is autonomy of employees in comparison to their relative lack of authority in complex and large bureaucracies and hierarchies of work organisation. It is found that cardiovascular and mental health of individual workers tend to be increased as they have greater control over the work process. And recent studies at the individual level by the European Foundation for the Improvement of Living and Working Conditions separately point to greater job satisfaction on the part of self-employed workers (as independents or within small firms) as well as greater subjective health.

Despite considerable research showing the importance of autonomy to employee mental and physical health, we feel that this study's finding of the considerable importance of self-employment rates to national working population health is also an indicator of a more widespread societal phenomenon. One would expect that, since self-employment is relatively high among the agricultural populations, mortality would therefore be lower among agriculturalists. We find, nevertheless, that agricultural populations have distinctly high mortality rates as compared to occupations within the manufacturing and service sectors. It is therefore clear that the beneficial effect of self- and small-firm employment applies mainly to the service sector (since self-employment is more prevalent in this sector), and is especially prominent for employment in the professions, wholesale and retail trade, and hotels and restaurants. These latter occupations are most prevalent in the advanced tertiary sector, and particularly in highly developed urban settings. The beneficial health effects pertaining to self-employment are thus very probably a feature of late economic development most prevalent in the "information economy". This information economy has produced not only great increases in real per capita economic growth, but has made the value of education and human capital generally, considerably greater with the passage of time. There has, however, been a profound downside to the development of the services and especially information economy in comparison to the decline in manufacturing employment. That is, with the increase in productivity, economic growth over the last few decades has been associated with considerably slower growth in the production of jobs. This has meant, as in the phrase of the economist Schumpeter, heightened "creative destruction" of jobs and industries, and therefore greater recessional as well as technological unemployment. The unemployment aspects of this creative destruction and their deleterious effects on health have been

described in epidemiological literature and in macroeconomic studies produced by the European Commission (Brenner).

However, in the course of such structural changes, it appears that self-employment, despite decade-long trends of per capita decline, has now begun a resurgence in many countries. The reasons for these trends are multiple and complex. However, there is agreement in the literature and from the data of our study that work inactivity, and unemployment in particular, are predictors of increase in the rate of self-employment. Thus, together with the increases in the professional occupations, wholesale and retail trade, and hotel and restaurant employment, there seems to have been a considerable push into self-employment as a result of firms undergoing rapid structural change.

Self-employment has additionally tended to represent the most innovative and entrepreneurial sector of the labour force, often providing the inspirational prototypes for subsequent industrial development. The self-employed are additionally highly resilient and able to “reinvent” themselves in the face of recession and structural change, thus maintaining security for themselves and their small firms. There is also evidence that one of the areas of successful European Commission active labour market policy has been in the provision of incentives to former employees of larger firms to engage in self-employment. Overall, then, it seems evident that self-employment provides the gateway to heightened innovation and prototypical economic growth in economies where the dominant industries consist of complex hierarchical firms in which adjustment to technological change is difficult and often threatens the existence of the large firms themselves. This is not only an issue of globalisation – i.e., changes in international competition and international division of labour– but actual changes in the scientific basis of production, services provision and changes in the technological basis of the division of labour within firms.

The reason that we devote considerable time to this issue is not only that it is the central issue of competitiveness and industrial survival during our era. In addition, in accordance with the data of this study, it is second only to GDP per capita itself as the dominant issue in the health of working age populations across the industrialised world – for nearly every important cause of illness and mortality.

Self-employment as an indicator of autonomy and investment in the era of the advanced services economy

As indicated, the literature in epidemiology supports fundamental relationships between high illness and mortality rates, on the one hand, and both high stress levels and extensive hierarchical systems on the other. These literatures, as we have seen, tend to support our findings that self- and small-firm employment are conducive to higher levels of health and longevity in the working population. However, it is also possible that the “self-employment” variable, given its power to influence mortality across countries in the entire industrialized world, represents an “indicator” or “proxy” of a much larger international phenomenon that relates to the progressive sectoral development of national economies over their trajectory of long-term economic growth.

As is well known, the traditional distinctions among sectors, within economic development, are primary (largely, agricultural production), secondary (industrial-manufacturing), and

tertiary (dominated by services industries). There is evidence to indicate that the resurgence of self- and small-firm employment (and proportionately, of family-employment) are characteristic of late, or advanced tertiary sector development. In order to understand the economic and epidemiological meaning of employment in this most recently developed sector it is worthwhile to identify the literature that has made similar distinctions between 'industrial' and 'post-industrial' society.

The industrial or "Fordist" period (as certain French sociologists have described it) includes the following:

(a) Capital-intensive, large-scale plants

(b) An inflexible production process

(c) Rigid hierarchical and bureaucratic structures

(d) The use of semi-skilled labour performing repetitive and routine tasks, often subject to the discipline of 'scientific management'

(e) A tendency toward strong unionisation and the vulnerability of production to industrial action

(f) The protection of national markets

While these innovations began in the interwar period with the production of cars in the United States, the general methods were rapidly employed in other sectors of manufacturing and were increasingly seen as the organizational basis on which the advanced economies could continue to develop and, especially after World War II, prosper. It should also be noted that industrialization-based ideas of scale, centrality of control, standardization and mass consumption not only influenced the agenda of capitalist production, but also underpinned the nature of soviet industrialization and the creation and delivery of welfare services in the free-market democracies.

Post-industrial society (and to a large extent 'Post-Fordism') refers to the new economic possibilities opened up by the rise of microchip technology, computers and robotics in the production and exchange of information and commodities. In contrast to the industrial society, the distinguishing feature of the post-industrial era is usually held to be the foundation of smaller units of enterprise, catering to segmented markets by the flexible production of specialized goods or services.

Associated social and economic changes involved in the post-industrial transition are:

(a) The decline of old manufacturing and smoke stack industries, together with the emergence of the so-called sunrise computer-based enterprises;

(b) More flexible, decentralized forms of the labour process and of work organization;

(c) A reorganized labour market into a skill-flexible core of employees and a time-flexible periphery of low-paid insecure workers performing contract labour;

(d) A consequent decline of the traditional, unionised blue-collar working class, and the pre-eminence within the occupational structure, of white collar, professional, technical, managerial, and other service-sector employees;

(e) The feminisation of many service occupations affected by the new technology;

(f) The promotion of types of consumption around the concept of individually chosen lifestyles, with an emphasis, therefore, on taste, distinctiveness, packaging, and appearance;

(g) The dominance and autonomy of multinational corporations in a global process of capitalist production;

(h) A new international division of labour, based on the new flexibility, within which global production can be organized;

For the purposes of our study the key occupational groups which are associated with self and small-firm employment are those that involve the professional, technical, managerial, and retail sales groups. On the other hand, it is not correct to say that the "post-industrial" service economy ceases to involve classic bureaucracies. Indeed, the great majority of service work, often directly connected with industrial production, involves the office work (components of 'white collar' work). Among students of the post-industrial transformation, it is a standard observation that modern, computerized office work is highly standardized – indeed, standardized as fully as the more traditional work in industrial production – both of which are heavily controlled by machine operations. And there is, furthermore, in epidemiological literature focusing on work stress, an identification of computer-based office work as classically tied to lack of autonomy as has been true of traditional industrial production systems.

Self-and small firm employment, since the 1980's, in advanced industrialized societies, can be seen as representing the advanced tertiary sector. These forms of employment, most specifically, point to the importance of innovation and entrepreneurship. Such innovation is the ultimate basis for economic growth, and it is typically the individual-based and smaller firms in which initial sources of innovation are developed. Such firms, if very successful, either tend to grow in size or to ally themselves with existing industry—or ultimately to be absorbed by existing industry (via mergers and acquisitions). In these ways, the emergence of the individual–based and small firm enterprises, constitute the engines of economic growth that are ultimately an intrinsic part of larger industrial structures. Interestingly enough, the emergence of individual-based and small firms requires relatively prosperous national economic conditions. The reason for this is that both sufficient investment for the emergence of such firms needs to be present and consumers need to be sufficiently solvent and optimistic to enlarge, or at least maintain, the consumption levels that will support the viability of such firms. We can therefore conceptualise the individual-based and small firm in the late 20th and early 21st centuries as signifying relatively prosperous conditions of investment and consumption that will enable the future development of innovative industries in the most competitive economies.

Measurement of self-employment

Data for the proportion of self-employed workers in the economy have been taken from the Key Indicators of the Labour Market (KILM), 3rd Edition, Table 3 (International Labour Organization 2003). For the year 2000, data is given for 34 countries out of the 38 main countries under investigation (data for the year 2000 is not given for Belgium, Finland, Malta and Bulgaria). The data have been compiled according to the International Classification of Status in Employment (ICSE), revised in 1993. The repository for the data has been the Yearbook of Labour Statistics, 2002, 61st issue (International Labour Organization) except for France, Luxembourg and Switzerland, for which data has been received from the OECD Labour Force Statistics, 1981-2001, 2002 Edition (Organization for Economic Co-operation and Development). The cross-country comparability for this indicator is diminished by the fact that for 11 countries only the civilian employment is covered, whereas the total employment is covered for the other countries. Also, for 5 countries, conscripts are excluded form the coverage. Another, but minor, difference lies in the fact, that for 8 countries members of producers' cooperatives are included in the self-employed workers.

Combining real GDP per capita and the rate of self-employment

This project has identified, for the first time, that at least two macroeconomic factors are of central importance to the health of industrialised country populations: real GDP per capita and the proportion of the working population that is self-employed. Our findings show remarkable consistency among causes of death, age-groups and gender in the importance of these two factors. Total mortality, cardiovascular mortality as well as mortality due to malignancies, cirrhosis, suicide and homicide, overall accidents, motor-vehicle accidents and non-motor-vehicle accidents all show strong and robust inverse relations to GDP per capita and self-employment. In one sense, these findings are not surprising in that they conform to two research literatures within epidemiology.

The first and most prominent is that in nearly all industrialised societies mortality from virtually all causes of death at all ages and for both sexes is inversely related to socioeconomic status. This relationship has been most prominently observed when occupational skill level and educational level have been the identified indicators of socioeconomic status. In the last two decades, however, income has been the more widely used indicator of socioeconomic status in which this inverse relationship has been found. Second, the literature on psychophysiological stress now indicates that all of the major causes of illness and death have, in common, a significant relation to emotional disturbance. The mechanisms involve cardiovascular responses, disturbances to immune system functioning (involving malignancies and infection), depression, aggression and fatigue (involving accidents, suicide and homicide) and psychophysiological coping responses, including the use of alcohol, tobacco, fats and probably carbohydrates (involving diabetes, cirrhosis and other metabolic diseases). Since both shocks to GDP growth and work stress are known to influence these causes of illness and death, it is clear that the research literature at the individual level of analysis provides a plausible foundation for, and is consistent with, our findings at the macroeconomic and national levels.

Finally, the literature indicates that there is a special, symbiotic, relation between GDP and the self-employment rate in the higher income industrialised societies. It appears that the

initial development, existence and continued survival of self-employed and small firms greatly depend, for financing, on a relatively prosperous business climate. This is especially true when the new entrepreneurial firm is typical of those representatives of scientific and commercial innovation that often characterise the knowledge economy. Thus, a relatively high self-employment rate will tend to coexist with high GDP per capita in a highly urbanised society dominated by the advanced tertiary sector. Nevertheless, ironically such a combination of high GDP per capita and self-employment may also be accompanied by relatively high unemployment rates in the same highly urbanised societies. This appears to be characteristic of trends in the past two decades where increased productivity is not accompanied by similar increases in job growth.

Shadow economy and income inequality

A third macroeconomic factor of considerable importance in its relation to many different types of mortality is the extent to which GDP consists of “shadow” economic activity. The shadow, black, or informal economy (depending on its official designation) consists of employment that is undertaken without the payment of government taxes and does not include regulation through health and safety measures, unemployment insurance, disability insurance or pensions. Our study finding is that for total mortality, cardiovascular mortality, accident mortality, the proportion of the economy that can be estimated as “shadow” is strongly positively related to higher death rates within the working-age population. This is the third most important variable that represents a risk factor to mortality across industrialised countries. As in the case of self-employment, this is an entirely new finding in demographic epidemiology.

By contrast, for the last decade and a half, income inequality has been hypothesised as a major factor potentially elevating the mortality rate of industrialised as well as developing societies. For this reason, we have felt it important to at least control for the Gini Index (measure of national income inequality) in the development of our general models predicting mortality. We do find that the Gini Index is positively related to higher mortality rates in overall mortality and cardiovascular mortality, but this relationship does not reach statistical significance if we only include the EU member states and the OECD countries in our sample. It is only when we enlarge our sample to include the CIS countries (especially Russia, Ukraine, Georgia) that the Gini Index attains firm statistical significance. Whether this is due to the need for having a large sample or to the possibility that the international importance of the Gini Index is only definitive for countries with relatively low GDP per capita is a matter still to be investigated.

Measurement of shadow economy

Obviously it is very difficult to get accurate information about the shadow economy activities as it is on the one hand a highly complex phenomenon in itself and at the other hand all persons who are engaged in these activities will not like to be identified. For the research work of this study we used data on the shadow economy that were provided by Prof. Dr. Friedrich Schneider from the Johannes-Kepler University of Linz in Austria who uses the DYMIMIC (DYnamic Multiple-Indicators Multiple-Causes) model to derive estimators of the size of the shadow economy, (see Schneider, 2005).

It is clear that any approach to estimating the size of the shadow economy can be criticized (see e.g., Renoy, et. al., 2004). The major advantage of Schneider's approach is that he provides estimators for a very large number of countries using a homogenous methodological approach. The application of his data within our framework provided coherent and plausible results and thus our findings in return show that his approach identified something that is economically meaningful and relevant.

Schneider F (2005) Shadow Economies around the World: What do we really know? European Journal of Political Economy 21(3), 598-642

Renoy P, Ivarsson S, van der Wusten-Gritsai O Meijer E (2004) Undeclared work in an enlarged union. An analysis of undeclared work. An in-depth study of specific items. European Commission, Directorate-General for Employment and Social Affairs Unit EMPL/A/1

Measurement of economic inequality

The 24 country series provides Gini data from the European Community Household Panel (ECHP, made available by Eurostat) that has either been calculated for 2000 or 2001. The countries included are, for Western Europe: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Spain, Sweden, United Kingdom; Eastern Europe: Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovenia. The series for 31 countries combines the two sources (ECHP and WDI) so that the 23 country series values from the ECHP have been added to the WDI for Belarus, Croatia, Moldova, Norway, the Russian Federation and Ukraine.

With regard to the 38 countries which were the main target countries of our study data, the GINI indexes were combined from the two sources ((ECHP and WDI) when data were available from either source. The 24 countries for which ECHP data have been used were: Austria, Belgium, Bulgaria, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Poland, Portugal, Romania, Slovenia, Spain, Sweden and United Kingdom. For 4 countries WDI GINI index data were used: Norway, Mexico, Turkey and the United States. Thus for 28 from the 38 countries GINI index data were available, the 10 countries for which no GINI index data were available from either source were: Australia, Canada, Cyprus, Iceland, Japan, Korea, Rep, Malta, Slovak Republic , Switzerland and New Zealand.

Proportionate impact of main economic predictors

The bar charts shown below indicate the relative power of the three most powerful macroeconomic predictors (real GDP per capita, rate of self-employment and proportion of the shadow economy to GDP) to explain differences in total mortality rates among countries, according to age and gender.

Figure 1: Adjusted R²: total mortality, both sexes (cross-sectional, year 2000)

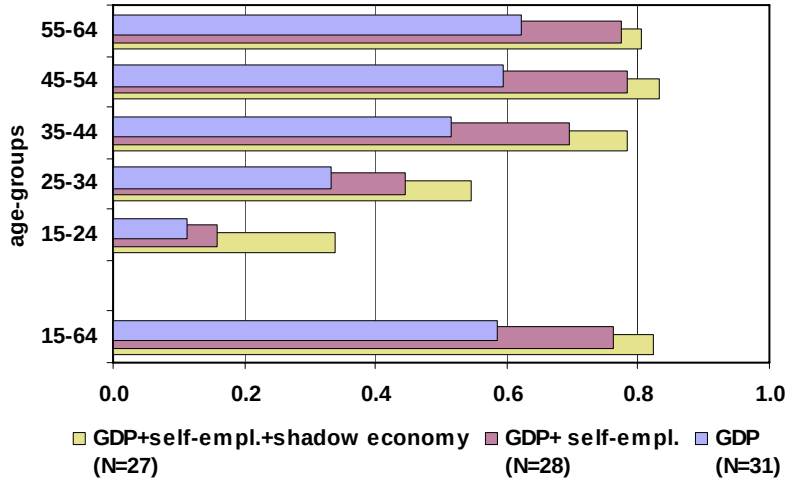


Figure 2: Adjusted R²: total mortality, males (cross-sectional, year 2000)

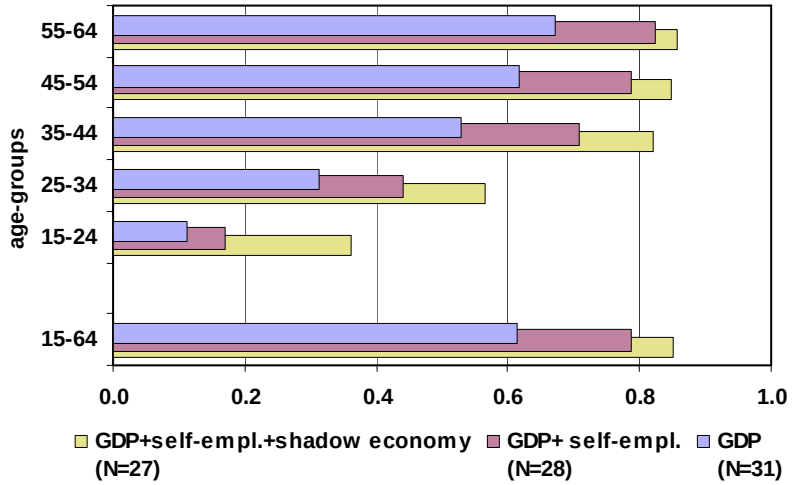
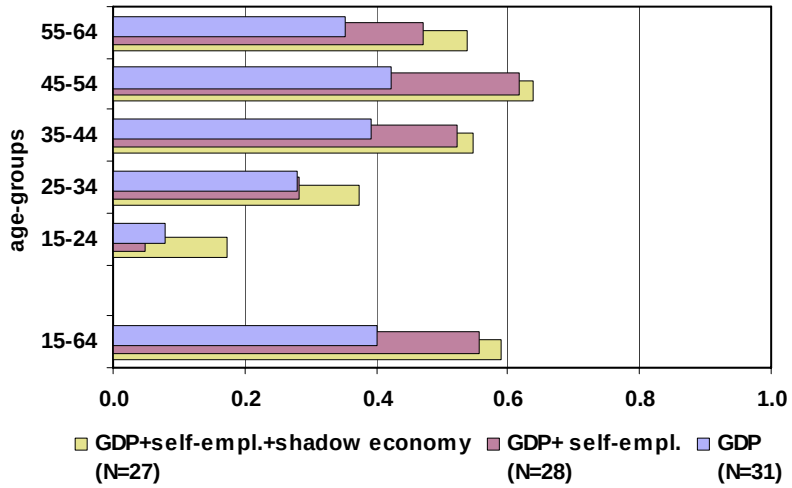


Figure 3: Adjusted R²: total mortality, females (cross-sectional, year 2000)



Controls for epidemiological risk factors

It is clearly the case that with 2-4 economic variables, as indicated above, it is possible to statistically account for the great majority of variation in mortality of working-age populations across the industrialised world. Nevertheless, it would be remiss not to control for the potential effects of the epidemiological risk factors that have been most prominently identified as potential causes of mortality. These include high national consumption of alcohol, tobacco, carbohydrates and animal fats. Controlling for such factors typically does enhance the capacity of our models to explain variation in mortality rates across countries, especially when we are considering specialised causes of death. It should be stated, however, that in the course of this study, we have not been able to measure the elaborate lag structures that constitute the long-term relations between the epidemiological risk factors and mortality.

At the same time, as we have indicated, all of these “life-style” factors, that are differentially prominent in various societies and cultures, are well recognised sources of potential psychological coping mechanisms related to work stress, depression and anxiety. Thus, it cannot be ruled out that these “consumption” variables belong within the more elaborated models of the mechanisms by which macroeconomic and labour market factors influence workers’ health. It is therefore likely that future models, summarising later stages of this research, will show both direct and indirect effects of macroeconomic and labour market factors. In that case, the indirect influences on mortality will still include GDP per capita, self-employment, ”shadow” economic activity and income inequality. These indirect effects, then, will operate partially through the mechanisms of consumption of tobacco, alcohol, carbohydrates and saturated fats.

Policy considerations

A principal consideration for European Commission policy is whether the “quality of work life” has implications for physical and mental health – in a manner in which such implications can be measured. If so, two statements follow. The first is that measures of health outcomes, such as overall and cardiovascular mortality in the working population, can serve as “hard” quantitative measures of the benefits of an acceptable quality of working life. They can therefore also be used as outcome measures in the evaluation of the effectiveness and efficiency of labour and macroeconomic policies. Second, if employment and social policies do beneficially affect health outcomes, through their influence on macroeconomic and labour market indicators, then it will also follow that productivity gains should result from such policies largely because they lead to improvements in the physical and mental health of workers. There is firm consensus within the literature on human capital that improved health of employees is a principal source of enhancement of labour productivity.

The second issue is whether conventional or innovative types of labour market or macroeconomic policy are applicable to measures of health outcome according to the findings of this study. It is clear, in the first place, that policies which increase productivity – and therefore result in higher real GDP per capita – are among the most important factors in improving the health of working populations. It therefore does not require much argument to plausibly assert that investment in research and development, education – and life-long

learning in general – i.e., human capital improvement, are important sources of improved employee health through enhancement of productivity.

Industrialised countries are now facing the challenge, however, that the continued increase of productivity has also been accompanied in the last few decades by stagnation in levels of (net) job creation that would normally accompany economic growth. Some thinkers have argued that if such trends continue, they will lead to a society of well to do professionals and others whose occupations depend on the knowledge economy. At the same time they will also increase the larger, and relatively low skilled, population with increasingly diminished job opportunities. This vision is of a society of economic cleavage that is not tolerable on political grounds. But it would also lead to a society in which many of its low skilled persons minimally participate in the economy and risk poverty status.

The question is: how can we continue to have high productivity growth, with its accompanying changes in the structure of industry, without causing large-scale technological unemployment and underemployment? At present, for example, several European countries with relatively high rates of productivity growth nevertheless have high and sustained unemployment rates. One important possibility, suggested by this study, is that unemployment, or work inactivity, due to rapid structural changes inherent in the modern knowledge economy are, depending on policy, responded to by increases in self- and small-firm employment. Self- and small-firm employment are thus potential “shock absorbers” in the era of the knowledge economy, in which displaced workers at varying levels of skill can (a) re-enter employment and (b) do so at higher levels of autonomy and perhaps even income. Much of the importance of self- and small firm employment during periods of rapid technological and societal change is their great capacity for innovation and adaptation. Put simply, a small and highly creative firm can rapidly adapt to markets and even create innovative market possibilities through its own activity. Indeed, it is argued in the management literature that the vast majority of innovations leading to greater productivity of the entire economy results from the innovative activities of individual proprietorships and small firms.

This is in contrast to the somewhat outdated notion, even held by experts, of the classic “bureaucratic” organisation. The rules and culture of such organisations are understood to be firmly entrenched within the interests of their management structure, which typically have large-scale investments in maintaining the status quo against (external and internal) competitors. Similarly, a large group of employees within such organisations are deeply invested in the current structure, in terms of their seniority, job skills and position – so that important changes are appropriately feared as signalling short- or long-term career damage. As the European Commission has stated several times in its policy documents, an economic framework encompassing both flexibility of employment and security of employment is the optimum for a satisfying work environment. One approach to such an ideal would be to encourage the development of smaller and individual-based firms, specialising in research and development, professional services, retail trade and other urban amenities. As far as we can know from the research literature, this tendency is already present in the development of advanced tertiary sector (i.e., knowledge economy) urban civilisation (Mingione 1997; Castells 2000). It is indeed part of the phenomenon referred to especially by French and American sociologists of technology as the ‘post-industrial’ era. However, to only concentrate

on the small or individual-based firms would be to neglect the very great majority of employment which occurs in medium to large and complex organisations.

If the generalisation stemming from this research is correct, that smaller and adaptable work units, resilient to the pressures of recession and structural change, are highly beneficial to mental and physical health, then one might utilise that prototype in imagining the organisation structure of the larger firm. What that means is that we view the larger complex organisation in terms of its structural components – as 'mini firms'. These mini firms can conceivably operate at different levels of technological sophistication or innovation. In other words, as a new important technology arises in an industry, one procedure would be to quickly restructure the entire organisation, thereby causing considerable internal conflict and ultimately pushing many employees out of the firm. An alternative is to introduce a major technological entity, or set of innovations, in a small part of a firm or in a newly created division, leaving the remainder of the firm temporarily intact.

This is not unusual in a great many firms now experiencing technological change, but it would be worthwhile to carry this logic somewhat further. Specifically, much of the entire firm, in its multiple components or divisions, could operate as semi-independent units, each with its own leadership, adapting or innovating in relation to different parts of the external market and thus maintaining its own growth pattern and ultimate survival. We have here a pleasant vision until we recognise that the course of competition and 'creative destruction' will eliminate, or threaten to eliminate, specified divisions of such a firm. The potential response to such a situation is to shift workers from those divisions that are likely to suffer reduced employment to those in which investment and employment are growing and finding a more sustainable niche in the external market.

But how can we rapidly shift employees from one division to another given that skill requirements will vary among divisions? An answer is for the firm to develop internal training methods – perhaps in conjunction with universities or secondary schools – in order to maintain the general level of skill requirements that would enable employees with some additional in-house training to shift from one division to another under conditions of rapid technological change. On an economy-wide basis, this would mean a new or refreshed linkage between industrial or service firms and the educational system. In other words, it would mean, as the European Commission has put it, a well-developed program of "life-long learning". Such learning, of course, would equip employees to not only shift their positions among divisions in a single firm, but rather to move from firm to firm or even from one industry to another. This model is in fact not entirely visionary. It almost certainly exists today in many high-technology firms and is a routine practice in universities.

In the university setting, within academic departments, the lines of scientific discovery and development change many times in the course of an individual career. In those situations the individual scientist or scholar must alter specialisation or even academic disciplines in order to remain a productive member of the intellectual community. The same can often be said for entire academic departments and even entire academic disciplines within a university. Within the knowledge economy, therefore, it would be logical to propose an 'industrial' model that is based on the prototype of highly productive universities. In such a scenario, the security of employment lies in the flexibility of employment, where flexibility in this case refers to the

capacity of employees to shift from one job to another – with minimal legal restrictions – as a result of having obtained the necessary skills. To the extent to which this situation is feasible for the economy as a whole, there would be a material reduction in the extent of unemployment and underemployment due to structural change. The smoother adjustment of the working population to technological change – i.e., without fundamental disruption to career patterns – would significantly improve physical and mental health of the working population and, therefore, long-term productivity as well.

The basis for such flexibility – or interchangeability of roles through skill-development – relates to the knowledge base of the worker. That knowledge base provides the worker relative autonomy in decision making in the work setting. This is of course appropriate and necessary in a knowledge economy, where much of the output of an employee is in the production and dissemination of knowledge itself. This will of course be true, especially when it is realised that even in the 'production' of goods and services, those goods and services embody (or are based on) the creation of new knowledge.

Is this scenario overly optimistic in today's highly competitive environment? Of course, there is no completely logical, technocratic solution to the "problems" of change introduced by competitive economies. And there are no substitutes for investment in research and development, entrepreneurship, physical and human capital, continuous industrial reorganisation and social protection. But without these investments, the likelihood of a healthy and productive society is considerably diminished.

From a more encouraging perspective, there is little doubt that many high technology firms, over the entire industrialised world, are now internally organised in structures of largely self-determining divisions. In such firms, a major effort is made to retain and promote employees whose skills can be adapted to work in multiple divisions. This model of the "high-technology" firm is perhaps what is signalled by the "indicator" of a high proportion of self-employed and small firms in the knowledge economy. Of equal significance is the view that even the modern, large high-technology firm does not function optimally in the absence of small, specialised firms from which innovations are obtained and to which particular projects can be outsourced.

Altogether, the presence of self-employed and small firms can be taken as a partial indicator, in highly urbanised societies, of the presence of the knowledge economy – and internally specialized work organisations – even in larger firms. At the same time, one must not forget that self-employed and family employed firms are of numerical importance among craftwork and in retail trade, restaurants and hotels. While these do not necessarily refer to high technology occupations, they also represent the standard pattern of advanced service employment in the urban setting of the early 21st Century.

Conclusion

This study used cross-sectional, pooled cross-sectional time-series, and time-series regression techniques to test hypotheses that the influence of standard risk factors to health in the working age population could be found at the national level of analysis. If this were found to be true, then policy makers might be able to use the results in the formulation or

alteration of occupational health policies in accordance with their measured effects on mortality. Further, the particular interest was to see whether indicators of change in the macro economy and the labour market were intrinsically related to mortality processes which could then differentiate the experience of industrialized countries. If this, in turn, could be substantiated, then mortality rates for the major causes, could be taken as prime indicators of the effectiveness of national policy in the areas of the macro economy, labour market, social protection, the management of firms and occupational health and safety. Our principal finding is that national mortality rates are highly responsive to economic changes in the overall economy and the labour markets within (internal) and outside (external) small and large firms.

The most important findings were that real GDP per capita and the proportion of the population that is self-employed influence the great majority of variation in mortality rates across industrialized countries. Both of these factors are highly inversely related to age-adjusted mortality rates. The second group of economic variables influencing variation in mortality rates are the proportion of the GDP that is constituted by the shadow economy (a major risk factor to higher mortality) and economic inequality (similarly influencing higher mortality rates).

Why is real GDP per capita such an important, indeed fundamental, source of low age-adjusted mortality? Perhaps the broadest answer is that since economic growth is dependent on the development of science and technology, it is actually the development of science and technology itself that is the foundation of improved health of workers in national populations. Science and technology provides the basis of solutions to traditional and newer problems of the adaptation of persons to the bio-physical-chemical environment and the human, or built, environment. Adaptation here refers to the development of solutions to problems of survival and maintenance of functioning (i.e., “health”). The fundamental importance of the economy to health is four-fold: it provides the basis for financing (1) the transformation of the scientific, conceptual basis of adaptation into its material manifestation based on engineering, (2) the initial sources of scientific work in research and development, (3) the entrepreneurship required to bring innovations into production processes and markets and (4) consumers’ and firms’ capacity to purchase the embodiments of these innovations, both as goods and services.

Specifically, the capacity of economic growth to finance the implementation of established occupational safety and health norms is of basic significance to the health of employees. These include norms pertaining to ergonomics, toxicology, climate control, chemical risk factors (especially carcinogens) and transportation hazards. Potentially of equal importance is the financing of medical and surgical technologies to reduce the severity of accidents or diseases originating in the workplace through (1) the development of emergency and ambulatory procedures and (2) in-hospital intensive care procedures to alleviate illness/disability and prolonged life. Further, when comparing countries it is important to bear in mind the differential access of working populations to available high-technology healthcare through the national, insured and private healthcare systems. All of these issues of employee access are again very largely a function of the wealth of societies – in their public and private sectors’ capacity to finance the ability to receive care.

We have identified an essential role of GDP per capita as a prime source of the ability of societies to finance and materialize scientific and technological advances in human adaptation. Concomitant with long-term economic growth is 'economic development.' This involves the classic movement (empirically observed, though not logically necessary) of many societies in the modern era from economic emphasis on the primary and secondary to that of the tertiary sector. Most recently in the late 20th and early 21st centuries, the further development has been within the late tertiary sector into the 'knowledge' or information economy. This appears to be characterised by substantially reduced manufacturing employment in complex hierarchical organizations and the full emergence of the scientific, technical and managerial professions in addition to the retail trade and restaurant and hotel amenities of the most diverse and highly developed urban societies.

When we focus on the narrowest indicators of this development of economic sectors, we can point to the statistical power of self-employment (and family employment) as an inverse predictor of mortality. This is consistent with the large occupational epidemiological literature which cites employee autonomy as a central factor in occupational health or, more technically, the importance of worker control over the work process. More broadly, however, it is plausible to extend this interpretation to development of the advanced tertiary sector which is characterized by smaller firms that are less hierarchically structured and more flexible in terms of their capacity to adapt to competitive changes in the marketplace. It is also consistent with the description of the individual proprietorship and small firm which are regarded as the principal sources of innovation, both in themselves and in relation to larger firms.

The entrepreneurial nature of the small firm is considered, in the economics literature, to be the basis of diffusion of innovations, and this entrepreneurial role is assumed to be the basis of technological development when seen as a basic learning process for work organizations and consumers. All told, we have evidence that at least the proportional presence of individual-based and small firms are an indication of (1) employee-manager autonomy, (2) the presence of advanced tertiary sector development dominated by smaller and more flexible firms in an innovative, information society environment and (3) a competitive economy with a relatively high degree of entrepreneurship and innovation.

It appears to be true that GDP per capita and self-employment, in their intrinsic benefits to health, apply to the working life of the most advanced economies. There is also evidence that the proportionate presence of the shadow economy and income inequality, in terms of their damage to health, relate to economies with relatively low GDP per capita and therefore relatively low development of the advanced tertiary sector. All in all, then, it seems clear that higher levels of employee health are associated, internationally with both higher levels of national income and of sectoral economic development.

These findings point to the wisdom of the European Commission in its assertion that a prime goal for the EU should be economic competitiveness. It seems clear that such competitiveness would be the basis of economic well-being and therefore occupational health as well. In promoting competitiveness with an eye to on economic productivity, there is evidence that investment in the health and safety of workers, via firm operations themselves and the healthcare system, is essential. Also of basic importance is investment in research

and development and in the education (“life-long learning”) of society, so that the skills of workers are able to continually match developments in the innovative economy.

Finally, our main findings are that real GDP per capita, the proportion of working population that is self-employed, the size of the shadow economy in relation to GDP and, to some extent income inequality — with minimal control for other epidemiological risks – are quite comprehensive mortality predictors in the 15-64 populations of highly industrialised countries.

Countries show various standards in their respective health and safety policies and have different means of financing the implementation and monitoring thereof. In order to derive conclusions on the effectiveness of different approaches to occupational health and safety policies, further research is recommended to analyse the impact of (properly enforced) health and safety policies on employee longevity in the context of specific economic and cultural changes.

Résumé

Objectif

L’objectif de cette recherche était de présenter et de tester une approche de la médecine du travail basée sur des indicateurs macroéconomiques et du marché du travail comme déterminants principaux de la santé et de la longévité des populations en âge de travailler dans des pays industrialisés sélectionnés. Ces pays comprennent 15 « anciens » Etats membres de l’Union européenne, les 10 « nouveaux » Etats membres, les trois pays candidats, la Bulgarie, la Roumanie et la Turquie et les 10 membres restants de l’OCDE dont les Etats-Unis, le Canada et le Japon ainsi que l’Australie et la Nouvelle-Zélande. Par ailleurs, pour un test plus étendu des hypothèses principales, sur une palette internationale plus large, nous avons inclus plusieurs pays membres de la CEI dont la Russie, l’Ukraine et la Géorgie dans des échantillons spécifiques. Pour tester les limites ultimes de la possible généralisation de notre modèle à tous les pays qui possèdent les données pertinentes dans les banques de données internationales, nous avons étudié l’impact des principaux facteurs économiques de mortalité dans 46 pays.

Les principaux résultats de la médecine du travail

Nous sommes partis d’une vision plutôt traditionnelle de la médecine du travail, qui inclut de manière classique les maladies professionnelles, les maladies et la mortalité. Ont été inclus selon l’usage, les accidents du travail, les toxines environnementales sur le lieu de travail et les maladies industrielles. Dans cette étude, nous avons adopté le point de vue selon lequel tous les problèmes de santé majeurs affectant la population en âge de travailler sont potentiellement sujets à des caractéristiques industrielles ou professionnelles du travail. Ces conséquences potentielles sur la santé, n’incluent donc pas uniquement les accidents du travail et les intoxications d’origine industrielle, mais toute une palette de maladies dues au stress et sources de mortalité. Elles concernent en particulier les problèmes relatifs au travail, dus au stress psychologique et qui par conséquent, incluent potentiellement les principales maladies chroniques, dont les maladies cardiovasculaires et en théorie, certains types de cancers ainsi que des cirrhoses du foie. D’autre part, le stress psychologique associé au travail est connu pour influer sur la dépression et l’humeur agressive qui peuvent par conséquent devenir des facteurs qui vont engendrerdes suicides, des homicides, des accidents du travail et des accidents de la route.

A l’origine, lorsque ce projet a été soumis, l’intention était de rechercher les conséquences d’une mauvaise santé sur la population en âge de travailler y compris la mort, les maladies cardiovasculaires et les accidents du travail. Au cours du développement du projet, il est apparu clairement qu' en théorie, il serait important d’examiner d’autres conséquences potentiellement graves du stress psychologique lié au travail. Par ailleurs, après une étude approfondie de l’occurrence des accidents non mortels liés au travail dans l’Union européenne, il a été constaté qu’il ne serait pas possible d’obtenir un ensemble de données cohérent avec une définition constante des accidents « rapportés ». C’est pourquoi il a été décidé d’utiliser uniquement des données de mortalité « sûres » (c’est-à-dire, pas des rapports de santé subjectifs) dans nos analyses multinationales.

Nous avons effectué une analyse détaillée des Statistiques européennes sur les accidents au travail (l'ESAW) et de son équivalent américain de système de surveillance des accidents du travail, à savoir, le Recensement américain des accidents mortels au travail (CFOI). La difficulté première avec l'utilisation de ces données pour une analyse épidémiologique est que différents pays utilisent différents systèmes financiers de primes et systèmes extra-salariaux afin d'inciter les personnes blessées à déclarer leurs accidents. Ainsi, alors qu'une certaine cohérence existe parmi les systèmes de recueil des données des différents pays, il n'est pas possible de présumer que les données des différents pays aient une signification similaire (c'est-à-dire, qu'elles soient « harmonisées »). D'autre part, nous avons des preuves (voir section 4: accidents au travail) que les différents systèmes nationaux de prime font que les taux d'accidents et de blessures sont difficilement comparables (y compris les accidents mortels au travail) entre les pays. Nous avons donc été dans l'impossibilité d'utiliser les données de morbidité par accident dans la présente analyse, nous apprécions toutefois à leur juste valeur les efforts fournis dans les principaux organismes de statistiques tels que Eurostat pour progresser considérablement dans l'harmonisation des données nationales spécifiques sur la morbidité par accident et les décès.

Notre cadre théorique s'est concentré sur les facteurs à risque qui sont potentiellement plus importants pour la santé de la population active. Au niveau de chacune des entreprises, ceci comprenait pour l'essentiel les dossiers traditionnels de la « sécurité » y compris les facteurs ergonomiques (c'est-à-dire, l'interaction entre l'homme et la machine) et le contrôle du cadre environnemental et en particulier les produits chimiques et toxiques sur le lieu de travail. Tandis que les pays industrialisés ont généralement développé des bases légales très élaborées pour la surveillance et le contrôle de la santé des travailleurs, c'est la mise en œuvre de ces procédures de surveillance et de contrôle qui est également critique. De plus, la mise en œuvre nécessite des investissements financiers dans des procédures technologiques sûres d'ergonomie et de toxicologie. Inversement, ceci est facilité par une économie suffisamment forte pour permettre la mise en œuvre de tels investissements.

De plus, il est important de reconnaître que les normes de sécurité elles-mêmes ne sont pas seulement le produit dérivé d'un consensus entre le gouvernement, l'industrie, les syndicats et les experts scientifiques mais également du développement des sciences de la santé au travail (en particulier de l'épidémiologie) et de leur diffusion parmi les scientifiques, les directions et les employés. Le développement et la diffusion de telles sciences dépendent pour leur part d'investissements dans la recherche sur « les facteurs humains », la recherche universitaire et gouvernementale et la recherche et le développement au sein de l'industrie. De tels investissements nécessitent à leur tour une économie suffisamment forte. En effet, nous pouvons dire qu'en général la modernisation de l'industrie, qui est la base de la productivité, nécessite des normes de santé et de sécurité avancées. Dès lors les niveaux de santé et de sécurité sur le lieu de travail sont en grande partie un produit dérivé de l'investissement dans la modernisation de l'industrie et de l'amélioration de la productivité.

Parallèlement, l'amélioration de l'équipement, l'environnement physique du travail et la structure des procédures de travail ne sont pas les seuls facteurs déterminants de la santé des employés. De nombreux facteurs prouvent que le stress au travail et la santé mentale des travailleurs sont d'une importance décisive pour leur santé physiologique et leur préparation aux conséquences de la dépression et de la frustration. La littérature de

recherche décrit la connexion entre le stress au travail et les maladies cardiovasculaires ainsi que les accidents et même les dommages causés au fonctionnement du système immunitaire, ce qui implique des infections communes de rhumes et de virus. De plus, le stress psychologique et la dépression induits par le travail sont également connus pour augmenter les niveaux d'utilisation pathologique de tabac et d'alcool et une forte consommation potentielle de glucides et de graisses comme moyen de faire face au stress. Ils sont également connus pour augmenter la sensation effective et subjective de fatigue qui à son tour tend à entraîner une diminution de la concentration mentale, de l'exercice et de la mobilité en générale. Ces réponses d'adaptation au stress, à l'anxiété, à la dépression se traduisant par des niveaux élevés de consommation de tabac, d'alcool, de glucides et de graisses ainsi que d'une réduction du niveau d'exercice, sont, comme chacun sait, des facteurs majeurs de risque des maladies chroniques modernes comme les troubles cardio-vasculaires, le diabète, les tumeurs malignes et la cirrhose du foie.

Tests des hypothèses principales

Le point de départ de cette étude a été d'examiner les indicateurs de santé dans les pays industrialisés en relation avec les risques épidémiologiques bien établis. Le but était d'observer, en premier lieu, si les risques courants à la santé au travail pouvaient être observés au niveau international, et par conséquent être utilisés pour expliquer les différences de politique dans le comportement des nations, qui auraient une influence sur leurs niveaux de santé au travail. Un objectif associé était d'examiner, en particulier, dans quelle mesure les indicateurs courants macroéconomiques et de politique du marché du travail étaient associés à des risques significatifs pour la santé au travail et donc aux écarts de mortalité entre les pays. Au niveau individuel d'analyse épidémiologique, plusieurs types de facteurs à risque ont été identifiés : (1) le statut socio-économique, dont le niveau de formation, le niveau de capacités professionnelles et le niveau de revenus (2) l'ampleur des relations sociales, (3) les caractéristiques socio-économiques du lieu de travail, parmi lesquelles : le degré d'autonomie ou de contrôle, par les employés sur le processus de travail ; la durée du temps de travail (y compris l'équilibre entre travail et vie personnelle), le degré de rémunération, dont les avantages salariaux et non-salariaux, la stabilité de l'emploi, la continuité et le développement de la carrière ; (4) les caractéristiques physiques du lieu de travail, dont l'ergonomie, les dangers pour la santé et la sécurité, le contrôle de la température et du climat en général, (5) des facteurs extérieurs de « style de vie », dont les facteurs de stress non professionnels, la forte consommation d'alcool, de tabac et de graisses animales et un faible degré d'exercice.

Dans cette étude, nous avons essayé de modéliser les taux de mortalité ajustés par âge pour les causes principales de décès, puisqu'ils varient entre les pays industrialisés. Cela signifie, dans l'idéal, d'essayer d'inclure dans un modèle unique autant de facteurs à risque appropriés parmi ceux qui affectent un certain type de mortalité (par exemple la mortalité due aux accidents industriels) puisqu'ils varient selon les pays.

Notre méthodologie principale consiste à utiliser l'analyse de régression multivariable standard comprenant l'utilisation d'un groupe maximum de facteurs de risque et d'avantages épidémiologiques, comme prédicateur à plusieurs variables communes (ajustées à l'âge) de la variation du taux de mortalité parmi les pays pour les années de 1995 à 2000. Différents

groupes de pays ont été analysés dans des échantillons séparés : (1) les Etats membres de l'UE (y compris ceux d'Europe de l'Est et de l'Ouest), (2) les Etats membres de l'UE plus les pays de l'OCDE, (3) les Etats membres de l'UE plus les pays de l'OCDE et plusieurs pays de la CEI. Les modèles de régression transversale résultants ont ensuite été testés, dans la mesure du possible avec l'emploi de techniques chronologiques transversales groupées (incluant des modèles d'effets randomisés). Une seconde procédure comprend des analyses chronologiques standard de la mortalité totale et de la mortalité cardiovasculaire parmi la population active dans les sept pays aux économies les plus fortes. Cette procédure inclut en particulier le PIB par habitant et le taux de chômage, comme prédicateurs cumulatifs pendant de 0 à 10 ans, des taux de mortalité ajustés par âge dans chaque pays.

Les variables socio-économiques statistiquement significatives dans les prévisions des taux de mortalité incluaient le niveau de revenus et le degré d'instruction (en particulier les études secondaires, mais pas une version réduite du niveau de compétences professionnelles). Les revenus plus élevés, les salaires et les indemnisations ont été constamment associés à des taux de mortalité plus bas pour presque toutes les causes de décès. L'autonomie du statut du travailleur illustrée par l'ampleur du travail indépendant a également été associée de manière significative à des taux de mortalité plus bas. Les taux de consommation d'alcool, de consommation de tabac, la consommation de glucides et (occasionnellement) de graisse animale ont été associés à des taux de mortalité plus élevés (particulièrement la mortalité totale, cardiovasculaire et due au cancer), mais ils ne contribuaient que faiblement à l'explication statistique générale de la variation des taux de mortalité pour la majorité des causes de décès.

L'un des objectifs principaux de cette recherche était d'observer si les facteurs macroéconomiques clefs et ceux du marché du travail contribuaient à expliquer les variations de la mortalité entre les pays parmi la population active. Notre étude a montré que ces facteurs étaient, en fait, les sources les plus importantes de variation de la mortalité. Le reste de ce rapport est consacré principalement à l'explication des effets potentiels sur la santé de ces facteurs principaux.

Les principaux facteurs de risque macroéconomiques

Il apparaît que l'indicateur macroéconomique clef, qui devrait avoir en théorie une influence sur le contrôle et la mise en œuvre en terme de santé et de sécurité, est le PIB par habitant. Ceci est dû au fait que le PIB par habitant mesure le revenu national global et qu'il constitue par conséquent la base pour des investissements potentiels de la part de l'industrie dans son ensemble, d'entreprises particulières et des gouvernements nationaux dans le développement et la diffusion de nouvelles technologies favorables à la santé des employés et qui contribuent ainsi à la productivité nationale. Comme déjà mentionné, tout aussi important est le potentiel généré par le PIB pour les investissements dans ces sciences et dans la formation de la population active, qui sera la base de l'utilisation sophistiquée de technologie encore plus productive.

Du point de vue du stress au travail, le PIB par habitant représente la capacité pour les employés de gagner à la fois des revenus directs et des avantages non salariaux. Ces derniers comprennent l'assurance chômage, l'assurance santé et d'invalidité et les retraites.

L’augmentation du PIB par tête met en avant le potentiel de l’économie à augmenter la mobilité sociale et par conséquent (1) à élever non seulement le statut social des travailleurs mais par le biais d’une plus grande augmentation de statut, (2) à fournir une motivation supplémentaire et un stimulant pour un travail hautement productif et une plus grande satisfaction dans la vie. Concernant les revenus, il convient de rappeler qu’un niveau de ressources économiques plus élevé permet à chaque employé d’obtenir des biens et des services en accord avec ses choix d’existence qui dépendront des valeurs personnelles. De plus, l’augmentation des ressources économiques ne permet pas seulement de parvenir à une plus grande satisfaction relative à un ensemble arbitraire de préférences (en quelque occasion particulière que ce soit), mais permet à l’individu d’avancer davantage dans ces domaines pour lesquels il ou elle a un intérêt marqué et pour lequel il ou elle s’engage au cours de sa vie. Enfin, dans la philosophie moderne de l’éthique, le bonheur individuel ne dépend pas uniquement de plaisirs et de conforts quotidiens, mais de la réalisation des choses les plus importantes de la vie qui incluent à la fois la carrière et la famille. Il est clair que la croissance fournit la base pour améliorer les niveaux de réalisation dans la majorité de domaines de réussite humaine et fournit ainsi une diversité accrue des activités professionnelles à travers lesquelles chaque travailleur peut exprimer ses talents et son engagement.

On peut argumenter avec succès que non seulement la croissance économique améliore la santé et la sécurité au travail, mais que les autres domaines principaux de la qualité du travail, identifiés par la Commission européenne, sont également enrichis. Ceux-ci incluent (1) la qualité intrinsèque du travail (dont la satisfaction professionnelle), (2) l’investissement dans les compétences, la formation permanente et le développement de carrière, (3) la flexibilité et la sécurité (dont l’accès à l’emploi et au système de protection sociale), (4) l’organisation du travail et l’équilibre travail et vie professionnelle (dont les heures travaillées et l’incorporation des éléments de la famille et des loisirs dans la politique de l’emploi), (5) la diversité et l’absence de discrimination basées sur une diversité accrue des activités en milieux cosmopolites ou urbains, et (6) la performance générale au travail, en mettant particulièrement l’accent sur la productivité de la main d’œuvre.

Il est évident que le PIB par habitant est le facteur déterminant qui devrait, en théorie, influencer la qualité générale de la vie professionnelle, ainsi que la santé et la sécurité au travail afin de réduire les taux de maladie et de mortalité parmi la population active dans presque tous les domaines de santé physique et mentale et diminuer le taux de mortalité. Cette hypothèse générale bien que possible et effectivement logique n’est pas l’hypothèse dominante dans l’épidémiologie sociale de la santé au travail. Au cours des 15 dernières années, l’hypothèse dominante dans la littérature de recherche était plutôt que quand un pays se caractérise par des niveaux élevés d’inégalité de revenus, les taux de maladie et de mortalité sont plus élevés. Dans ce cadre hypothétique, la thématique du PIB global par habitant et la croissance économique ont été en grande partie écartés. Les résultats principaux de cette étude indiquent que le PIB par habitant et la croissance économique globale sont effectivement les sources les plus importantes de la santé de la population active.

Le deuxième facteur le plus important qui a été déterminé comme ayant une influence bénéfique sur les taux de mortalité parmi les populations actives des pays est l’ampleur du

développement du travail indépendant (auquel s'ajoute le travail familial) parmi la population active (par contraste avec l'emploi salarié). Les principales sources littéraires soutenant l'hypothèse originale dominent en sciences de gestion, la psychologie industrielle et la sociologie ainsi qu'en épidémiologie. Le thème clef est l'autonomie des employés par rapport à leur relatif manque d'autorité dans de vastes et complexes bureaucraties et hiérarchies d'organisation du travail. Il est démontré que la santé cardiovasculaire et mentale des travailleurs indépendants tend à augmenter lorsqu'ils ont un plus grand contrôle de leur processus de travail. D'autre part, des études récentes parmi les travailleurs indépendants menées par la Fondation européenne pour l'amélioration des conditions de vie et de travail montrent par elles-mêmes une plus grande satisfaction professionnelle chez les travailleurs indépendants (tels travailleurs indépendants ou au sein de petites entreprises) ainsi qu'une santé subjective meilleure.

Malgré les recherches considérables montrant l'importance de l'autonomie pour le mental et la santé physique des employés, nous avons le sentiment que le résultat de cette étude relative à l'importance des taux de travail indépendant pour la santé de la population active nationale, est également un indicateur d'un phénomène sociétal plus large. On pourrait s'attendre à ce que, du fait que le travail indépendant est relativement élevé parmi les populations agricoles, la mortalité soit plus basse parmi les agriculteurs. Nous trouvons pourtant que les populations agricoles ont des taux de mortalité nettement supérieurs comparés aux professions des secteurs des services et de l'industrie. Il est clair, par conséquent, que l'effet bénéfique du travail indépendant et dans les petites entreprises s'applique principalement au secteur des services (étant donné que le travail indépendant prévaut dans ce secteur), et il est particulièrement présent pour l'emploi sans les professions du commerce de gros et de détail, l'hôtellerie et la restauration. Ces dernières professions sont plus répandues dans le secteur tertiaire avancé et particulièrement dans les zones urbaines très développées. Les effets bénéfiques pour la santé associés au travail indépendant sont donc très probablement une caractéristique des derniers développements économiques qui prévalent dans « l'économie de l'information ». Cette économie de l'information a non seulement généré une forte croissance économique réelle par habitant mais, au fil du temps, elle a également considérablement augmenté la valeur de la formation et du capital humain en général. Elle a toutefois eu un impact négatif considérable sur le développement des services et en particulier de l'économie de l'information, comparé au déclin de l'emploi dans l'industrie manufacturière. A cet égard, du fait de l'augmentation de la productivité, la croissance économique au cours des dernières décennies a été associée à une croissance ralentie dans la production d'emplois. Cela signifie comme le formule l'économiste Schumpeter, une « destruction créative » accrue des emplois dans l'industrie et, par conséquent, un chômage récessionnel et technologique plus important. Les aspects du chômage de cette destruction créative et leurs effets délétères sur la santé ont été décrits dans la littérature épidémiologique et dans des études macroéconomiques produites par la Commission européenne (Brenner).

Toutefois, au cours de tels changements structurels, il apparaît que le travail indépendant, malgré une tendance à la baisse par habitant pendant des décennies, connaît maintenant une résurgence dans de nombreux pays. Les raisons de cette tendance sont multiples et complexes. Cependant, un consensus existe dans la littérature et sur la base des données de notre étude selon lequel l'inactivité professionnelle, et le chômage en particulier, sont les

signes annonciateurs d'une augmentation du taux de travail indépendant. Ainsi associé à l'augmentation de l'activité professionnelle, dans le commerce de gros et de détail, l'hôtellerie et la restauration, il semble y avoir eu une poussée considérable vers le travail indépendant, ce qui constitue le résultat du changement structurel subi par les entreprises.

Par ailleurs, le travail indépendant a également représenté le secteur le plus innovant et le plus entrepreneurial de la population active, fournissant souvent les prototypes inspirant le développement industriel subséquent. Les travailleurs indépendants sont en outre très souples et capables de se réinventer face à la récession et les changements structurels, conservant ainsi leur propre sécurité et leurs petites entreprises. Il est également prouvé que l'un des secteurs de politique de l'emploi active de la Commission européenne, qui connaît le succès, est la mise à disposition d'incitations aux anciens employés de grandes entreprises à se mettre à leur compte. En général, il semble évident que le travail indépendant soit la passerelle vers une innovation et une croissance économique prototypée accrue dans les économies où les industries dominantes sont constituées d'entreprises à la hiérarchie complexe dans lesquelles l'adaptation aux changements technologiques est difficile et menace souvent l'existence même de ces grandes entreprises. Ce n'est pas uniquement un problème lié à la globalisation, tels que les changements dans la compétition internationale et la division internationale du travail, mais des changements actuels dans la base scientifique de la production, la fourniture de services et les changements dans la base technologique de la division du travail dans les entreprises.

La raison pour laquelle nous consacrons un temps considérable à ce problème, c'est que, non seulement c'est le problème central de la concurrence et de la survie industrielle à notre époque, mais également, selon les données de cette étude, c'est également le deuxième problèmele plus important après le PIB par habitant concernant la santé dans les populations en âge de travailler dans l'ensemble du monde industrialisé, pour presque toutes les causes importantes de maladie et de mortalité.

Le travail indépendant comme indicateur d'autonomie et d'investissement à l'ère de l'économie tertiaire avancée

Comme déjà mentionné, la littérature épidémiologique soutient la thèse d'une relation étroite entre les taux de maladie et de mortalité d'une part, et d'autre part les signes de stress et les systèmes hiérarchiques extensifs. Ces textes, comme nous l'avons vu, tendent à conforter nos résultats selon lesquels le travail indépendant et dans les petites entreprises, entraînent des niveaux de santé et de longévité supérieurs dans la population active. Toutefois, il est également possible que la variable « travail indépendant », étant donné sa forte influence sur la mortalité dans les différents pays dans l'ensemble du monde industrialisé, représente un « indicateur » ou « représentant » d'un phénomène international beaucoup plus large associé au développement sectoriel progressif des économies nationales au cours de leur trajectoire de croissance économique à long terme.

Comme tout un chacun le sait, on distingue traditionnellement entre les secteurs du développement économique les secteurs: primaire (essentiellement la production agricole), secondaire (industries manufacturières), et tertiaire (dominé par l'industrie des services). Il est prouvé que la résurgence de l'emploi indépendant et dans les petites entreprises (et

proportionnellement, de l'emploi familial) sont caractéristiques du développement récent du secteur tertiaire avancé. Afin de comprendre la signification économique et épidémiologique de l'emploi dans ce secteur de développement récent, il vaut la peine d'identifier la littérature qui fait des distinctions similaires entre société « industrielle » et société « post-industrielle ».

La période industrielle ou fordiste (comme certaines sociologues français l'ont qualifiée) a les caractéristiques suivantes :

(a) des usines de grande taille fortement capitalisées

(b) un processus de production rigide

(c) des structures hiérarchiques et bureaucratiques rigides

(d) l'utilisation de personnel semi qualifié pour l'exécution de tâches répétitives et routinière, souvent soumis à la discipline de la « gestion scientifique »

(e) une tendance à une forte syndicalisation et vulnérabilité de la production à l'action industrielle

(f) la protection des marchés nationaux

Tandis que ces innovations commençaient pendant l'entre-deux-guerres avec la production de voitures aux Etats-Unis, les méthodes générales furent rapidement employées dans d'autres secteurs de production industrielle et furent de plus en plus considérées comme la base organisationnelle sur laquelle les économies avancées pourraient continuer de se développer et, particulièrement après la Seconde guerre mondiale, de prospérer. Il faut également noter que les notions fondées sur l'industrialisation, à savoir échelle, centralisation du contrôle, standardisation et consommation de masse non seulement ont influencé l'ordre du développement de la production capitaliste mais ont aussi été à la base de l'industrialisation soviétique et de la création et la fourniture des services sociaux dans les démocraties à marché ouvert.

La société post-industrielle (et en grande partie la société post-fordiste) renvoie aux nouvelles possibilités économiques ouvertes par l'émergence des technologies des micro-puces, des ordinateurs et de la robotique dans la production et l'échange d'informations et de marchandises. Par contraste avec la société industrielle, la caractéristique distinctive de l'ère post-industrielle est généralement considérée comme étant la création de plus petites unités d'entreprises alimentant des marchés segmentés grâce la production d'articles de bien-être et de services spécialisés.

Les changements sociaux et économiques associés résultant de la transition post-industrielle sont :

(a) Le déclin de l'ancienne industrie manufacturière et lourde, associé à l'émergence des entreprises d'avenir fortement informatisées ;

(b) des formes plus flexibles et décentralisées des processus de travail et de l'organisation du travail ;

(c) un marché du travail réorganisé en un noyau d'employés polyvalents et un environnement souple de travailleurs à statut précaire effectuant les tâches de sous-traitance ;

(d) un déclin important de la classe ouvrière traditionnelle syndiquée des cols bleus, et la prééminence au sein de la structure professionnelle des cols blancs que ce soient les professions libérales, les techniciens ou les cadres et autres employés du secteur des services ;

(e) la féminisation de nombreux emplois de services touchés par les nouvelles technologies ;

(f) la promotion de types de consommation autour du concept de styles de vie choisis individuellement, avec par conséquent un accent mis sur le coût, la spécificité, l'emballage et l'apparence ;

(g) la dominance et l'autonomie de sociétés multinationales dans un processus mondial de production capitaliste ;

(h) une nouvelle division internationale du travail basée sur une nouvelle flexibilité au sein de laquelle une production mondiale peut être organisée ;

Aux fins de notre étude, les groupes professionnels clefs qui sont associés à l'emploi indépendant et à l'emploi dans les petites entreprises, sont ceux qui incluent les groupes des professions libérales, des techniciens, des cadres et du commerce de détail. D'autre part, il n'est pas correct de dire que l'économie des services postindustrielle cesse d'inclure les bureaucraties classiques. En effet, la plus grande part du travail de service, souvent directement connectée avec la production industrielle, inclut le travail de bureau (composants du travail des « cols blancs »). Parmi les gens qui étudient la transformation postindustrielle, on observe communément que le travail de bureau informatisé moderne est très fortement standardisé, en fait, autant standardisé que le travail traditionnel dans la production industrielle, qui sont tous deux largement contrôlés par les machines. De plus, dans la littérature épidémiologique consacrée au stress professionnel, on identifie de façon classique un lien entre travail de bureau informatisé et manque d'autonomie comme ce fut le cas pour les systèmes de production industriels traditionnels.

Depuis les années 1980, le travail indépendant et le travail en petites entreprises, dans les sociétés industrialisées avancées, peuvent être considérés comme représentant le secteur tertiaire avancé. Ces formes d'emploi mettent tout particulièrement en exergue l'importance de l'innovation et de l'entreprenariat. Une telle innovation est la base fondamentale de la croissance économique et c'est en règle générale dans les petites entreprises et les entreprises d'une personne que les sources initiales d'innovation sont développées. De telles entreprises, quand elles réussissent bien, ont tendance à grandir ou à s'allier avec l'industrie existante ou finalement à être absorbée par l'industrie existante (par le biais de fusions et d'acquisitions). Ainsi, l'émergence des entreprises individuelles et des petites entreprises, constitue le moteur de la croissance économique, ces entreprises étant finalement une partie intrinsèque de structures industrielles plus grandes. Il est assez intéressant de noter que l'émergence de petites entreprises et d'entreprises individuelles nécessite des conditions de croissance nationale relativement prospères. Ceci est dû à la fois au fait que des

investissements suffisants à l'émergence de telles entreprises sont nécessaires et que la clientèle doit être suffisamment solvable et optimiste pour faire croître ou du moins maintenir les niveaux de consommation qui vont soutenir la viabilité de telles entreprises. Nous pouvons par conséquent conceptualiser l'entreprise individuelle et la petite entreprise de la fin du 20ème siècle et du début du 21ème siècle comme étant synonyme de conditions d'investissement relativement prospère et de consommation qui permettront le développement futur d'industries innovantes dans la plupart des économies du secteur concurrentiel.

Mesure du travail indépendant

Les données relatives à la part des travailleurs indépendants dans l'économie sont extraites des indicateurs clefs du marché du travail (KILM), 3ème édition, Tableau 3 (Organisation mondiale du travail 2003). Pour l'année 2000, les données sont fournies pour 34 pays sur les 38 principaux pays faisant l'objet de cette étude (données de l'année 2000 pour la Belgique, la Finlande, Malte et la Bulgarie non fournies). Les données ont été recueillies conformément à la Classification internationale de la situation de l'emploi (ICSE), révisée en 1993. Le document de données statistiques a été l'Annuaire, 2002, 61ème édition (Organisation internationale du travail) à part pour la France, le Luxembourg et la Suisse, pour lesquelles les données sont celles des Statistiques de l'OCDE (Organisation pour la coopération et le développement économique) sur la population active de 1981 à 2001, Edition 2002. La comparabilité croisée de ces indicateurs entre les pays est diminuée par le fait que pour 11 pays seul l'emploi civil est couvert, alors que la totalité de l'emploi est couvert pour les autres pays. De plus, pour 5 pays, les soldats du contingent sont exclus du champ d'étude. Une autre différence, mineure toutefois, réside dans le fait que pour 8 pays, les membres des coopératives de production sont inclus dans les travailleurs indépendants.

Combinaison du PIB réel par habitant et du taux de travail indépendant

Ce projet a identifié pour la première fois qu'au moins deux facteurs macroéconomiques sont d'une importance centrale pour la santé des populations des pays industrialisés : le PIB réel par habitant et la proportion de la population qui travaille indépendamment. Nos résultats révèlent une remarquable constance parmi les causes de décès, les groupes d'âge et le sexe pour l'importance de ces deux facteurs. La mortalité totale, la mortalité cardiovasculaire ainsi que la mortalité par cancer, cirrhose, suicide et homicide, accidents dans leur ensemble, accidents de la circulation et accidents hors circulation, tous sont très fortement inversement proportionnels au PIB par habitant et à la part du travail indépendant. Dans un sens, ces résultats ne sont pas surprenants dans la mesure où ils confirment la littérature consacrée à la recherche en épidémiologie.

Le premier point, et le plus marquant, est que dans presque toutes les sociétés industrialisées, la mortalité liée à pratiquement toutes les causes de décès, pour tous les âges et pour les deux sexes, est inversement liée au statut socioéconomique. Cette relation a été principalement observée quand les niveaux de qualification professionnelle et de formation ont été les facteurs identifiés du statut économique. Toutefois, au cours des deux dernières décennies, les revenus ont été le facteur de statut économique le plus largement employé dans lequel cette relation inversée a été trouvée. Deuxièmement, la littérature sur le

stress psychophysiologique montre maintenant que toutes les causes majeures de maladie et de décès ont en commun une relation significative avec un trouble émotionnel. Ces mécanismes comprennent des réponses cardiovasculaires, les troubles de fonctionnement du système immunitaire (à l'origine des cancers et des infections), la dépression, l'agressivité et la fatigue (à l'origine des accidents, des suicides et des homicides) et des adaptations psychophysiologiques, dont la consommation d'alcool, de tabac, de graisses et probablement de glucides (à l'origine du diabète, de la cirrhose et d'autres maladies métaboliques). Puisque les atteintes à la croissance du PIB et au stress au travail sont connues pour influencer ces causes de maladie et de décès, il est clair que la littérature de recherche au niveau individuel d'analyse fournit un fondement plausible à nos résultats au niveau macroéconomique et national et est cohérent avec ceux-ci.

Enfin, la littérature indique qu'il existe une relation symbiotique particulière entre le PIB et le taux de travail indépendant dans les revenus supérieurs des sociétés industrialisées. Il apparaît que le développement initial, l'existence et la survie continue du travail indépendant et des petites entreprises dépendent en grande partie, pour le financement, d'un climat d'affaires relativement prospère. Ceci est particulièrement vrai lorsque la nouvelle entreprise entrepreneuriale est représentative de l'innovation scientifique et commerciale qui caractérise souvent l'économie du savoir. Ainsi, un taux de travail indépendant relativement élevé aura tendance à coexister avec un PIB par habitant élevé dans une société fortement urbanisée dominée par un secteur tertiaire avancé. Néanmoins, assez ironiquement, une telle combinaison de PIB élevé par habitant et le travail indépendant peut également être accompagnée de taux de chômage relativement élevés dans les mêmes sociétés fortement urbanisées. Ceci semble être caractéristique des tendances des deux dernières décennies où l'augmentation de la productivité n'a pas été accompagnée d'une augmentation similaire des emplois.

Economie souterraine et inégalités de revenus

Un troisième facteur macroéconomique d'importance considérable dans sa relation avec de nombreux types de mortalité, est la mesure dans laquelle l'activité de l'économie souterraine contribue au PIB. L'économie souterraine, « au noir » ou non déclarée (selon sa désignation officielle) comporte un emploi qui échappe au paiement des impôts gouvernementaux et n'est pas soumis aux règlements de la médecine et de la sécurité du travail, à l'assurance chômage, à l'assurance invalidité ou au régime des retraites. Le résultat de notre étude est que s'agissant du taux de mortalité total, de la mortalité cardiovasculaire, et de la mortalité accidentelle, la proportion de l'économie qui peut être considérée comme étant « souterraine » est nettement liée à des taux de mortalité plus élevés parmi la population en âge de travailler. C'est la troisième variable par ordre d'importance qui représente un facteur à risque de mortalité dans les pays industrialisés. Comme dans le cas du travail indépendant, ceci est un résultat entièrement nouveau dans le domaine de l'épidémiologie démographique.

En revanche, au cours des quinze dernières années, les inégalités de revenus ont été hypothétisées comme un des facteurs majeurs d'augmentation du taux de mortalité des sociétés industrialisées et en voie de développement. C'est la raison pour laquelle nous avons considéré comme important de contrôler au moins l'indice de Gini (mesure des inégalités de revenus nationaux) dans les développements de nos modèles généraux de

prévision de la mortalité. Nous pensons vraiment que l'indice de Gini est lié de façon positive à des taux de mortalité plus élevés dans la mortalité totale et à la mortalité liée aux problèmes cardiovasculaires mais cette relation n'a pas de signification statistique si nous incluons uniquement les Etats membres de l'Union européenne et les pays de l'OCDE dans notre échantillon. Ce n'est que lorsque nous élargissons notre échantillon pour inclure les pays de la CEI (en particulier la Russie, l'Ukraine et la Géorgie) que l'indice de Gini atteint une signification statistique réelle. Resterait à déterminer si ceci est dû au besoin de disposer d'un large échantillon ou à la possibilité que l'importance internationale de l'indice de Gini ne soit seulement déterminante que pour les pays avec un PIB par habitant relativement bas.

Mesure de l'économie souterraine

Il est manifestement très difficile d'obtenir des informations précises sur l'économie souterraine car d'une part, elle est par sa nature même un phénomène très complexe et d'autre part, toutes les personnes qui sont engagées dans ces activités ne souhaitent pas être identifiées. Pour le travail de recherche de cette étude, nous avons utilisé des données sur l'économie souterraine fournies par le Prof. Dr. Friedrich Schneider de l'Université Johannes-Kepler de Linz en Autriche qui utilise le modèle DYMIMIC (dynamique à indicateurs et causes multiples) pour déduire des estimations de la taille de l'économie souterraine (voir Schneider, 2005).

Il est clair que chaque approche d'estimation de la taille de l'économie souterraine peut être critiquée (voir par ex., Renoy, et. al., 2004). L'avantage majeur de l'approche de Schneider est qu'il fournit des estimations pour un très grand nombre de pays en utilisant une approche méthodologique homogène. L'application de ses données dans notre cadre d'étude fournit des résultats cohérents et plausibles et ainsi, en retour, nos données montrent que son approche a identifié quelque chose qui est important économiquement et pertinent.

Schneider F (2005) Shadow Economies around the World: What do we really know? European Journal of Political Economy 21(3), 598-642

Renoy P, Ivarsson S, van der Wusten-Gritsai O Meijer E (2004) Undeclared work in an enlarged union. An analysis of undeclared work. An in-depth study of specific items. European Commission, Directorate-General for Employment and Social Affairs Unit EMPL/A/1

Mesure des inégalités économiques

La série de 24 pays fournit des données Gini provenant du Panel européen des ménages (ECHP, mis à disposition par Eurostat), calcul effectué pour 2000 ou 2001. Les pays considérés pour l'Europe de l'Ouest sont : Autriche, Belgique, Danemark, Finlande, France, Allemagne, Grèce, Irlande, Italie, Pays-Bas, Portugal, Espagne, Suède, Royaume-Uni et pour l'Europe de l'Est : Bulgarie, République tchèque, Estonie, Hongrie, Lettonie, Lituanie, Pologne, Roumanie, Slovénie. La série de 31 pays combine les deux sources (ECHP et WDI) de sorte que les données de la série de 23 pays de l'ECHP ont été ajoutées aux WDI pour la Biélorussie, la Croatie, la Moldavie, la Norvège, la Fédération de Russie et l'Ukraine.

Concernant les 38 pays qui étaient les pays cibles principaux de nos données d'étude, les indices de Gini ont été combinés à partir de deux sources (ECHP et WDI) quand les données étaient disponibles dans les deux sources. Les 24 pays pour lesquels les données ECHP ont été employées sont : Autriche, Belgique, Bulgarie, République Tchèque, Danemark, Estonie, Finlande, France, Allemagne, Grèce, Hongrie, Irlande, Italie, Lettonie, Lituanie, Luxembourg, Pays-Bas, Pologne, Portugal, Roumanie, Slovénie, Espagne, Suède et Royaume-Uni. Pour 4 pays les données de l'indice de GINI WDI ont été employées : Norvège, Mexique, Turquie et Etats-Unis. Ainsi, pour 28 des 38 pays les données de l'indice de GINI WDI étaient disponibles, les 10 pays pour lesquels aucun indice de GINI n'était disponible pour aucune des sources, étaient : Australie, Canada, Chypre, Islande, Japon, Corée, République Slovaque, Suisse et Nouvelle-Zélande.

Impact proportionnel relatif aux principales prévisions économiques

Les barres du graphique ci-dessous illustrent le pouvoir relatif des trois prédicateurs macroéconomiques les plus importants (PIB réel par habitant, taux de travail indépendant et la proportion de l'économie souterraine par rapport au PIB) pour expliquer les différences par rapport à la mortalité totale dans les pays en fonction de l'âge et du sexe.

Figure 1 : R² ajusté : mortalité totale, les deux sexes (transversal, année 2000)

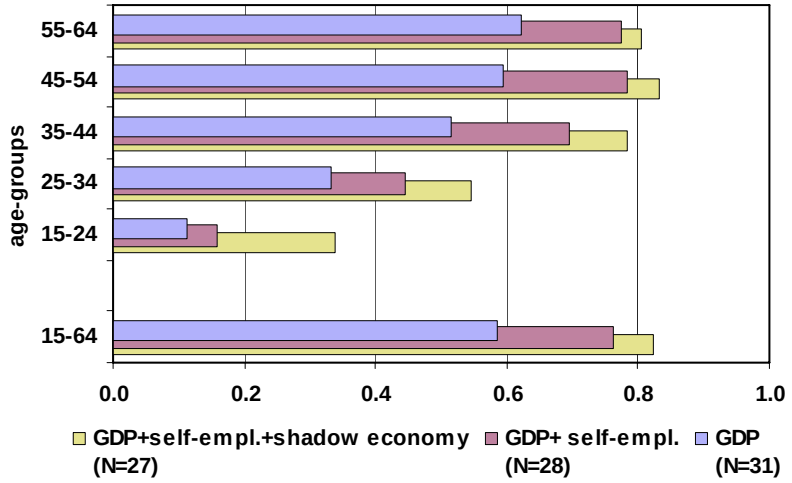


Figure 2 : R² ajusté : mortalité totale, hommes (transversal, année 2000)

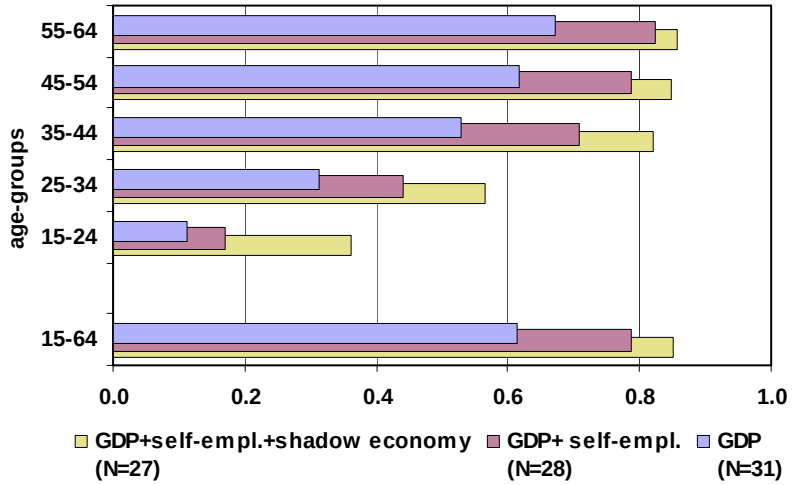
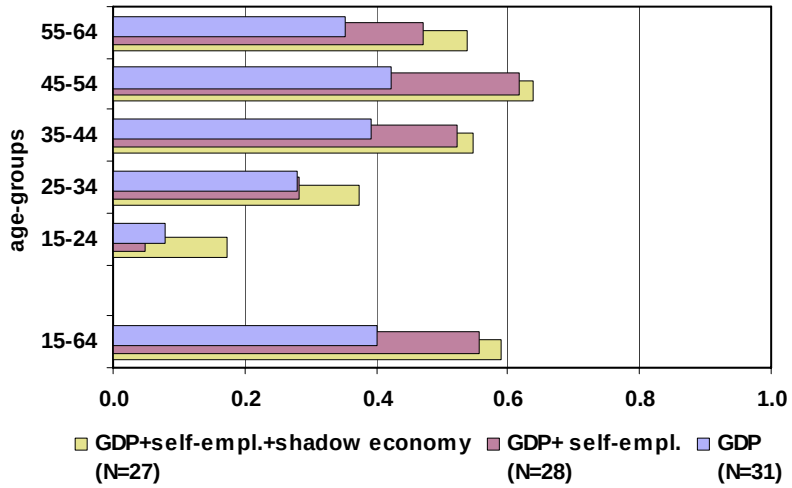


Figure 3 : R² ajusté : mortalité totale, femmes (transversal, année 2000)



Contrôles des facteurs de risque épidémiologiques

Il est clair qu'avec 2 à 4 variables économiques, comme indiquées ci-dessus, il est possible d'expliquer statistiquement la grande majorité des variations de mortalité dans les populations en âge de travailler dans l'ensemble du monde industrialisé. Toutefois, ce serait une négligence que de ne pas contrôler les effets potentiels des facteurs de risque épidémiologique qui ont été mis en évidence comme des causes potentielles de mortalité. On compte parmi ces causes la forte consommation nationale d'alcool, de tabac, de glucides et de graisses animales. En général, le contrôle de tels facteurs ne renforce pas la capacité de nos modèles à expliquer les variations des taux de mortalité selon les pays, en particulier lorsque nous étudions les causes spécifiques de mortalité. Il faut cependant dire qu'au cours de cette étude, nous n'avons pas été capables de mesurer les structures décalées élaborées qui constituent les relations à long terme entre les facteurs à risques épidémiologiques et la mortalité.

Parallèlement, comme nous l'avons indiqué, tous ces facteurs de « mode de vie » d'importance variable dans les différentes sociétés et cultures, sont des sources bien identifiées de mécanismes d'adaptation psychologique potentielle liés au stress au travail, à la dépression et à l'anxiété. Ainsi, il ne peut être exclu que ces variables de consommation comptent parmi les modèles les plus élaborés des mécanismes par lesquels les facteurs macroéconomiques et du marché du travail influencent la santé des travailleurs. Il est donc probable que les modèles futurs, pour résumer les dernières étapes de cette recherche, montreront des effets à la fois directs et indirects des facteurs macroéconomiques et du marché du travail. Dans ce cas, les influences indirectes sur la mortalité continueront d'inclure le PIB par habitant, le travail indépendant, l'activité économique « souterraine » et les inégalités de revenus. Ces effets indirects vont alors agir partiellement par l'intermédiaire des mécanismes de consommation de tabac, d'alcool, de glucides et de graisses saturées.

Considérations politiques

Une considération principale pour la politique de la Commission européenne est de savoir si la « qualité de vie au travail » a des implications pour la santé physique et mentale, de sorte que de telles implications puissent être mesurées. Cette éventualité appelle deux remarques. La première est que les mesures de résultat de santé, telles que la mortalité totale et la mortalité cardiovasculaire parmi la population active, peuvent servir de mesure de résultat « solide » des bénéfices d'une qualité acceptable de la vie active. Elles peuvent donc être utilisées comme mesure de résultat dans l'évaluation de l'efficacité et de l'efficience des politiques de l'emploi et macroéconomiques. Deuxièmement, si les politiques de l'emploi et les politiques sociales n'affectent pas de manière positive les résultats de santé, par leur influence sur les indicateurs macroéconomiques et du marché du travail, il devrait découler de ces politiques des gains de productivité, en grande partie parce qu'ils entraînent des améliorations de la santé physique et mentale des travailleurs. Il y a un large consensus dans la littérature sur le capital humain selon lequel une meilleure santé des employés est une source principale d'amélioration de la productivité du travail.

Le deuxième problème est de savoir si les types conventionnels, ou innovateurs de politique du marché du travail et macroéconomique sont applicables aux résultats de santé selon les

résultats de cette étude. Il est clair, en premier lieu, que les politiques qui augmentent la productivité et, par conséquent, augmentent le PIB réel par habitant, font partie des facteurs les plus importants dans l'amélioration de la santé des populations actives. Par conséquent, il n'est pas nécessaire d'argumenter longuement pour établir de façon plausible que les investissements dans la recherche et le développement, l'éducation et, en général, dans la formation continue, c'est-à-dire l'amélioration du capital humain, sont des sources d'amélioration de la santé des employés par l'amélioration de la productivité.

Cependant, les pays industrialisés font désormais face au défi d'une augmentation continue de la productivité également accompagnée au cours des dernières décennies d'une stagnation de la création (nette) d'emplois qui accompagne normalement la croissance économique. Certains penseurs ont expliqué que si de telles tendances se maintiennent, elles vont mener à une société de riches professionnels et autres dont le travail dépend de l'économie du savoir. Parallèlement, il va également y avoir une augmentation de la population majoritaire et relativement faiblement qualifiée avec des possibilités de plus en plus limitées de travail. Cette vision est celle d'une société de clivages économiques qui n'est pas politiquement tolérable. Mais cela mènerait également à une société dans laquelle nombre de personnes faiblement qualifiées participeraient de façon minimale à l'économie et risqueraient un statut de pauvreté.

La question est la suivante : comment pouvons-nous continuer à avoir une forte croissance de productivité, avec des changements associés de la structure de l'industrie sans causer un chômage et un sous-emploi technologique de grande ampleur ? Actuellement, par exemple, plusieurs pays européens disposant de taux de croissance de productivité relativement élevés ont cependant des taux de chômage élevés et constants. Une possibilité importante, suggérée par cette étude, est que le chômage, ou l'inactivité professionnelle, due à des changements structuraux rapides inhérents à l'économie moderne du savoir soit, en fonction de la politique, contrebalancé par une augmentation de l'emploi indépendant et des petites entreprises. L'emploi indépendant et dans les petites entreprises sont alors de potentiels « absorbeurs de chocs » dans le domaine de l'économie du savoir, dans laquelle les travailleurs déplacés à différents niveaux de qualification peuvent (a) retrouver un emploi et (b) et ce à des niveaux d'autonomie et éventuellement de revenus supérieurs. L'importance que revêt surtout l'emploi indépendant et l'emploi dans les petites entreprises pendant des périodes de changements technologiques et sociétaux rapides, est leur grande capacité d'innovation et d'adaptation. En termes simples, une petite entreprise très créative peut rapidement s'adapter aux marchés et même créer des marchés innovants par sa propre activité. En effet, il est dit dans la littérature de gestion que la grande majorité des innovations menant à une plus grande productivité de l'ensemble de l'économie résulte des activités innovantes de propriétés individuelles et de petites entreprises.

Ceci contraste avec une notion un peu démodée, soutenue même par des experts, de l'organisation classique « bureaucratique ». Les règles et la culture de telles organisations sont considérées comme étant fermement enracinées dans les intérêts de leurs structures de gestion, qui en général sont des investissements de grande ampleur dans le maintien du statu quo vis-à-vis des concurrents (externes et internes). De même, de nombreux employés, au sein de telles organisations, sont profondément investis dans la structure existante, en terme d'ancienneté, de compétences et de positions professionnelles, de sorte que des

changements importants sont à juste titre craints comme signifiant à court ou à long terme des dommages pour les carrières. Comme la Commission européenne l'a mentionné à plusieurs reprises dans ses documents politiques, un cadre économique comprenant à la fois la flexibilité de l'emploi et la sécurité de l'emploi est optimal pour un environnement de travail satisfaisant. Une approche pour parvenir à cet idéal serait d'encourager le développement de petites entreprises ou d'entreprises individuelles spécialisées dans la recherche et le développement, les services professionnels, le commerce de détail et autres commerces urbains. A ce que l'on sait par la littérature de recherche, cette tendance est déjà présente dans le développement du secteur tertiaire avancé (par ex. l'économie de la connaissance) de la civilisation urbaine (Mingione 1997 ; Castells 2000). Cela fait partie en effet de ce phénomène auquel les sociologues français et américains de la technologie font référence comme étant l'ère « post-industrielle ». Toutefois, pour se concentrer uniquement sur les petites entreprises et les entreprises individuelles cela reviendrait à négliger la grande majorité des emplois qui se trouvent dans les organisations complexes de tailles moyenne et grande.

Si la généralisation découlant de cette recherche est correcte, à savoir que les unités de travails petites et flexibles, qui résistent aux pressions de la récession et aux changements structuraux, sont très bénéfiques à la santé mentale physique, alors on pourrait utiliser ce prototype pour imaginer une structure d'organisation pour l'entreprise de plus grande taille. Ce que cela signifie, c'est que nous considérons l'organisation plus grande et complexe en termes de composants structurels, comme de « mini-entreprises ». On peut concevoir que ces mini-entreprises puissent opérer à différents niveaux de sophistication ou d'innovation technologique. En d'autres termes, lorsqu'une nouvelle technologie importante émerge dans une industrie, une procédure consisterait à restructurer rapidement l'ensemble de l'organisation, causant ainsi un conflit interne considérable qui au bout du compte mènerait à exclure de nombreux employés hors de l'entreprise. Une alternative serait d'introduire une entité technologique majeure, ou un ensemble d'innovations, dans une petite partie de l'entreprise ou dans une division nouvellement créée et laisser le reste de l'entreprise temporairement intacte.

Ceci n'est pas si inhabituel dans un grand nombre d'entreprises qui subissent actuellement des changements technologiques, mais cela vaudrait la peine de développer quelque peu cette logique. En particulier, la majorité de l'entreprise dans son ensemble, dans ses composants ou entités multiples, pourrait fonctionner sous forme d'unités semi-indépendantes, chacune avec sa propre direction, s'adaptant ou innovant en relation avec différentes parties du marché extérieur et maintenant ainsi son propre modèle de croissance et sa survie ultime. Nous avons là quelque chose de plaisant, jusqu'à ce que nous prenions conscience que la logique de la concurrence et de la destruction créative éliminera ou menacera d'éliminer les divisions spécifiques d'une telle entreprise. La réponse possible à une telle situation est de transférer les employés de ces divisions qui risquent de souffrir d'un emploi réduit vers celles dans lesquelles les investissements et l'activité tendent à croître et de trouver des niches mieux adaptées dans le marché extérieur.

Mais comment faire rapidement passer les employés d'une division à l'autre étant donné que les exigences de qualification peuvent varier entre les divisions ? Une réponse pour l'entreprise est de développer des méthodes de formation internes, éventuellement en liaison

avec les universités ou les établissements secondaires afin de maintenir le niveau général de qualification requis qui permettrait aux employés par le biais d'une formation interne supplémentaire de passer d'une division à l'autre en cas de changement technologique rapide. Pour l'économie en général, cela signifie la création ou la réactivation d'un lien entre les entreprises industrielles ou de services et le système éducatif. En d'autres termes, cela signifierait, comme le formule la Commission européenne, un programme bien conçu de « formation permanente ». Une telle formation permettrait bien entendu aux employés non seulement de changer de position entre les divisions dans une seule et même entreprise, mais également de passer d'une entreprise à une autre ou même d'une industrie à l'autre. En fait ce modèle n'est pas entièrement une vue de l'esprit. C'est quelque chose qui existe aujourd'hui dans de nombreuses entreprises de haute technologie et c'est également pratique courante à l'université.

Dans le cadre universitaire, dans les départements, les branches de découverte scientifiques et de développement changent de nombreuses fois au cours d'une carrière individuelle. Dans ces situations, le scientifique individuel ou le boursier doit changer de spécialisation voire même de discipline universitaire pour rester un membre productif de la communauté intellectuelle. On peut souvent en dire autant à propos de départements universitaires entiers et même pour de disciplines universitaires au sein des facultés. C'est pourquoi il serait logique, dans l'économie de la connaissance, de proposer un modèle industriel qui soit basé sur le prototype des universités hautement productives. Dans un tel scénario, la sécurité de l'emploi réside dans la flexibilité de l'emploi : la flexibilité dans ce cas réside dans la capacité des employés à passer d'un emploi à un autre, avec des restrictions légales minimales après avoir obtenu les compétences nécessaires. Dans la mesure où cette situation est possible pour l'économie dans son ensemble, il y aurait une réduction matérielle de l'ampleur du chômage ou du sous-emploi dû aux changements structurels. L'ajustement en douceur de la population active aux changements technologiques, c'est-à-dire sans interruption fondamentale des modèles de carrière, améliorerait considérablement la santé physique et mentale de la population active et par conséquent la productivité à long terme.

La base d'une telle flexibilité, ou interchangeabilité de rôles par le développement des compétences dépend des connaissances de base du travailleur. Cette base de connaissance fournit au travailleur une relative autonomie de décision dans l'organisation du travail. Ceci est bien entendu approprié et nécessaire dans une économie de la connaissance, où la majorité du rendement d'un employé est la production et la dissémination de la connaissance elle-même. Ceci sera bien entendu vrai, particulièrement lorsque l'on réalise que même dans la « production » de biens et de services, ces biens et ces services incluent (ou sont basés sur) la création de nouvelles connaissances.

Ce scénario n'est il pas trop optimiste dans l'environnement actuel hautement concurrentiel ? Bien entendu, il n'y a pas de solution technologique entièrement logique aux problèmes du changement créé par les économies compétitives. Et il n'y a pas de substitut aux investissements dans la recherche et le développement, l'entreprenariat, le capital physique et humain, la réorganisation industrielle continue et la protection sociale. Mais sans ces investissements, la probabilité d'une société saine et productive est considérablement réduite.

Dans une perspective plus encourageante, il est presque certain que des nombreuses entreprises de haute technologie, réparties dans l'ensemble du monde industrialisé, soient maintenant organisées au niveau interne dans des structures de divisions largement autonomes. Dans de telles entreprises, un effort important est fourni pour retenir et promouvoir les employés dont les qualifications peuvent être adaptées au travail dans différentes divisions. Ce modèle d'entreprise de haute technologie représente peut-être ce qui est signalé par l'indicateur d'une haute proportion de travailleurs indépendants et de petites entreprises dans l'économie de la connaissance. De même, l'entreprise de haute technologie moderne de grande taille ne fonctionne pas au mieux en l'absence de petites entreprises spécialisées génératrices d'innovations et dans lesquelles des projets particuliers peuvent être délégués.

Dans l'ensemble, la présence de travailleurs indépendants et de petites entreprises peut être prise comme un indicateur partiel, dans les sociétés fortement urbanisées, de la présence de l'économie de la connaissance, et d'organisations du travail internes spécialisées, même dans les grandes entreprises. Parallèlement, il ne faut pas oublier que le travail indépendant et les entreprises familiales constituent une importante composante numérique dans l'artisanat, le commerce de détail, la restauration et l'hôtellerie. Alors que celles-ci ne se réfèrent pas nécessairement à des métiers dans le domaine des hautes technologies, ils représentent également le modèle courant de l'emploi de service avancé dans les sites urbains du début du 21èmesiecle.

Conclusion

Pour cette étude des techniques de régression transversales, des séries chronologiques transversales et chronologiques ont été employées pour tester l'hypothèse selon laquelle l'influence des facteurs de risque pour la santé standard parmi la population en âge de travailler peut être relevée au niveau d'une analyse nationale. Si cela était avéré, alors les politiques devraient être en mesure d'utiliser les résultats dans la formulation ou la modification des politiques de santé au travail en accord avec leurs effets mesurés sur la mortalité. D'autre part, l'intérêt particulier était de voir si les indicateurs de changement dans la macroéconomie et sur le marché du travail étaient intrinsèquement liés aux processus de la mortalité qui pourraient alors permettre de différencier l'expérience des pays industrialisés. Si ceci pouvait être également prouvé, alors les taux de mortalité pour les causes majeures, pourraient être pris comme indicateurs primaires de l'efficacité de la politique nationale dans les domaines de la macroéconomie, du marché du travail, de la protection sociale, de la gestion des entreprises et de santé et de sécurité au travail. Notre découverte principale est que les taux de mortalité nationaux sont, en grande partie, sensibles aux changements économiques dans l'ensemble de l'économie et le marché du travail à l'intérieur (interne) et extérieur (externe) des petites et grandes entreprises.

Les résultats les plus importants sont les suivants: le PIB réel par habitant et la proportion de la population qui travaille en indépendant, influencent la grande majorité des variations des taux de mortalité dans les pays industrialisés. Ces deux facteurs sont étroitement inversement liés au taux de mortalité ajusté. Le second groupe de variables influençant les taux de mortalité est la proportion du PIB constituée par l'économie souterraine (un facteur

de risque majeur pour une mortalité plus élevée) et l'inégalité économique (influençant similairement les taux de mortalité plus élevés).

Pour quelle raison le PIB réel par habitant est-il une source si importante, voire fondamentale d'une faible mortalité ajustée par âge ? La réponse la plus large est peut-être que puisque la croissance économique dépend du développement des sciences et des technologies, c'est en fait le développement même des sciences et des technologies, qui est le fondement d'une santé améliorée pour les travailleurs des populations nationales. Les sciences et les technologies fournissent la base des solutions aux problèmes traditionnels et à ceux plus récents de l'adaptation des personnes à l'environnement bio-physico-chimique et de l'environnement humain ou construit. L'adaptation fait ici référence au développement de solutions aux problèmes de survie et de maintenance du fonctionnement (c'est-à-dire « santé »). L'importance fondamentale de l'économie pour la santé est quadruple: elle fournit la base du financement (1) la transformation de la base d'adaptation scientifique et conceptuelle en sa manifestation matérielle basée sur l'ingénierie, (2) les sources initiales de travail scientifique dans la recherche et le développement, (3) l'entreprenariat nécessaire à la transformation des innovations en des processus de production et des marchés et (4) la capacité des consommateurs et des entreprises à acheter les concrétisations de ces innovations, à la fois comme biens et services.

De façon plus précise, la capacité particulière de la croissance économique à financer la mise en œuvre des normes établies de sécurité et de santé au travail est d'une signification élémentaire pour la santé des employés. Ceci comprend des normes relatives à l'ergonomie, la toxicologie, le contrôle du climat, les facteurs de risque chimique (particulièrement cancérigènes) et les risques du transport. Le financement des technologies médicales et chirurgicale pour réduire la gravité des accidents ou des maladies dont l'origine est liée au lieu de travail est d'une importance potentiellement égale par le biais du (1) développement des procédures d'urgence et ambulatoires et (2) des procédures de soins intensifs dans les hôpitaux pour soulager la maladie ou le handicap et prolonger la vie. D'autre part, lorsque l'on compare les pays, il est important de garder à l'esprit l'accès différencié des populations actives aux soins de santé de haute technologie disponible par le biais de système nationaux et privés d'assurance. Tous ces thèmes de l'accès des employés sont à leur tour en grande partie fonction de la santé des sociétés, de leurs capacités à financer la capacité d'administration des soins dans les secteurs public et privé.

Nous avons identifié le rôle essentiel du PIB par habitant comme une des sources primaires de la capacité des sociétés à financer et matérialiser les avancées scientifiques et technologiques dans l'adaptation humaine. Le « développement économique » et la croissance économique à long terme sont concomitants. Ceci inclut le mouvement classique (observé empiriquement bien que logiquement non nécessaire) de nombreuses sociétés de l'ère moderne d'un accent économique passant des secteurs primaire et secondaire vers le secteur tertiaire. Plus récemment, à la fin du 20ème et au début du 21ème siècle, la poursuite s'est opérée au sein même du secteur tertiaire par le passage à l'économie du « savoir » ou de l'information. Cela paraît être caractérisé par un emploi de production considérablement réduit dans des organisations hiérarchiques complexes et par la pleine émergence des professions scientifiques, techniques et de gestion en plus des établissements de commerce

de détail, de restauration et d'hôtellerie des sociétés urbaines les plus variées et hautement développées.

Lorsque nous nous concentrons sur l'indicateur le plus étroit de ce développement des secteurs économiques, nous pouvons mettre en avant le pouvoir statistique du travail indépendant (et du travail familial) comme prédicateur inverse de mortalité. Ceci est cohérent avec l'ensemble de la littérature épidémiologique du travail qui cite l'autonomie des employés comme facteur central de la santé du travail ou, plus techniquement, l'importance du contrôle du travail sur le processus de travail. Plus généralement toutefois, il est plausible d'étendre cette interprétation au développement du secteur tertiaire avancé qui se caractérise par des entreprises plus petites qui sont moins hiérarchiquement structurées et plus flexibles dans leur capacité à s'adapter aux changements concurrentiels sur le marché. Il est également cohérent avec la description de l'exploitation personnelle et de petite entreprise qui sont considérées comme étant les sources principales d'innovation, à la fois en elles-mêmes et en relation avec les entreprises de plus grande taille.

La nature entrepreneuriale des petites entreprises est considérée, en littérature économique, comme étant la base de la diffusion des innovations, et ce rôle entrepreneurial est considéré comme étant la base du développement technologique lorsqu'il est considéré comme un processus d'apprentissage de base pour les organisations du travail et les consommateurs. En somme, nous avons des preuves que au moins la présence proportionnelle d'entreprises individuelle et de petite taille sont une indication (1) d'autonomie employé-gérant, (2) de la présence de développement d'un secteur tertiaire avancé dominé par des entreprises plus petites et plus flexibles dans l'environnement d'une société de l'information innovante et (3) d'une économie concurrentielle avec un degré relativement élevé d'entreprenariat et d'innovation.

Il s'est avéré que le PIB par habitant et le travail indépendant, dans leurs bénéfices intrinsèques pour la santé, s'appliquent pour la vie professionnelle dans les économies les plus avancées. Il est également prouvé que la présence proportionnelle de l'économie souterraine et de l'inégalité des revenus, en termes de dommages pour la santé, sont liés aux économies avec un PIB par habitant relativement bas et par conséquent un développement relativement faible du secteur tertiaire avancé. L'un dans l'autre, il semble clair que des niveaux plus élevés de santé des employés sont associés au niveau international, à la fois à des niveaux de revenus nationaux plus élevés et à un développement économique sectoriel.

Ces résultats mettent en évidence la sagesse de la Commission européenne dans son affirmation selon laquelle l'objectif premier de l'UE devrait être la compétitivité économique. Il semble clair qu'une telle compétitivité serait la base du bien-être économique et par conséquent de la santé du travail également. En améliorant la compétitivité, tout en surveillant la productivité économique, il est clair que les investissements dans la santé et la sécurité des travailleurs, via des opérations des entreprises elles-mêmes et dans le système de soins sont essentiels. D'une importance fondamentale est également l'investissement dans la recherche et le développement et dans la formation (« formation permanente ») de la société de sorte que les qualifications puissent correspondre en permanence aux développements de l'économie innovante.

Enfin, nos résultats principaux sont les suivants: le PIB réel par habitant, la proportion de la population active qui travaille en indépendant, la taille de l'économie souterraine par rapport au PIB, et dans une certaine mesure les inégalités de revenus, avec un contrôle minimum des autres risques épidémiologiques, sont des prédicateurs de mortalité assez complets pour les populations de 15 à 64 ans des pays fortement industrialisés. Les pays ont différentes normes de politiques de santé et de sécurité respectives et ils ont différents moyens de mise en œuvre financière et de contrôle de ces politiques. Afin de tirer des conclusions sur l'efficacité des différentes approches de politiques de santé au travail et de sécurité, d'autres recherches seraient souhaitables pour analyser l'impact des politiques de santé et de sécurité (correctement mises en œuvre) sur la longévité des employés dans le contexte de changements économiques et culturels spécifiques.

Zusammenfassung

Ziel

Das Ziel dieser Untersuchung war es, eine Methode in Bezug auf die Gesundheit im Arbeitsleben zu beschreiben und zu überprüfen. Diese Methode beruht auf makroökonomischen Indikatoren sowie Indikatoren des Arbeitsmarkts, die die Hauptbestimmungsgröße für Gesundheit und Langlebigkeit der Bevölkerung im arbeitsfähigen Alter in ausgesuchten Industrieländern sind. Unter diesen Ländern befinden sich die 15 Länder der “alten” Europäischen Union, die zehn “neuen” Mitgliedsstaaten, die drei EU-Anwärterstaaten Bulgarien, Rumänien und die Türkei, sowie die zehn verbleibenden OECD-Länder, unter ihnen die Vereinigten Staaten, Kanada und Japan, sowie Australien und Neuseeland. Um die Haupthypothesen noch gründlicher auf einer breiteren internationalen Ebene überprüfen zu können, haben wir zusätzlich mehrere GUS-Staaten, darunter Russland, die Ukraine und Georgien in ausgewählte Ländergruppen mit einbezogen. Wir haben die Auswirkungen der Hauptwirtschaftsindikatoren auf die Mortalitätsrate in 46 Ländern ausgewertet, um so festzustellen, inwiefern unser Modell auf alle Länder, von denen die relevanten Daten mit Hilfe von internationalen Datenbanken zugänglich sind, allgemein angewandt werden kann.

Gesundheit im Arbeitsleben: die wichtigsten Endpunkte

Wir sind von der traditionellen Sichtweise der Gesundheit im Arbeitsleben, die die typischen ‘Berufskrankheiten’, Krankheiten und Mortalität beinhaltet, abgewichen. Diese umfassten üblicherweise die Unfälle am Arbeitsplatz, Giftstoffe am Arbeitsplatz sowie Berufskrankheiten. Wir haben in dieser Studie ebenfalls den Gesichtspunkt berücksichtigt, dass die hauptsächlichen Gesundheitsprobleme, von der die Bevölkerung im arbeitsfähigen Alter betroffen ist, möglicherweise auf die spezifischen Charakteristika gerade dieser Arbeit zurückzuführen sind. Aus diesem Grund beinhalten diese potentiellen gesundheitlichen Ergebnisse für die Gesundheit nicht nur Arbeitsunfälle und Industriegiftstoffe, sondern die gesamte Breite der stressbedingten Krankheiten und Ursachen der Mortalität. Sie betreffen hauptsächlich arbeitsbedingte Probleme, zu denen auch psychologischer Stress gehört, und diese arbeitsbedingten Probleme sind daher möglicherweise die Verursacher der am häufigst verbreiteten chronischen Krankheiten, zu denen kardiovaskuläre Erkrankungen und theoretisch auch bestimmte Arten von bösartigen Tumoren sowie Leberzirrhose zählen. Darüber hinaus beeinflusst arbeitsbedingter psychologischer Stress Depressionen und kann eine aggressive Stimmung hervorrufen, die wiederum in Selbstmord, Mord, Arbeitsunfällen und Autounfällen resultieren kann.

Als dieses Projekt anfangs vorgeschlagen wurde, sollten eigentlich die gesundheitlichen/krankheitsbedingten Ergebnisse der Bevölkerung im arbeitsfähigen Alter untersucht werden, und dies mit besonderem Augenmerk auf die Gesamtsterberate, kardiovaskuläre Erkrankungen und Arbeitsunfälle. Mit dem Voranschreiten des Projekts wurde uns immer deutlicher, dass es zumindest theoretisch wichtig sein würde, auch andere, möglicherweise gravierende berufsbedingte Folgen des psychologischen Stresses zu untersuchen. Des weiteren wurde nach intensiven Untersuchungen über das Vorhandensein

von nichttödlichen berufsbedingten Unfällen für die Länder der Europäischen Union festgestellt, dass es nicht möglich sein wird, kohärente Datenmengen zu erhalten, die übereinstimmende Definitionen von „gemeldeten“ Unfällen enthalten. Es wurde dann entschieden, dass nur „harte“ Daten (d.h. keine subjektiven Gesundheitsberichte) in Bezug auf die Mortalitätsrate in unserer Mehrländeranalyse verwendet werden sollten.

Wir haben eine intensive Analyse der Europäischen Statistik über Arbeitsunfälle (ESAW) sowie seinem US-amerikanischen Pendant des Überwachungssystems für berufsbedingte Krankheiten, dem *US Census of Fatal Occupational Injuries* (CFOI), durchgeführt. Die Hauptschwierigkeit bei der Benutzung dieser Datenbanken für epidemiologische Analysen lag darin, dass verschiedene Länder verschiedene Systeme von finanziellen und nicht lohnbezogenen Anreizen haben, um die Verletzten dazu zu bewegen, ihre Unfälle zu melden. Es existiert zwar eine gewissen Konsistenz innerhalb der Meldesysteme der verschiedenen Länder, allerdings ist es dennoch nicht möglich davon auszugehen, dass die Daten von verschiedenen Ländern auch die gleiche Bedeutung haben (d.h. „vereinheitlicht“ sind). Darüber hinaus verfügen wir über Belege (siehe Abschnitt 4: Unfälle am Arbeitsplatz), dass die verschiedenen nationalen Anreizsysteme für den Mangel an Vergleichbarkeit der Unfall-/Verletzungsraten (einschließlich tödlicher Arbeitsunfälle) zwischen den verschiedenen Ländern verantwortlich sind. Aus diesem Grund konnten wir in dieser Analyse keine Daten bezüglich Unfallmortalität verwenden. Wir begrüßen dennoch die Anstrengungen, die die großen statistischen Organisationen, wie z.B. Eurostat unternommen haben, um die länderspezifischen Daten in Bezug auf Unfallmorbidität und Opferzahlen zu vereinheitlichen.

Unser theoretischer Rahmen konzentrierte sich auf Risikofaktoren, die möglicherweise am wichtigsten für die Gesundheit der arbeitenden Bevölkerung sind. Auf der individuellen Firmenebene umfassten diese im Wesentlichen die traditionellen Gebiete der “Sicherheit”, die die ergonomischen Faktoren (d.h. Mensch-Maschine-Interaktion) und die Kontrolle der umweltbedingten, und hier besonders der chemischen, Giftstoffe am Arbeitsplatz beinhalten. Während die Industrieländer üblicherweise ein sehr ausgearbeitetes juristisches Fundament für Gesundheit der Arbeitnehmer und die Überwachung der Sicherheit gelegt haben, ist die Durchführung dieser Überwachungs- und Kontrollprozedere ebenfalls entscheidend. Darüber hinaus erfordert die Durchführung finanzielle Investitionen in ergonomisch und toxikologisch sichere technische Vorgänge. Dies wird im Gegenzug durch eine ausreichend stabile Wirtschaft erleichtert, die dazu beiträgt, dass solche Investitionen überhaupt getätigt werden können.

Es ist darüber hinaus auch wichtig zu sehen, dass die Sicherheitsstandards nicht nur ein Nebenprodukt des Konsens zwischen der Regierung, der Industrie, den Gewerkschaften und von wissenschaftlichen Experten sind, sondern auch der Entwicklung der Wissenschaften für Arbeitsgesundheit (insbesondere der epidemiologischen Wissenschaften) und ihrer Verbreitung in der Wissenschaft, im Management und bei den Arbeitnehmern. Die Entwicklung und Verbreitung solcher Wissenschaften hängen auch wieder von Investitionen in die Forschung über „menschliche Faktoren“, der Forschung an Universitäten und von Seiten der Regierung, sowie der Forschung und Entwicklung innerhalb der Industrie ab. Solche Investitionen erfordern ebenfalls eine hinreichend stabile Wirtschaft, die diese Investitionen ermöglicht. In der Tat können wir sagen, dass im Großen und Ganzen die Modernisierung der Industrie, die die Grundlage der Produktivität ist, in großem Maße

verbesserte Gesundheits- und Sicherheitsstandards erfordern wird. Es kann dann gesagt werden, dass die Gesundheits- und Sicherheitsniveaus am Arbeitsplatz weitgehend ein Nebenprodukt von Gesamtinvestitionen in die Modernisierung der Industrie und der Produktivitätssteigerung sind.

Zur gleichen Zeit sind die Verbesserung der Ausstattung, des physischen Arbeitsumfelds und der Struktur der Arbeitsmethoden nicht die einzigen bestimmenden Größen in Bezug auf die Gesundheit der Arbeitnehmer. Es gibt eine große Anzahl an Beweisen, dass Stress am Arbeitsplatz und die psychische Gesundheit der Arbeitnehmer wichtig sind, um ihre physiologische Gesundheit und die Neigung zu den Auswirkungen von Depression und Frustration zu bestimmen. Die Forschungsliteratur beschreibt die Verbindung zwischen Stress am Arbeitsplatz und kardiovaskulären Erkrankungen, aber auch Unfällen oder sogar Schädigungen des Immunsystems, was Auswirkungen auf die allgemeinen Infektionskrankheiten, wie Schnupfen und Viren, hat. Darüber hinaus sind der psychologische Stress und Depressionen, die ihren Ursprung in der Arbeit haben, dafür bekannt, den pathologischen Konsum von Tabak und Alkohol, sowie eventuell ebenfalls den Konsum von Kohlenhydraten und Fetten als Anti-Stress-Mittel zu erhöhen. Sie sind auch dafür bekannt, dass sie das tatsächliche und subjektive Müdigkeitsgefühl erhöhen, was wiederum zu einer Verschlechterung der Konzentration, der Bewegung und der allgemeinen Beweglichkeit führt. Diese Schutzreaktionen gegen Stress, Angstgefühle und Depression resultieren in einem erhöhten Konsum von Tabak, Alkohol, Kohlenhydraten, Fetten und in einer geringeren Beweglichkeit. Es ist allgemein bekannt, dass dies die Hauptrisikofaktoren für die modernen chronischen Krankheiten sind, zu denen auch Herz-Kreislauf-Störungen, Diabetes, bestimmte bösartige Tumore und Leberzirrhose gehören.

Überprüfung der Haupthypothesen

Diese Studie begann mit der Idee, die Indikatoren für Gesundheit in Industrieländern in Bezug auf schon etablierte epidemiologische Risiken oder Prädiktoren zu untersuchen. Das Ziel war es, zu aller erst herauszufinden, ob die Standardrisiken in Bezug auf eine geschädigte Gesundheit am Arbeitsplatz auch auf internationaler Ebene anzutreffen sind, und ob sie aus diesem Grund dafür verwendet werden können, um die verschiedenen Politiken der Nationen zu erklären, und die dann ihre unterschiedlichen Niveaus bezüglich der Gesundheit am Arbeitsplatz beeinflussen würden. Ein damit verbundenes Ziel war es zu untersuchen, inwiefern die normalen makroökonomischen und arbeitsmarktspezifischen Indikatoren mit wesentlichen Arbeitsgesundheitsrisiken und demzufolge mit nationalen Unterschieden in der Mortalität in Verbindung stehen. Während der individuellen epidemiologischen Analyse konnten verschiedene Risikofaktoren identifiziert werden: (1) der sozioökonomische Status, einschließlich dem Bildungsgrad, der Grad der beruflichen Qualifikation und der Einkommenshöhe (2) Ausmaß der sozialen Bindungen, (3) sozioökonomische Besonderheiten des Arbeitsplatzes, einschließlich: Erweiterung der Autonomie oder Kontrolle der Arbeitsabläufe durch die Arbeitnehmer; Dauer der Arbeitszeit (einschließlich Gleichgewicht Arbeit-Leben), Höhe der Vergütung, einschließlich tarifliche und außertarifliche Leistungen, Sicherheit des Arbeitsplatzes, Fortbestand und Weiterentwicklung der Karriere; (4) physische Besonderheiten des Arbeitsplatzes, einschließlich Ergonomie, Gesundheits- und Sicherheitsrisiken, Temperatur und allgemeine Klimaüberwachung, (5)

externe Faktoren der „Lebensweise“, einschließlich nicht arbeitsbedingter Stressfaktoren, hoher Konsum von Alkohol, Tabak und tierischen Fetten und wenig Bewegung.

Wir haben in dieser Studie versucht, altersbereinigte Mortalitätsraten für die Haupttodesursachen zu modellieren, da diese in den Industrieländern schwanken. Dies bedeutet idealerweise, dass man versucht, in ein einziges Modell so viele der entsprechenden Risikofaktoren wie möglich einzuschließen, und zwar so wie sie in einem bestimmten Mortalitätstyp aufeinandertreffen würden (z.B. Mortalität aufgrund von Arbeitsunfällen), gemäß der Schwankungen in den einzelnen Ländern.

Unsere Hauptmethodik bestand in der Anwendung einer üblichen multiplen Regressionsanalyse, einschließlich der Verwendung einer größtmöglichen Gruppe von epidemiologischen Risiken (und Vorteilen) als gemeinsame Prädiktatoren für die (altersbereinigte) Mortalitätsvariation unter den Ländern für die Jahre 1995 – 2000. Verschiedene ausgewählte Ländergruppen wurden analysiert: (1) EU-Mitgliedsstaaten (einschließlich derer in Ost- und Westeuropa), (2) EU-Mitgliedsstaaten zuzüglich zusätzlicher OECD-Länder, (3) EU-Mitgliedsstaaten zuzüglich zusätzlicher OECD-Länder und mehrerer GUS-Staaten. Die daraus resultierenden Querschnittsregressionsmodelle wurden dann weiter überprüft, wenn möglich unter Verwendung von gepoolten Querschnitts-/Zeitreihentechniken (unter Einbeziehung von Modellen mit zufälligen Effekten). Eine zweite Vorgehensweise beinhaltete eine herkömmliche Zeitreihenanalyse der Gesamtmortalität und der Mortalität aufgrund von kardiovaskulären Erkrankungen unter der arbeitenden Bevölkerung der sieben größten Volkswirtschaften. Diese Vorgehensweise umfasste besonders das Pro-Kopf-BIP und die Arbeitslosenquote als kumulative verzögerte Prädikatoren über 0-10 Jahre für die altersbereinigte Mortalität in jedem Land.

Sozialwirtschaftliche Variablen, die eine statistische Signifikanz in der Voraussage der Mortalitätsraten zeigten, umfassten die Einkommenshöhe und den Bildungsgrad (insbesondere eine höhere Schulbildung, aber keine skalierten beruflichen Qualifikationen). Ein höheres Einkommen, Löhne und Leistungen waren beständig mit niedrigeren Mortalitätsraten für alle Todesursachen assoziiert. Die Autonomie des Status des Arbeitnehmers wurde durch den Umfang der Autonomie ausgedrückt und war ebenfalls in großem Umfang mit niedrigen Mortalitätsraten verbunden. Das Ausmaß des Konsums von Alkohol, Tabak Kohlenhydraten und (teilweise) tierischen Fetten waren mit höheren Mortalitätsraten verbunden (besonders kardiovaskuläre Erkrankungen und bösartige Tumore), aber trugen in relativ geringem Maße zu der allgemein statistischen Erklärung der Varianz in den Mortalitätsraten bei den Haupttodesursachen bei.

Ein Hauptziel dieser Untersuchung war es festzustellen, ob makroökonomische Schlüsselfaktoren bzw. Schlüsselfaktoren des Arbeitsmarkts einen Einfluss auf die Erklärung der Mortalitätsschwankungen unter der arbeitenden Bevölkerung innerhalb der verschiedenen Länder haben. Unsere Studie hat herausgefunden, dass diese Faktoren tatsächlich die wichtigsten Quellen für die Schwankungen der Mortalitätsraten waren. Fast der gesamte restliche Teil dieses Berichts bezieht sich auf die Erklärung der möglichen Auswirkungen dieser Schlüsselfaktoren auf die Gesundheit.

Die makroökonomischen Hauptrisikofaktoren

Es ist offensichtlich, dass der makroökonomische Schlüsselindikator, der theoretisch die Überwachung und Verbesserung der Gesundheit und Sicherheit beeinflusst, das Pro-Kopf-BIP ist. Der Grund dafür ist, dass das Pro-Kopf-BIP das gesamte Nationaleinkommen misst und aus diesem Grund die Grundlage für eine mögliche Finanzierung von Seiten der Industrie als Ganzem, einzelnen Firmen und nationalen Regierungen für die Entwicklung und Verbreitung von neuen Technologien, die die Gesundheit der Arbeitnehmer fördern ist– und dementsprechend zu der nationalen Produktivität beiträgt. Wie bereits eingangs erläutert, ist das Potential, hervorgerufen durch das Wachstum des BIP, ebenfalls wichtig für Investitionen in die Wissenschaften und in die Bildung der arbeitenden Bevölkerung. Diese Investitionen sind dann die Basis für eine intelligentere Anwendung einer Technologie, die noch produktiver ist.

In Bezug auf den Arbeitsstress stellt das Pro-Kopf-BIP die Funktion für Arbeitnehmer dar, sowohl ein direktes Einkommen als auch außertarifliche Leistungen zu beziehen. Zu Letzterem gehören die Arbeitslosenversicherung, eine Kranken- und Invaliditätsversicherung sowie Renten. Ein Anstieg des BIP deutet darauf hin, dass die Wirtschaft das Potential besitzt, die soziale Mobilität zu erhöhen und daraus resultierend (1) nicht nur den sozialen Status der Arbeitnehmer zu verbessern, aber durch diese Verbesserung des Status (2) eine größere Motivation, mehr Produktivität und eine größerer Zufriedenheit im täglichen Leben zu generieren. In Bezug auf das Einkommen sollte auch nicht vergessen werden, dass höhere Einkommensquellen es den einzelnen Arbeitnehmern erlauben, Güter und Dienstleistungen zu beziehen, die dem gewünschten Lebensstandard entsprechen. Der Lebensstandard des Einzelnen richtet sich allerdings nach persönlichen Werten. Darüber hinaus ermöglichen steigende Einkommensquellen nicht nur eine größere Zufriedenheit in Bezug auf eine willkürliche Anzahl von Präferenzen (zu verschiedenen speziellen Anlässen), sondern erlaubt es dem Einzelnen, weiter auf den Gebieten voranzukommen, für die er/sie sich besonders interessiert und auf denen er/sie sich sein/ihr Lebens lang engagieren wird. Schlussendlich hängt laut der modernen Philosophie der Ethik das Glücksgefühl des Einzelnen nicht von den tagtäglichen Freuden und Annehmlichkeiten ab, sondern von dem Erreichen der wichtigsten Dinge im Leben, zu denen auch die Karriere und die Familie gehören. Es steht fest, dass durch Wachstum die Grundlage für ein Erzielen von besseren Ergebnissen in vielen Bereichen von menschlichen Bestrebungen gelegt wir. Darüber hinaus ermöglicht es ebenfalls eine immer weiter anwachsende Anzahl von Tätigkeiten. in denen die einzelnen Arbeitnehmer ihre Talente und ihr Engagement zeigen können.

Man kann erfolgreich argumentieren, dass nicht nur Gesundheit und Sicherheit am Arbeitsplatz durch ein wirtschaftliches Wachstum verbessert werden , sondern dass ebenfalls die anderen Hauptgebiete der Arbeitsplatzqualität, wie sie durch die Europäische Kommission identifiziert wurden, ebenso bereichert werden. Dies schließt (1) eine intrinsische Arbeitsplatzqualität (einschließlich Arbeitszufriedenheit), (2) Investitionen in Qualifikationen, lebenslanges Lernen und Karriereentwicklung, (3) Flexibilität und Sicherheit (einschließlich Zugang zu Beschäftigung und Systeme der sozialen Sicherheit), (4) Arbeitsorganisation und ein ausgeglichenes Berufsleben (einschließlich gearbeiteter Stunden und die Miteinbeziehung von Familien- und Freizeitelementen in die Beschäftigungspolitik), (5) Vielfalt und Nichtdiskriminierung basierend auf einer immer größer werdenden Vielfalt von

Berufen im weltoffenen/urbanen Umfeld, und (6) eine allumfassende Arbeitsleistung, mit einer besonderen Betonung der Arbeitsproduktivität, mit ein.

Es ist klar, dass das Pro-Kopf-BIP der hervorstechende Faktor ist, der theoretisch die allgemeine Qualität des Arbeitslebens sowie Gesundheit und Sicherheit am Arbeitsplatz beeinflusst, mit dem Ziel geringere Krankheits- und Mortalitätsraten unter der arbeitenden Bevölkerung in fast allen Gebieten der physischen und geistigen Gesundheit und reduzierte Mortalitätsraten zum Ergebnis zu haben. Diese allgemeine Hypothese ist, obwohl sie plausibel und logisch ist, nicht die vorherrschende Hypothese in der sozialen Epidemiologie der Arbeitsgesundheit. Im Gegenteil, während der letzten 15 Jahre sah die vorherrschende These der Forschungsliteratur eher so aus, dass je größer die Einkommensungleichheit in einem Land ist, desto höher sind die Krankheits- und die Mortalitätsrate. Innerhalb dieses hypothetischen Rahmens wurde das Thema des allgemeinen Pro-Kopf-BIPs sowie des allgemeinen Wirtschaftswachstums im Wesentlichen außer Acht gelassen. Die Hauptergebnisse dieser Studie zeigen jedoch, dass das Pro-Kopf-BIP und das allgemeine Wirtschaftswachstum in der Tat die wichtigsten Quellen der Gesundheit der arbeitenden Bevölkerung sind.

Der zweitwichtigste Faktor, der einen positiven Einfluss auf die Mortalitätsraten der arbeitenden Bevölkerung in den Ländern hat, ist das Ausmaß der Selbstständigkeit (dazu gehört auch die Arbeit im Familienverbund) unter der arbeitenden Bevölkerung (im Gegensatz zu Lohn- und Gehaltsbeschäftigung). Die bedeutendsten Literaturquellen, aus denen die ursprüngliche Hypothese hergeleitet ist, sind bedeutend innerhalb der Betriebswissenschaft, der Arbeits-, Betriebs- und Organisationspsychologie, sowie der Epidemiologie. Das Schlüsselthema ist die Autonomie des Arbeitnehmers im Vergleich zu ihrem relativen Mangel an Autorität in komplexen und umfangreichen Bürokratien und Hierarchien der Arbeitsorganisation. Es wurde herausgefunden, dass die kardiovaskuläre und geistige Gesundheit von einzelnen Arbeitnehmern besser war, wenn sie einen größeren Einfluss auf den Arbeitsprozess hatten. Jüngste Studien der Europäischen Stiftung zur Verbesserung der Lebens- und Arbeitsbedingungen zeigen ebenfalls auf, dass es eine höhere Arbeitszufriedenheit unter den Selbstständigen gibt (entweder als Selbstständiger oder innerhalb einer kleinen Firma), sowie eine bessere subjektive Gesundheit.

Trotz umfangreicher Forschungen, die die Bedeutung der Autonomie für die geistige und körperliche Gesundheit aufzeigt, haben wir das Gefühl, dass die Ergebnisse dieser Studie bezüglich der außerordentlichen Wichtigkeit der Selbstständigkeitsquoten für die Gesundheit der arbeitenden Bevölkerung auf nationalem Niveau ebenfalls ein Indikator eines weit verbreiteten gesellschaftlichen Phänomens ist. Da die Selbstständigkeitsquote unter Landwirten weit verbreitet ist, würde man erwarten, dass die Mortalitätsrate unter Landwirten gering ist. Wir haben herausgefunden, dass es unter Landwirten im Vergleich zu Berufen der verarbeitenden Industrie und des Dienstleistungssektors eine merklich höhere Mortalitätsrate gibt. Hieraus wird deutlich, dass die positiven Auswirkungen der Selbstständigkeit und einer Beschäftigung in einem kleinem Unternehmen sich hauptsächlich auf den Dienstleistungssektor beziehen (da Selbstständigkeit in diesem Sektor vorherrschend ist), und es trifft hier besonders auf die Berufe im Groß- und Einzelhandel sowie im Hotel- und Gaststättengewerbe zu. Diese zuletzt genannten Berufsgruppen sind besonders im fortgeschrittenen Dienstleistungssektor und hierbei insbesondere in einem hoch entwickelten

städtischen Umfeld vorherrschend. Die positiven Auswirkungen auf die Gesundheit, die der Selbstständigkeit zugesprochen werden, sind aus diesem Grund höchstwahrscheinlich ein Merkmal der jüngsten wirtschaftlichen Entwicklung, und zwar insbesondere der „Informationswirtschaft“. Diese Informationswirtschaft hat nicht nur zu einem großen realen Pro-Kopf-Wirtschaftswachstum geführt, sondern hat auch den Wert der Bildung sowie des Humankapitals im Allgemeinen herausgestellt. Die Wichtigkeit vorher genannter Werte wurde im Lauf der Zeit auch immer offensichtlicher. Es hat sich dennoch gezeigt, dass die Entwicklung des Dienstleistungssektors und insbesondere der Informationswirtschaft auch einen Nachteil hat, nämlich einen Rückgang der Beschäftigung in der verarbeitenden Industrie. Das Wirtschaftswachstum wurde in den letzten Jahrzehnten trotz einer höheren Produktionsrate immer mit einer viel langsameren Schaffung von Arbeitsplätzen in Verbindung gebracht. Dies bedeutete, wie von dem Wirtschaftswissenschaftler Joseph A. Schumpeter gesagt, eine erhöhte “schöpferische Zerstörung” von Arbeitsplätzen und Unternehmen und trägt aus diesem Grund genauso viel zu einer Rezession bei wie die technologische Arbeitslosigkeit. Die Auswirkungen auf die Arbeitslosigkeit dieser schöpferischen Zerstörung und ihrer schädlichen Auswirkungen auf die Gesundheit wurden in der epidemiologischen Literatur sowie in makroökonomischen Studien der Europäischen Kommission (Brenner) beschrieben.

Im Laufe dieser strukturellen Veränderungen sieht es dennoch so aus, als ob die Selbstständigkeit jetzt trotz einer jahrzehntelangen Tendenz des Rückgangs des Pro-Kopf-Einkommens in vielen Ländern wieder auf dem Vormarsch ist. Die Gründe für diese Tendenzen sind vielfältig und komplex. Es gibt jedoch eine Übereinstimmung zwischen der Literatur und den Ergebnissen unserer Studie, die aufzeigt, dass Untätigkeit, hier insbesondere Arbeitslosigkeit, die Prädiktoren für eine ansteigende Selbstständigkeitsquote sind. Demnach, und aufgrund der steigenden Anzahl von Berufen im Groß- und Einzelhandel sowie des Hotel- und Gaststättengewerbes scheint es, dass der Einstieg in die Selbstständigkeit das Ergebnis von Unternehmen sind, die einen strukturellen Wandel erfahren.

Selbstständigkeit neigt zusätzlich dazu, den innovativsten und unternehmerischsten Sektor der Arbeitskräfte darzustellen, denn dieser Sektor bringt häufig die inspiriertesten Prototypen für eine darauf folgende industrielle Entwicklung hervor. Darüber hinaus sind die Selbstständigen sehr anpassungsfähig und fähig, sich im Angesicht von Rezessionen und strukturellen Veränderungen “neu zu erfinden”, um so die Sicherheit für sich und ihre kleinen Unternehmen aufrecht zu erhalten. Es gibt ebenfalls Beweise dafür, dass eines der Gebiete auf denen die Europäische Kommission eine aktive Arbeitsmarktpolitik erfolgreich durchgeführt hat, die Bereitstellung von Anreizen für frühere Angestellte großer Unternehmen war, damit sie den Schritt in die Selbstständigkeit wagen. Im Allgemeinen kann gesagt werden, dass es so aussieht als ob Selbstständigkeit der Zugang zu mehr Innovation und prototypischem Wirtschaftswachstum in Volkswirtschaften ist, in denen die vorherrschenden Industrien aus komplexen hierarchischen Unternehmen, in denen eine Anpassung an technische Veränderungen schwierig ist und oft die Existenz dieser Unternehmen bedroht, bestehen. Das ist nicht nur ein Problem der Globalisierung – d.h. der Veränderungen im internationalen Wettbewerb und der internationalen Arbeitsteilung – sondern auch der gegenwärtigen Veränderungen in der wissenschaftlichen Basis der

Produktion, der Bereitstellung von Dienstleistungen und der Veränderungen in der technologischen Basis der Arbeitsteilung innerhalb von Unternehmen.

Der Grund, warum wir diesem Thema soviel Zeit widmen ist, dass es nicht nur das Hauptthema von Wettbewerbsfähigkeit und industriellem Überleben in unserem Zeitalter ist. Gemäß der Ergebnisse unserer Studie wird es darüber hinaus nur von der Wichtigkeit des Pro-Kopf-BIP übertroffen in Bezug auf die Gesundheit der Bevölkerung im arbeitsfähigen Alter in den Industriestaaten – für fast jeden wichtigen Auslöser von Krankheit und Tod.

Selbstständigkeit als Indikator für Autonomie und Investitionen im Zeitalter des hoch entwickelten Dienstleitungssektors

Wie bereits erwähnt, befürwortet die epidemiologische Literatur die grundsätzliche Verbindung zwischen hohen Krankheits- und Mortalitätsraten auf den einen Seite, und ein hohes Stressniveau sowie ein extensives hierarchisches System auf der anderen Seite. Wir haben bereits festgestellt, dass diese Literatur unsere Ergebnisse in Bezug auf Selbstständigkeit und Beschäftigung in einem kleinen Unternehmen trägt und zwar dahingehend, dass Selbstständigkeit und die Beschäftigung in einem kleinen Unternehmen förderlich sind für eine bessere Gesundheit und eine lange Lebensdauer der arbeitenden Bevölkerung. Es ist dennoch möglich, dass die ‘Selbstständigkeits’-Variable’ durch ihren hohen Einfluss auf die Mortalitätsrate in den Ländern der gesamten industrialisierten Welt einen ‘Indikator” oder ‘Vertreter’ für ein großes internationales Phänomen darstellt, das in Bezug zu der progressiven sektoralen Entwicklung von Volkswirtschaften auf ihrem Weg zu einem langfristigen Wirtschaftswachstum steht.

Die traditionellen Abgrenzungen der Sektoren in der wirtschaftlichen Entwicklung sind bekannt: Primärsektor (zum größten Teil Landwirtschaft), Sekundärsektor (industriell – verarbeitend), Tertiärsektor (von den Dienstleistungen beherrscht). Es gibt Belege dafür, dass das Wiederaufleben der Selbstständigkeit und der Beschäftigung in kleinen Unternehmen (und entsprechend auch Familienunternehmen) charakteristisch ist für eine späte oder fortgeschrittene Entwicklung des Tertiärsektors. Um die wirtschaftliche und epidemiologische Bedeutung von Beschäftigung in diesem Sektor, der sich erst kürzlich entwickelt hat, zu verstehen, ist es lohnenswert, die Literatur zu identifizieren, die ähnliche Unterscheidungen zwischen der „industriellen“ und „postindustriellen“ Gesellschaft gemacht hat.

Das industrielle oder „Fordistische“ Zeitalter (wie einige französische Soziologen es bezeichnet haben) umfasst Folgendes:

(a) Kapitalintensive, große Betriebe

(b) Einen unflexiblen Produktionsprozess

(c) Starre hierarchische und bürokratische Strukturen

(d) Die Verwendung von Geringqualifizierten, die immer wieder die gleichen Routineaufgaben ausführen, sie unterliegen oft der Disziplin der „wissenschaftlichen Betriebsführung“

(e) Eine Tendenz in Richtung starker gewerkschaftlicher Organisation und die Anfälligkeit der Produktion gegenüber gewerkschaftlichen Kampfmassnahmen

(f) Der Schutz der nationalen Märkte

Während diese Innovationen in den Jahren zwischen den beiden Weltkriegen mit der Produktion von Fahrzeugen in den USA begannen, wurden die allgemeinen Methoden schnell in den anderen Sektoren der verarbeitenden Industrie angewandt und wurden immer mehr als die organisatorische Grundlage gesehen, auf der die entwickelten Volkswirtschaften sich weiterentwickeln sollten und besonders nach dem zweiten Weltkrieg gedeihen sollten. Es muss ebenfalls festgehalten werden, dass die auf der Industrialisierung basierenden Konzepte in Bezug auf Ausmaß, Zentralität der Kontrolle, Standardisierung und Massenkonsum nicht nur die Vorstellungen der kapitalistischen Produktion beeinflusst haben, sondern auch die Art der sowjetischen Industrialisierung und der Schaffung und der Andienung von Fürsorge in den Demokratien mit freier Marktwirtschaft untermauert haben.

Die postindustrielle Gesellschaft (und zu einem großen Ausmaß der “Post-Fordismus”) bezieht sich auf neue wirtschaftliche Möglichkeiten, die sich aus dem Aufstieg der Mikrochiptechnologie, der Computer und Roboter in der Produktion und in dem Austausch von Informationen und Waren ergeben haben. Im Gegensatz zu der industriellen Gesellschaft, ist das unterscheidende Merkmal des postindustriellen Zeitalters die Gründung von kleineren Unternehmen, die sich auf die Versorgung von abgegrenzten Märkten durch die flexible Produktion von bestimmten Gütern oder Waren spezialisiert haben.

Damit verbundene soziale und wirtschaftliche Veränderungen in dem postindustriellen Übergang sind:

(a) Der Niedergang der alten verarbeitenden und Schwerindustrie im Einklang mit dem Aufkommen von so genannten Sonnenaufgangs-Computerunternehmen;

(b) Flexiblere und dezentralisierte Formen des Arbeitsprozesses und der Arbeitsorganisation;

(c) Ein geänderter Arbeitsmarkt bestehend aus einem qualifikationsflexiblen Kern von Arbeitnehmern sowie einer zeitflexiblen peripheren Gruppe von niedrig bezahlten, nicht abgesicherten Arbeitnehmern, die Vertragsarbeiten ausführen;

(d) Ein Niedergang der traditionellen, in Gewerkschaften organisierten Klasse der Arbeiter und innerhalb der beruflichen Strukturen die Überlegenheit der Angestellten, die im technischen bzw. führenden Bereich, in den freien Berufen oder im Dienstleistungssektor tätig sind;

(e) Die Feminisierung vieler Dienstleistungsberufe, beeinflusst durch die neuen Technologien;

(f) Die Förderung von verschiedenen Arten des Konsums um das Konzept der individuell gewählten Lebensstile herum, mit Betonung auf Geschmack, Besonderheit, Verpackung und Erscheinung;

(g) Das Vorherrschen und die Autonomie von multinationalen Zusammenschlüssen in einem globalen Prozess der kapitalistischen Produktion;

(h) Eine neue internationale Arbeitsteilung, basierend auf der neuen Flexibilität, in der die globale Produktion organisiert werden kann.

Zum Zwecke unserer Studie sind die Schlüsselberufsgruppen, die mit der Selbstständigkeit und mit der Beschäftigung in einem kleinen Unternehmen in Verbindung gebracht werden die Berufsgruppen, die die freien Berufe, die technischen und leitenden Berufe sowie den Einzelhandel betreffen. Auf der anderen Seite ist es nicht richtig zu sagen, dass die „postindustrielle“ Dienstleistungswirtschaft aufhört, die klassische Bürokratie mit sich zu ziehen. In der Tat umfasst ein Großteil der Arbeit im Dienstleistungssektor, die oft direkt mit der Industrieproduktion verbunden ist, Bürotätigkeiten (Komponenten der „Angestelltentätigkeit“). Von den Beobachtern der postindustriellen Transformation wird immer wieder festgestellt, dass die moderne, rechnergestützte Bürotätigkeit sehr vereinheitlicht ist – in der Tat genauso vereinheitlicht wie die mehr traditionelle Arbeit in der industriellen Produktion – beide sind stark durch Maschinentätigkeiten geprägt. Darüber hinaus gibt es in der epidemiologischen Literatur über Arbeitsstress eine Identifizierung der rechnergestützten Bürotätigkeit als klassische Tätigkeit, die mit einem Mangel an Autonomie einhergeht, was ebenso auf die traditionellen industriellen Produktionssysteme zutrifft.

Seit den 80er Jahren wird die Selbstständigkeit und die Beschäftigung in einem kleinen Unternehmen in fortgeschrittenen, industrialisierten Gesellschaften als repräsentativ für den Tertiärsektor angesehen. Diese Arten der Beschäftigung unterstreichen ganz besonders die Wichtigkeit von Innovation und Unternehmergeist. Solch eine Innovation ist die ultimative Grundlage für ein wirtschaftliches Wachstum, und es sind normalerweise die Selbstständigen und die kleinen Unternehmen, in denen die anfänglichen Quellen der Innovation entwickelt werden. Sind solche Firmen erfolgreich, haben sie entweder die Tendenz, größer zu werden oder sich mit bereits existierenden Firmen zu verbinden – oder letztendlich von der bereits existierenden Industrie einverleibt zu werden (entweder durch Fusionen oder Aufkäufen). Auf diese Art und Weise stellt die Selbstständigkeit bzw. die Entstehung von kleinen Unternehmen die Antriebskräfte des wirtschaftlichen Wachstums dar, die letztendlich ein intrinsischer Teil von größeren industriellen Strukturen sind. Es ist interessant zu sehen, dass die Gründung von selbstständigen Tätigkeiten und von kleinen Unternehmen relativ gut florierende nationale wirtschaftliche Bedingungen erfordert. Der Grund dafür ist, ist dass sowohl ausreichenden Investitionen für das Entstehen dieser Firmen vorhanden sein müssen, und auch, dass die Verbraucher solvent und optimistisch genug sein müssen, um den Konsum entweder zu verstärken, ihn aber zumindest auf dem gleichen Niveau zu halten, damit das Überleben dieser Unternehmen gesichert ist. Wir können aus diesem Grund die Selbstständigen und kleinen Unternehmen des späten 20. und frühen 21. Jahrhunderts so beschreiben, dass sie relativ florierende Bedingungen für Investitionen und Konsum, die die zukünftige Entwicklung von innovativen Industrien in den wettbewerbsstärksten Volkswirtschaften ermöglichen, darstellen.

Messung der Selbstständigkeit

Die Daten in Bezug auf den Anteil der selbstständigen Arbeitnehmer in der Wirtschaft stammen aus den Schlüsselindikatoren des Arbeitsmarkts (KILM), 3. Ausgabe, Tabelle 3 (Internationale Arbeitsorganisation 2003). Für das Jahr 2000 sind Daten für 34 von den insgesamt 38 Hauptuntersuchungsländern vorhanden (es gibt keine Daten für das Jahr 2000 für Belgien, Finnland, Malta und Bulgarien). Die Daten wurden gemäß der *International Classification of Status in Employment* (ICSE), überarbeitet 1993, zusammengetragen. Die Quelle der Daten war das Jahrbuch der Arbeitsstatistik, 2002, 61. Ausgabe (Internationale Arbeitsorganisation), außer für Frankreich, Luxemburg und der Schweiz. Deren Daten stammen aus der OECD-Arbeitskräftestatistik, 1981-2001, Ausgabe 2002 (Organisation für Wirtschaftliche Zusammenarbeit und Entwicklung). Die länderübergreifende Vergleichbarkeit für diesen Indikator verkleinert sich durch die Tatsache, dass elf Länder nur die zivile Beschäftigung abdecken, während die anderen Länder die Gesamtbeschäftigung abdecken. Darüber hinaus werden Wehrpflichtige von fünf Ländern nicht abgedeckt. Ein anderer, aber weniger schwerwiegender Unterschied liegt in der Tatsache, dass in acht Ländern Mitglieder der Herstellergenossenschaften nicht zu den selbstständigen Arbeitnehmern gezählt werden.

Kombination des Pro-Kopf BIP und die Selbstständigkeitsrate

Dieses Projekt hat zum ersten Mal identifiziert, dass mindestens zwei makroökonomische Faktoren von zentraler Bedeutung für die Gesundheit der Bevölkerung in Industriestaaten sind: das reale Pro-Kopf-BIP und der Anteil der Selbständigen an der arbeitenden Bevölkerung. Unsere Ergebnisse zeigen eine außergewöhnliche Übereinstimmung in Bezug auf die Todesursachen, Altersgruppen und Geschlecht in der Wichtigkeit dieser beiden Faktoren. Die Gesamtmortalität, die Mortalität aufgrund von kardiovaskulären Erkrankungen, sowie die Mortalität aufgrund von bösartigen Tumoren, Zirrhose, Selbstmord und Mord, Unfälle im allgemeinen, Kraftfahrzeugunfälle, Unfälle ohne Beteiligung eines Kraftfahrzeugs zeigen alle eine starke und stabile umgekehrte Beziehung zu dem Pro-Kopf-BIP und der Selbstständigkeit. In einer gewissen Weise sind diese Ergebnisse nicht überraschend, denn sie stimmen mit zwei Forschungsveröffentlichungen im Bereich der Epidemiologie überein.

Erstens ist es viel bedeutender, dass in fast allen Gesellschaften der Industrieländer die Mortalität für fast alle Todesursachen für alle Altersgruppen und für beide Geschlechter umgekehrt mit dem sozioökonomischen Status zusammenhängen. Diese Verbindung konnte am besten beobachtet werden, wenn das Niveau der beruflichen Qualifikation und das Bildungsniveau die identifizierten Indikatoren des sozioökonomischen Status waren. In den letzten zwei Jahrzehnten wurde das Einkommen trotz allem immer mehr zum Indikator des sozioökonomischen Status, in dem diese umgekehrte Beziehung gefunden wurde. Zweitens zeigen die Veröffentlichungen über psychophysiologischen Stress jetzt auf, dass alle Hauptursachen für Krankheit und Tod eine Gemeinsamkeit haben, nämlich eine wichtige Verbindung zu emotionaler Unruhe. Die Mechanismen umfassen kardiovaskuläre Erkrankungen, Störungen des Immunsystems (einschließlich bösartige Tumore und Infektionen), Depressionen, Aggressionen und Müdigkeit (einschließlich Unfälle, Selbstmord und Mord) und Antworten, um mit dem psychophysiologischen Stress umzugehen, nämlich den Konsum von Alkohol, Tabak, Fetten und möglicherweise auch Kohlenhydraten (die Diabetes, Zirrhose und andere metabolische Krankheiten mit sich bringen). Seitdem bekannt

ist, dass sowohl das Wachstum des BIP und Arbeitsstress diese Ursachen von Krankheit und Tod zu beeinflussen, ist es klar, dass Forschungsveröffentlichungen auf der Ebene von Analysen ebenfalls plausible Grundlagen liefern, die in Einklang mit unseren Ergebnissen auf makroökonomischer und nationaler Ebene stehen.

Letztendlich verweist die Literatur darauf, dass es eine spezielle, symbiotische Verbindung zwischen dem BIP und der Selbstständigkeitsrate in den Industriegesellschaften mit einem höheren Einkommen gibt. Es scheint, dass die anfängliche Entwicklung, Existenz und das weitere Überleben von Selbstständigen und kleinen Unternehmen zu einem großen Teil, zumindest was die Finanzierung betrifft, von einem relativ florierenden Geschäftsklima abhängt. Dies ist besonders zutreffend, wenn ein neues Unternehmen genau den Vertretern der wissenschaftlichen und kommerziellen Innovation entspricht, welche die Informationsökonomie repräsentieren. Folglich wird eine relativ hohe Selbstständigenquote versuchen, mit einem hohen Pro-Kopf BIP in einer hoch urbanisierten Gesellschaft, die durch den hoch entwickelten Tertiärsektor beherrscht wird, zu koexistieren. Gleichwohl kann ironischerweise die Kombination solch eines hohen Pro-Kopf-BIPs und Selbstständigkeit von einer relativ hohen Arbeitslosenquote innerhalb der gleichen hoch urbanisierten Gesellschaften begleitet werden. Dies scheint charakteristisch zu sein für die Tendenzen der letzten zwei Jahrzehnte, in denen eine erhöhte Produktivität nicht von einem ähnlichen Anstieg der Anzahl der Arbeitsplätze begleitet war.

Schattenwirtschaft und Einkommensungleichheit

Ein dritter makroökonomischer Faktor von wesentlicher Bedeutung in Bezug zu seiner Beziehung zu den vielen verschiedenen Arten der Mortalität ist das Ausmaß zu dem das BIP aus Aktivitäten der Schattenwirtschaft besteht. Die Schatten-, schwarze oder inoffizielle Wirtschaft (abhängig von seiner offiziellen Bezeichnung) besteht aus Beschäftigung, die ausgeübt wird, ohne dass Steuern an die Regierung gezahlt werden. Darüber hinaus beinhaltet diese Art von Beschäftigung keine Regelungen durch Gesundheits- und Sicherheitsmaßnahmen, Arbeitslosenversicherung, Invaliditätsversicherung oder Alterssicherung. Das Ergebnis unserer Studie besagt, dass in Bezug auf die Gesamtmortalität, Herz-Kreislauf-Mortalität und Unfallmortalität, das Verhältnis der Wirtschaft, die als Schattenwirtschaft eingestuft werden kann, stark positiv assoziiert ist mit höheren Mortalitätsraten innerhalb der Bevölkerung im arbeitsfähigen Alter. Dies ist die dritte wichtige Variable, die einen Risikofaktor für die Mortalität in den Industrieländern darstellt. Wie in dem Fall der Selbstständigkeit, handelt es sich um ein völlig neues Ergebnis in der demografischen Epidemiologie.

Im Gegensatz dazu wurde in den letzten 15 Jahren die Einkommensungleichheit immer als der Hauptfaktor angenommen, der möglicherweise die Mortalitätsrate von sowohl Industrieländern als auch von Entwicklungsländern ansteigen lässt. Aus diesem Grund haben wir es als für wichtig gehalten, zumindest den Ginikoeffizienten (Messung der nationalen Einkommensungleichheit) in der Entwicklung unserer allgemeinen Modelle zur Voraussage der Mortalität zu überprüfen. Wir haben herausgefunden, dass der Ginikoeffizient fest mit höheren Gesamtmortalitätsraten und Herz-Kreislauf-Mortalitätsraten verbunden ist, aber diese Verbindung erreicht nicht statistisch signifikant, wenn wir nur die EU-Mitgliedsstaaten und die OECD-Länder in unsere Stichprobe mit einbeziehen. Der

Ginikoeffizient erreicht nur klare statistische Signifikanz, wenn wir in unsere Länderauswahl auch die GUS-Staaten (insbesondere Russland, die Ukraine und Georgien) mit einbeziehen. Es muss noch untersucht werden, ob dieses Ergebnis aufgrund der Notwendigkeit einer größeren Ländergruppe oder aufgrund der Möglichkeit dass die internationale Bedeutung des Konzentrationskoeffizienten nur definierend für Länder mit einem relativ niedrigen Pro-Kopf-BIP erzielt wurde.

Messung der Schattenwirtschaft

Es ist offensichtlich sehr schwierig, genaue Angaben über die Aktivitäten der Schattenwirtschaft zu erhalten, denn auf der einen Seite ist die Schattenwirtschaft an sich ein sehr komplexes Phänomen und auf der anderen Seite möchten diejenigen, die in diese Aktivitäten involviert sind, nicht identifiziert werden. Für die Forschungsarbeit für diese Studie haben wir Daten über die Schattenwirtschaft verwendet, die von Prof. Dr. Friedrich Schneider von der Johannes-Kepler-Universität in Linz in Österreich zur Verfügung gestellt wurden. Prof. Dr. Friedrich Schneider verwendet das DYMIMIC- (DYnamic Multiple-Indicators Multiple-Causes) Verfahren, um Schätzwerte über die Größe der Schattenwirtschaft davon abzuleiten (siehe Schneider, 2005).

Es steht fest, dass jegliches Verfahren zur Schätzung der Größe der Schattenwirtschaft kritisiert werden kann (siehe z.B., Renoy, et. al., 2004). Der größte Vorteil von Schneiders Verfahren liegt darin, dass es Schätzwerte für eine große Anzahl von Ländern liefert, die ein homogenes methodologisches Verfahren verwenden. Die Anwendung seiner Daten innerhalb unserer Studie hat uns zu kohärenten und plausiblen Ergebnissen kommen lassen, und unsere Ergebnisse wiederum zeigen, dass sein Verfahren etwas identifiziert, was wirtschaftlich bedeutsam und wichtig ist.

Schneider F (2005) Shadow Economies around the World: What do we really know? (Schattenwirtschaften dieser Welt: Was wissen wir wirklich?) European Journal of Political Economy 21(3), 598-642

Renoy P, Ivarsson S, van der Wusten-Gritsai O Meijer E (2004) Undeclared work in an enlarged union. An analysis of undeclared work. An in-depth study of specific items (Nicht angegebene Arbeit in einer erweiterten Union. Eine Analyse von nicht angemeldeter Arbeit. Eine Tiefenstudie von spezifischen Punkten). Europäische Kommission, Generaldirektorat für Arbeit und Soziales, Abteilung EMPL/A/1

Messung der wirtschaftlichen Ungleichheit

Die Datenreihe für 24 Länder gibt uns den Ginikoeffizienten des European Community Household Panel (ECHP, veröffentlicht durch Eurostat) und wurde entweder für 2000 oder 2001 berechnet. Die Länder in Westeuropa sind: Österreich, Belgien, Dänemark, Finnland, Frankreich, Deutschland, Griechenland, Irland, Italien, die Niederlande, Portugal, Spanien, Schweden, das Vereinigte Königreich; in Osteuropa: Bulgarien, die Tschechische Republik, Estland, Ungarn, Lettland, Litauen, Polen, Rumänien, Slowenien. Die Datenreihe für 31 Länder wird aus zwei Quellen kombiniert (ECHP und WDI), so dass die Werte für 23 Länder des ECHP zu dem WDI für Weißrussland, Kroatien, Moldawien, Norwegen, der Russischen Föderation und der Ukraine dazugenommen wurden.

In Bezug auf die 38 Länder, die die Hauptzielländer unserer Studie waren, stammen die Ginikoeffizienten aus zwei Quellen (ECHP und WDI), je nachdem welche Quelle uns Daten bezüglich dieses Landes liefern konnte. Die 24 Länder, bei denen wir Daten des ECHP verwendet haben, sind Österreich, Belgien, Bulgarien, Tschechische Republik, Dänemark, Estland, Finnland, Frankreich, Deutschland, Griechenland, Ungarn, Irland, Italien, Lettland, Litauen, Luxemburg, die Niederlande, Polen, Portugal, Rumänien, Slowenien, Spanien, Schweden und das Vereinigte Königreich. Für vier Länder wurden WDI-Ginikoeffizienten verwendet: Norwegen, Mexiko, Türkei und die Vereinigten Staaten. Folglich waren für 28 der 38 Länder Daten in Bezug auf den Ginikoeffizienten vorhanden. Die zehn Länder, für die keine Daten bezüglich des Ginikoeffizienten in einer der Quellen vorhanden waren, sind: Australien, Kanada, Zypern, Island, Japan, Korea, die Republik Malta, die Slowakische Republik, die Schweiz und Neuseeland.

Proportionale Auswirkungen der wirtschaftlichen Haupteinflusswerte

Die nachfolgenden Balkendiagramme zeigen den relativen Einfluss der drei wichtigsten makroökonomischen Prädikatoren (reales Pro-Kopf-BIP, Selbstständigenrate und die Schattenwirtschaft im Verhältnis zum BIP), um die Unterschiede in den Gesamtmortalitätsraten innerhalb der Länder nach Alter und Geschlecht darzustellen.

Abbildung 1: Bereinigtes R²: Gesamtmortalität, beide Geschlechter (Querschnitt, Jahr 2000)

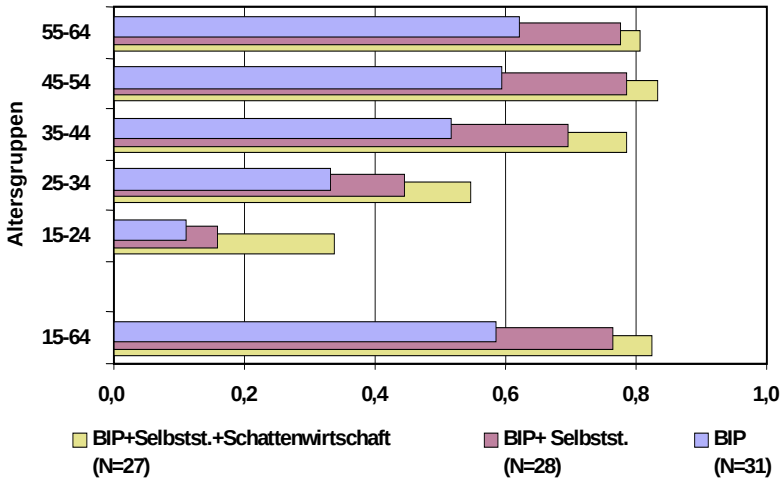


Abbildung 2: Bereinigtes R²: Gesamtmortalität, Männer (Querschnitt, Jahr 2000)

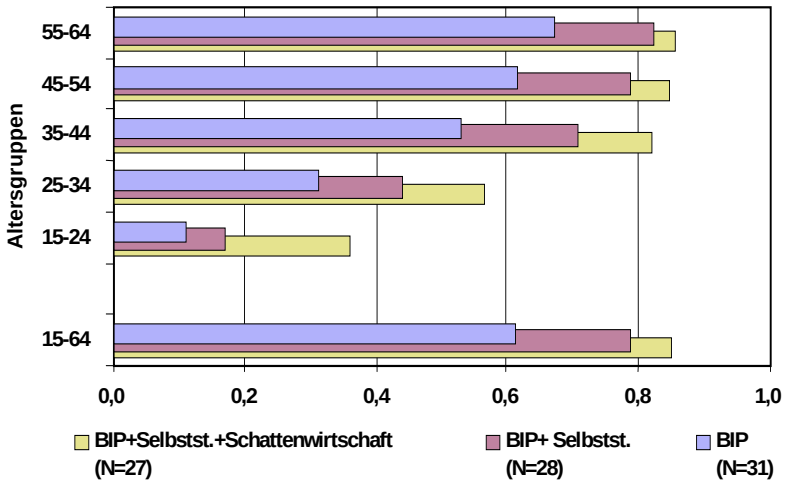
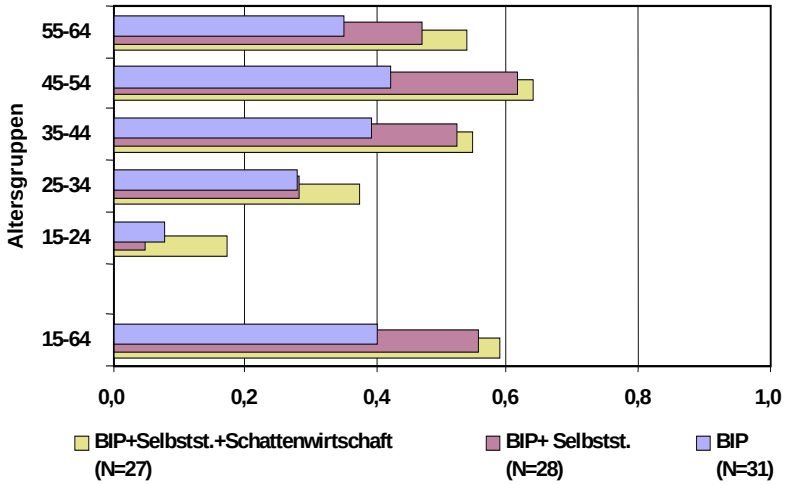


Abbildung 3: Bereinigtes R²: Gesamtmortalität, Frauen (Querschnitt, Jahr 2000)



Adjustierung für epidemiologischen Risikofaktoren

Dieser Fall liegt klar vor, wenn mit 2-4 wirtschaftlichen Variablen, wie oben gezeigt, es statistisch möglich ist, den Hauptanteil der Variation in Bezug auf die Mortalität der Bevölkerung der Industrieländer, die im arbeitsfähigen Alter ist, zu erklären. Dennoch wäre es eine Nachlässigkeit, nicht die möglichen Auswirkungen der epidemiologischen Risikofaktoren zu berücksichtigen, denn diese wurden deutlich als mögliche Ursachen für die Mortalität identifiziert. Sie umfassen einen hohen nationalen Konsum von Alkohol, Tabak, Kohlenhydraten und tierischen Fetten. Eine Berücksichtigung dieser Faktoren verbessert normalerweise nicht die Fähigkeit unserer Modelle, die Variation in der Mortalitätsrate in den verschiedenen Ländern zu erklären, besonders nicht, wenn wir sehr spezielle Todesursachen berücksichtigen. Wir sollten dennoch festhalten, dass es uns im Laufe dieser Studie nicht möglich war, die komplizierten Wirkungsverzögerungsstrukturen, die die langfristigen Assoziationen zwischen den epidemiologischen Risikofaktoren und der Mortalität ausmachen, zu messen.

Wie bereits erwähnt, sind zur gleichen Zeit all diese “Lebensstil”-Faktoren, die in den verschiedenen Gesellschaften mehr oder weniger ausgeprägt sind, anerkannte Quellen von möglichen psychologischen “Coping”-Mechanismen, die in Zusammenhang mit Arbeitsstress, Depressionen und Angstgefühlen stehen. Es kann folglich nicht ausgeschlossen werden, dass diese “Konsum”-Variablen zu den komplizierteren Modellen der Mechanismen gehören, durch die die makroökonomischen Faktoren und die Faktoren des Arbeitsmarkts die Gesundheit des Arbeitnehmers beeinflussen. Es ist von daher sehr wahrscheinlich, dass zukünftige Modelle, die die späteren Phasen dieser Forschung zusammenfassen, sowohl die direkten als auch die indirekten Auswirkungen der makroökonomischen und Faktoren des Arbeitsmarktes aufzeigen werden. In diesem Fall werden die indirekten Einflüsse auf die Mortalität immer noch das Pro-Kopf-BIP, die Selbstständigkeitsrate, die Aktivitäten der Schattenwirtschaft und die Einkommensungleichheit umfassen. Diese indirekten Auswirkungen werden sich dann teilweise durch die Mechanismen des Konsums von Tabak, Alkohol, Kohlenhydraten und gesättigten Fetten manifestieren.

Politische Überlegungen

Eine der Hauptüberlegungen in Bezug auf die Politik der Europäischen Kommission ist, ob die “Qualität des Arbeitslebens” Auswirkungen auf die körperliche und geistige Gesundheit hat – und zwar so, dass diese Auswirkungen gemessen werden können. Sollte dies der Fall sein, so erfordert dies die zwei folgenden Aussagen. Die Erste besagt, dass Messungen von gesundheitlichen Folgeerscheinungen, wie die Gesamtmortalität und die Herz-Kreislauf-Mortalität innerhalb der arbeitenden Bevölkerung als „harter“ quantitativer Messwert für die Vorteile einer akzeptablen Qualität des Arbeitslebens dienen können. Sie können aus diesem Grund auch als Endpunkte in der Bewertung der Wirksamkeit und der Effizienz von Arbeits- und makroökonomischen Politiken eingesetzt werden. Zweitens, wenn Beschäftigungs- und Sozialpolitiken durch ihren Einfluss auf makroökonomische und Arbeitsmarktindikatoren, positive Auswirkungen auf die Gesundheit haben, dann wird eine Folgeerscheinung sein, dass sich die Produktivität durch diese Politiken erhöht, denn sie führen zu einer Verbesserung der körperlichen und geistigen Gesundheit der Arbeitnehmer. Es gibt einen feststehenden Konsens in der Literatur über Humankapital, dass eine

verbesserte Gesundheit der Arbeitnehmer die Hauptquelle für eine erhöhte Arbeitsproduktivität ist.

Die zweite Frage ist, ob konventionelle oder innovative Arten der Arbeitsmarkt- oder makroökonomischen Politik auf die Ergebnismessungen in Bezug auf Gesundheit gemäß den Ergebnissen dieser Studie angewandt werden können. Es ist natürlich klar, dass Politiken, die die Produktivität erhöhen – und demzufolge in einem höheren Pro-Kopf-BIP resultieren – zu den wichtigsten Faktoren gehören, die die Gesundheit der Bevölkerung verbessern. Es benötigt demzufolge nicht vieler Argumente, um plausibel darzustellen, dass Investitionen in die Forschung und Entwicklung, in die Bildung – und in lebenslanges Lernen im Allgemeinen – d.h. Verbesserung des Humankapitals, wichtige Quellen für eine verbesserte Gesundheit der Arbeitnehmer durch eine Erhöhung der Produktivität sind.

Die Industriestaaten stehen jetzt der Herausforderung gegenüber, dass die weitere Erhöhung der Produktivität in den letzten Jahrzehnten von einer abnehmenden Schaffung von (netto) Arbeitsplätzen, die normalerweise den wirtschaftlichen Aufschwung begleitet, betroffen war. Einige Denker haben argumentiert, dass, wenn diese Tendenz anhält, sie zu einer Gesellschaft führen wird, die aus gutsituierten Akademikern und aus solchen, die von der wissensbasierten Gesellschaft abhängen, besteht. Zur gleichen Zeit wird dies auch zu einem Anstieg desjenigen Bevölkerungsanteils führen, der geringe Qualifikationen aufweist und aus diesem Grund weniger Chancen auf dem Arbeitsmarkt haben. Diese Vision einer Gesellschaft wirtschaftlicher Spaltung kann aus politischer Sicht nicht toleriert werden. Aber sie würde auch zu einer Gesellschaft führen, in der viele der weniger Qualifizierten sich nur minimal an der Wirtschaft beteiligen und sie somit in die Armut abzugleiten drohen.

Die Frage ist: Wie können wir weiterhin ein hohes Produktivitätswachstum haben und zwar mit den Veränderungen, die in der Industriestruktur bewirkt werden, allerdings ohne dass es zu einer weitreichenden technischen Arbeitslosigkeit oder Unterbeschäftigung führt? Zum Beispiel gibt es zur Zeit mehrere europäische Länder, die eine relativ hohe Produktivitätsrate haben und aber auch eine anhaltend hohe Arbeitslosenquote verzeichnen. Eine wichtige Möglichkeit, die in dieser Studie vorgebracht wird ist, dass auf Arbeitslosigkeit, oder Inaktivität aufgrund von schnellen strukturellen Veränderungen, die der modernen wissensbasierten Gesellschaft eigen sind und die politikabhängig sind, mit einer Erhöhung der Selbstständigenquote und der vermehrten Beschäftigung in kleinen Unternehmen geantwortet wird. Selbstständigkeit und die Beschäftigung in kleinen Unternehmen sind folglich mögliche “Schockauffänger” in dem Zeitalter der wissensbasierten Gesellschaft, in der freigesetzte Arbeitnehmer mit unterschiedlichen Qualifikationen (a) in die Beschäftigung zurückkehren können und (b) dies mit einem höheren Grad an Autonomie und eventuell auch mit mehr Einkommen tun können. Die Wichtigkeit der Selbstständigkeit und der Beschäftigung in kleinen Unternehmen während Zeiten von schnellen technologischen und gesellschaftlichen Veränderungen liegt darin, dass sie die große Fähigkeit besitzen, innovativ zu wirken und sich anzupassen. Um es einfach auszudrücken: Ein kleines und relativ kreatives Unternehmen kann sich den Märkten schnell anpassen und sogar innovative Möglichkeiten auf dem Markt durch eigene Aktivitäten schaffen. Es wird in der betriebswirtschaftlichen Literatur in der Tat argumentiert, dass ein Großteil der Innovationen, die zu einer höheren Produktivität der gesamten Wirtschaft führen, aus individuellen Firmeneigentümern und kleinen Firmen resultiert.

Dies steht im Gegensatz zu der ein wenig überholten Annahme der klassischen „bürokratischen“ Organisation, eine Annahme die übrigens auch von Experten vertreten wird. Die Regelungen und Kulturen solcher Organisationen sind tief mit den Interessen ihrer Betriebsführungsstruktur verankert, die normalerweise umfangreiche Investitionen umfassen, um den Status Quo gegen Konkurrenten (von außen und von innen) aufrecht zu erhalten. Ähnlich ist innerhalb solcher Organisationen eine große Gruppe von Arbeitnehmern tief in die augenblickliche Struktur aufgrund des Dienstalters, Qualifikation und Position verankert – so dass wichtige Änderungen als kurz- oder langfristig karriereschädigend empfunden werden. Die Europäische Kommission hat in ihren politischen Plänen mehrmals darauf hingewiesen, dass ein wirtschaftlicher Rahmen sowohl die Flexibilität der Beschäftigung als auch die Sicherheit der Beschäftigung umfassen muss, denn diese stellen das Optimum für eine befriedigende Arbeitsumgebung dar. Eine Herangehensweise an solch ein Ideal wäre die Förderung der Entwicklung von kleinen Unternehmen und der Selbstständigkeit, die sich auf Forschung und Entwicklung, Dienstleistungen, Einzelhandel und andere städtische Annehmlichkeiten spezialisiert haben. Die Forschungsliteratur besagt, dass es diese Tendenz bereits in der Entwicklung des fortgeschrittenen Tertiärsektors (d.h. wissensbasierte Gesellschaft) in der städtischen Zivilisation gibt (Mingione 1997; Castells 2000). Dies ist in der Tat Teil des Phänomens, das besonders französische und amerikanische Technologie-Soziologen als das „postindustrielle“ Zeitalter bezeichnen. Jedoch würde eine Konzentration auf kleine Unternehmen und Selbstständigkeit bedeuten, dass man den Hauptteil der Beschäftigung vernachlässigt, den man in mittelgroßen und großen und sehr komplexen Organisationen findet.

Wenn die aus dieser Studie stammende Verallgemeinerung richtig ist, dass kleine und anpassungsfähige Arbeitseinheiten, die widerstandsfähiger gegenüber dem Druck der Rezession und der strukturellen Veränderungen sind, und sich dementsprechend positiv auf die geistige und körperliche Gesundheit auswirken, dann sollte man diesen Prototyp verwenden, um die Organisationsstruktur eines großen Unternehmens aufzubauen. Dies bedeutet, dass wir die größere, komplexe Organisation in ihren strukturellen Komponenten sehen müssen – als „Miniunternehmen“. Diese Miniunternehmen können möglicherweise auf verschiedenen Ebenen des hohen technologischen Entwicklungsstands oder der Innovation tätig sein. Anders ausgedrückt bedeutet dies, wenn eine neue wichtige Technologie in einem Industriezweig aufkommt, so würde ein Verfahren die gesamte Organisation schnell restrukturieren. Hierbei würde es so einem beträchtlichen internen Konflikt kommen und viele Arbeitnehmer würden gezwungen werden, das Unternehmen zu verlassen. Eine Alternative wäre die Einführung einer bedeutenden technologischen Einheit, oder eine Reihe von Innovationen, in einem kleinen Teil des Unternehmens oder in einer neugegründeten Abteilung, so dass der Rest des Unternehmens nicht davon betroffen ist.

Diese Vorgehensweise ist in vielen großen Unternehmen, die sich jetzt dem technologischen Wandel gegenübersehen, nicht ungewöhnlich, aber es würde sich lohnen, diese Denkweise noch weiter auszubauen. So kann ein Großteil des gesamten Unternehmens mit seinen zahlreichen Komponenten und Abteilungen als halb unabhängige Einheiten arbeiten, von denen jede ihre eigene Führung hätte und sich durch Anpassung oder Innovation den verschiedenen Teilen des externen Markts anpassen könnte und somit ihre eigene Wachstumsstruktur und letztendlich ihr Überleben aufrecht erhalten könnte. Dies ist eine angenehme Vision bis zu dem Moment, wo wir erkennen, dass der Verlauf des Wettbewerbs

und die “schöpferische Zerstörung” bestimmte Abteilungen dieses Unternehmens ausschalten bzw. drohen auszuschalten. Die mögliche Antwort auf solch eine Situation wäre es, Arbeitnehmer dieser Abteilungen die wahrscheinlich von Arbeitszeitverringerung bedroht sind, in die Abteilungen zu versetzen, in denen es vermehrt Investitionen und Beschäftigung gibt, damit so eine nachhaltige Nische auf dem externen Markt gefunden werden kann.

Aber wie können wir schnell Arbeitnehmer von einer Abteilung in die andere versetzen, da doch die Qualifikationsanforderungen in den verschiedenen Abteilungen unterschiedlich sind? Eine Lösung wäre, dass das Unternehmen ein internes Weiterbildungsprogramm entwickelt – vielleicht gemeinsam mit Universitäten oder weiterführenden Schulen – so dass das allgemeine Niveau der Qualifikationsanforderungen aufrecht erhalten wird und welches es den Angestellten ermöglichen würde, mit einer kleinen zusätzlichen firmeninternen Weiterbildung von einer Abteilung in die andere zu wechseln, sollten es die schnellen technologischen Veränderungen erfordern. Aus wirtschaftlicher Sicht bedeutet das, dass es eine neue oder wieder aufgefrischte Verbindung zwischen der Industrie bzw. Dienstleistungsunternehmen und dem Bildungssystem gibt. Anders gesagt, stellt dies wie so schön von der Europäischen Kommission gesagt, ein gut ausgearbeitetes Programm des „lebenslangen Lernens“ dar. Solch ein Lernen ermöglicht es den Arbeitnehmern, innerhalb eines Unternehmens von einer Abteilung in die andere zu wechseln, allerdings können sie auch von einem Unternehmen in ein anderes wechseln oder sogar von einem Industriezweig zu einem anderen. Dieses Modell ist nicht vollkommen unrealistisch. Es existiert wie fast selbstverständlich in vielen Hightech-Firmen und ist auch an Universitäten weit verbreitet.

Im Universitätsumfeld mit seinen akademischen Instituten verändern sich die wissenschaftlichen Entdeckungen und Entwicklungen viele Male im Laufe einer einzelnen Karriere. In diesen Situationen muss der einzelne Wissenschaftler oder Student seine Spezialisierung oder sogar sein akademisches Studienfach ändern, um weiterhin ein produktives Mitglied der intellektuellen Gesellschaft zu bleiben. Das Gleiche trifft oft auf ganze akademische Institute oder Studiengänge einer Universität zu. Innerhalb der wissensbasierten Gesellschaft wäre es aus diesem Grund logisch, ein “industrielles” Modell vorzuschlagen, das auf dem Prototypen der sehr produktiven Universitäten basiert. In solch einem Szenario liegt die Sicherheit der Beschäftigung in der Flexibilität der Beschäftigung, wobei Flexibilität sich hier auf die Fähigkeit des Arbeitnehmers von einem Arbeitsplatz zum anderen zu wechseln, bezieht. Hierbei sollte es nur minimale rechtliche Einschränkungen geben und der Arbeitnehmer muss natürlich die notwendigen Qualifikationen erworben haben. Bis zu dem Maß, bis zudem dies für die Wirtschaft als Ganzes durchführbar ist, würde es eine Verringerung der Arbeitslosenquote und der Unterbeschäftigung aufgrund von strukturellen Veränderungen geben. Die vorsichtige Anpassung der arbeitenden Bevölkerung an den technologischen Wandel – d.h. ohne grundlegende Unterbrechungen der Karrieremuster – würde die körperliche und geistige Gesundheit der arbeitenden Bevölkerung signifikant verbessern und aus diesem Grund würde sich ebenfalls die langfristige Produktivität erhöhen.

Die Grundlage für diese Art von Flexibilität – oder Austauschbarkeit der Rollen durch eine Weiterentwicklung der Qualifikationen – steht in Verbindung mit der Wissensgrundlage der Arbeitnehmer. Diese Wissensgrundlage ermöglicht dem Arbeitnehmer eine relative Autonomie in der Entscheidungstreffung im Arbeitsumfeld. Das ist in einer wissensbasierten

Wirtschaft natürlich angemessen und notwendig, denn ein großer Teil der Leistung eines Arbeitnehmers liegt in der Produktion und in der Weitergabe von Wissen an sich. Dieses trifft ganz besonders zu wenn man sich bewusst wird, dass sogar in der “Produktion” von Gütern und Dienstleistungen diese Güter und Dienstleistungen die Schaffung von neuem Wissen verkörpern (oder darauf basieren).

Ist dieses Szenario überoptimistisch in dem sehr stark vom Wettbewerb beeinflussten heutigen Umfeld? Natürlich gibt es keine vollständig logische, technokratische Lösung der “Probleme” des Wandels, die von wettbewerbsfähigen Volkswirtschaften eingebracht werden. Es gibt auch keinen Ersatz für Investitionen in Forschung und Entwicklung, Unternehmertum, dingliches und menschliches Kapital, für eine ständige Reorganisation der Industrie und des Sozialschutzes. Aber ohne diese Investitionen verringert sich die Wahrscheinlichkeit einer gesunden und produktiven Gesellschaft beträchtlich.

Aus einer ermutigenderen Perspektive betrachtet, kann man sagen, dass es nur wenige Zweifel gibt, dass viele Hightech-Unternehmen in der gesamten industrialisierten Welt jetzt intern organisiert sind in Abteilungsstrukturen, die selbst Entscheidungen treffen. In diesen Unternehmen werden große Anstrengungen unternommen, um die Arbeitnehmer zu behalten und zu fördern, deren Qualifikationen es ihnen erlaubt, in verschiedenen Abteilungen zu arbeiten. Dieses Modell des Hightech-Unternehmens ist das, was vielleicht von dem “Indikator” einer großen Proportion von Selbstständigen und kleinen Unternehmen und der wissensbasierten Wirtschaft signalisiert wird. Von gleicher Bedeutung ist die Sichtweise, dass sogar moderne, große Hightech-Unternehmen nicht optimal arbeiten, wenn es keine kleinen, spezialisierten Unternehmen gibt, von denen Innovationen ausgehen und an die einzelne Projekte ausgelagert werden können.

Insgesamt kann man das Vorhandensein von Selbstständigen und kleinen Unternehmen als Teilindikator in hochurbanisierten Gesellschaften für das Vorhandensein der wissensbasierten Wirtschaft – und intern spezialisierten Arbeitsorganisationen – auch in größeren Unternehmen sehen. Man sollte zur gleichen Zeit nicht vergessen, dass Selbstständige und Familienunternehmen von zahlenmäßig relevanter Bedeutung im Handwerk und im Einzelhandel sowie im Hotel- und Gaststättengewerbe sind. Sie haben zwar nicht notwendigerweise eine Verbindung zu den Hightech-Berufen, allerdings repräsentieren sie die Standardstruktur der Beschäftigung im fortgeschrittenen Dienstleistungssektor im städtischen Umfeld des frühen 21. Jahrhunderts.

Schlussfolgerung

Diese Studie hat Querschnitts- und gepoolte Querschnitts- und Zeitreihenregressionsmodelle sowie Zeitreihenregressionsmodelle verwandt, um Hypothesen zu überprüfen, mit Hilfe derer der Einfluss von Standardrisikofaktoren auf die Gesundheit der Bevölkerung im arbeitsfähigen Alter auf der nationalen Analyseebene festgestellt werden kann. Sollte sich dieses als wahr herausstellen, sollten die Entscheidungsträger in der Lage sein, die Ergebnisse in der Formulierung oder Änderung von arbeitsplatzbezogener Gesundheitspolitik gemäß ihrer gemessenen Auswirkungen auf die Mortalität zu verwenden. Darüber hinaus gab es auch ein besonderes Interesse daran herauszufinden, ob die Indikatoren des Wandels in der Makroökonomie und auf dem Arbeitsmarkt per se mit

Mortalitätsprozessen in Verbindung stehen, was dann den Unterschied in der Erfahrung der Industrieländer erklären würde. Sollte dieses dann noch untermauert werden können, kann man die Mortalitätsraten für die Haupttodesursachen als wesentliche Indikatoren für die Wirksamkeit der nationalen Politiken auf den Gebieten der Makroökonomie, des Arbeitsmarkts, des Sozialschutzes, der Betriebsführung von Unternehmen und der Gesundheit und Sicherheit am Arbeitsplatz angenommen werden. Unser Hauptergebnis ist, dass die nationalen Mortalitätsraten stark auf die wirtschaftlichen Veränderungen in der Gesamtwirtschaft und der Arbeitsmärkte innerhalb (intern) und außerhalb (extern) kleiner und größerer Unternehmen reagieren.

Die wichtigsten Ergebnisse waren, dass das reale Pro-Kopf-BIP und der Anteil der Bevölkerung, die selbstständig tätig ist, den Hauptteil der Variationen in den Mortalitätsraten der Industriestaaten ausmachen. Jeder dieser Faktoren ist stark umgekehrt proportional mit den altersbereinigten Mortalitätsraten verbunden. Die zweite Gruppe von wirtschaftlichen Variablen, die die Abweichungen in den Mortalitätsraten beeinflusst, besteht aus dem Anteil des BIP, das von der Schattenwirtschaft ausgemacht wird (ein Hauptrisikofaktor für eine höhere Mortalität) und der wirtschaftlichen Ungleichheit (beeinflusst ähnlich höhere Mortalitätsraten).

Warum ist das reale Pro-Kopf-BIP so eine wichtige Quelle, eigentlich sogar fundamentale Quelle, einer geringen altersbereinigten Mortalität? Die vielleicht breiteste Antwort lautet: Da das Wirtschaftswachstum von der Entwicklung der Wissenschaft und der Technologie abhängt, so ist es eigentlich die Entwicklung der Wissenschaft und der Technologie selbst, die die Grundlage für eine bessere Gesundheit der Arbeitnehmer in nationalen Volkswirtschaften darstellt. Wissenschaft und Technologie liefern die Grundlage für die Lösung von althergebrachten und neueren Problemen hinsichtlich der Anpassung von Menschen hinsichtlich des biologisch-physikalisch-chemischen Umfeldes und dem menschlichen bzw. dem erschaffenen Umfeld. Anpassung bezieht sich hier auf die Entwicklung von Lösungen in Bezug auf die Probleme des Überlebens und des Funktionierens (d.h. „Gesundheit“). Die fundamentale Bedeutung der Wirtschaft für die Gesundheit besteht aus vier Punkten: Sie liefert die Grundlage für die Finanzierung (1) der Transformation der wissenschaftlichen, begrifflichen Basis der Anpassung in deren materielle Manifestation, basierend auf der technologischen Umsetzung, (2) die anfänglichen Quellen der wissenschaftlichen Arbeit auf dem Gebiet der Forschung und Entwicklung, (3) das Unternehmertum, das notwendig ist, um Innovationen in den Produktionsprozess und auf die Märkte zu bringen und (4) die Fähigkeit der Konsumenten und Unternehmen, die Verkörperung dieser Innovationen zu erwerben, sowohl als Güter als auch als Dienstleistungen.

Die besondere Bedeutung des Wirtschaftswachstums als Voraussetzung zur Finanzierung von bewährten Standards der Arbeitssicherheit und Gesundheit ist für die Gesundheit der Arbeitnehmer unerlässlich. Diese umfassen Normen, die die Ergonomie, die Toxikologie, die Klimakontrolle, chemische Risikofaktoren (besonders Karzinogene) und Beförderungsgefahren betreffen. Von möglicherweise gleicher Bedeutung ist die Finanzierung von medizinischen und chirurgischen Technologien, um die Schwere von Unfällen oder Krankheiten, deren Ursprung am Arbeitsplatz liegt, zu vermindern. Dies kann geschehen durch (1) die Entwicklung von Verfahren für den Notfall und für den ambulanten

Fall und (2) intensive Behandlungen im Krankenhaus, um Krankheit/Invalidität zum Zwecke eines längeren Lebens zu lindern. Darüber hinaus ist es wichtig, wenn man Länder vergleicht, nicht zu vergessen, dass die arbeitende Bevölkerung einen unterschiedlichen Zugang zu der zur Verfügung stehenden Hightech-Gesundheitsversorgung aufgrund des nationalen Systems von gesetzlichen und privaten Gesundheitsfürsorgesystemen hat. All diese Fragen in Bezug auf den Zugang des Arbeitnehmers sind wiederum das Resultat des Wohlstandes von Gesellschaften – in der Fähigkeit ihres öffentlichen und privaten Sektors die Möglichkeit, Gesundheitsfürsorge zu bekommen, zu finanzieren.

Wir haben eine wichtige Rolle des Pro-Kopf-BIP identifiziert. Es ist eine der Hauptquellen der Fähigkeit von Gesellschaften wissenschaftliche und technologische Fortschritte in der menschlichen Anpassung zu finanzieren und zu verwirklichen. „Wirtschaftliche Entwicklung“ geht einher mit einem langfristigen Wirtschaftswachstum. Das beinhaltet die klassische Tendenz (empirisch beobachtet, jedoch logisch nicht notwendig) vieler Gesellschaften des modernen Zeitalters, die wirtschaftliche Relevanz von dem Primär- und Sekundärsektor auf den Tertiärsektor zu verlagern. Kürzlich, d.h. im späten 20. und frühen 21. Jahrhundert, entwickelte sich der Tertiärsektor in die “Wissens-“ oder Informationswirtschaft. Dies scheint von einer erheblich geringeren Beschäftigung in der verarbeitenden Industrie, die in komplexen, hierarchischen Organisationen aufgebaut ist, gekennzeichnet zu sein. Darüber hinaus ist sie gekennzeichnet von einem starken Aufkommen von wissenschaftlichen, technischen und leitenden Berufen, zusätzlich zum Einzelhandel und den Hotel- und Gaststättengewerbe, welche die Vorzüge von hoch diversifizierten und hoch entwickelten urbanen Gesellschaften darstellen.

Wenn wir uns auf die beschränktesten Indikatoren dieser Entwicklung des wirtschaftlichen Sektors konzentrieren, können wir die statistische Bedeutung der Selbstständigkeit (und der Familienunternehmen) als inverser Prädiktor der Mortalität herausheben. Dies stimmt mit der weitreichenden epidemiologischen Literatur in Bezug auf das Arbeitsleben überein, die die Autonomie des Arbeitnehmers als zentralen Faktor in der Gesundheit im Berufsleben zitiert. Genau genommen ist dies die Bedeutung der Kontrolle des Arbeitnehmers, die er über die Arbeitsabläufe hat. Allgemein gesagt ist es möglich, diese Interpretation auf die Entwicklung des fortgeschrittenen Tertiärsektors auszudehnen. Dieser kennzeichnet sich durch kleinere Unternehmen aus, die weniger hierarchisch strukturiert sind und die auch flexibler sind in Bezug auf ihre Fähigkeiten, sich an die wettbewerbsbedingten Veränderungen des Marktes anzupassen. Es stimmt auch überein mit der Beschreibung des individuellen Eigentums und kleinen Unternehmen, die als Hauptquellen der Innovation gelten, sowohl an sich als auch in Verbindung mit größeren Unternehmen.

Die unternehmerische Natur von kleinen Firmen wird in der Wirtschaftsliteratur als Basis für die Verbreitung von Innovationen gesehen. Diese unternehmerische Rolle wird als die Grundlage für die technologische Entwicklung gesehen, allerdings unter der Voraussetzung, dass diese als grundlegender Lernprozess für die Arbeitsorganisationen und den Konsumenten gesehen wird. Alles in allem haben wir den Beleg, dass zumindest das verhältnismäßige Vorhandensein von Selbstständigen und kleinen Unternehmen ein Hinweis ist auf (1) Arbeitnehmer-Manager-Autonomie, (2) das Vorhandensein einer Entwicklung des fortgeschrittenen Tertiärsektors, der von kleinen und flexiblen Unternehmen in einem innovativen Umfeld der Informationsgesellschaft beherrscht wird und (3) eine

wettbewerbsfähige Wirtschaft, mit einem relativ hohen Anteil von Unternehmertum und Innovation.

Es scheint zu stimmen, dass das Pro-Kopf-BIP und die Selbstständigkeit mit ihren intrinsischen Vorteilen für die Gesundheit auf das Arbeitsleben der am fortgeschrittensten Volkswirtschaften angewandt werden kann. Es gibt ebenfalls Belege dafür, dass das proportionale Vorhandensein von Schattenwirtschaft und Einkommensungleichheit und ihre Schädigung der Gesundheit in Volkswirtschaften vorkommen, die ein relativ niedriges Pro-Kopf-BIP haben und deren fortgeschrittener Tertiärsektor aus diesem Grund ebenfalls nicht so weit entwickelt ist. Alles in allem scheint es deutlich zu sein, dass eine bessere Gesundheit der Arbeitnehmer auf internationaler Ebene sowohl mit einem höheren Einkommensniveau als auch mit dem sektoralen wirtschaftlichen Wachstum verbunden ist.

Diese Ergebnisse zeigen die Weisheit der Europäischen Kommission in ihrer Behauptung auf, dass eines der Hauptziele der EU die wirtschaftliche Wettbewerbsfähigkeit sein sollte. Es scheint klar zu sein, dass solch eine Wettbewerbsfähigkeit die Grundlage des wirtschaftlichen Wohlbefindens ist und aus diesem Grund ebenfalls für die Gesundheit am Arbeitsplatz. Es gibt Anhaltspunkte, dass Investitionen in Gesundheit und Sicherheit von Arbeitnehmern durch die Unternehmen selbst und durch das Gesundheitssystem wichtig sind. Dies fördert dann ebenfalls die Wettbewerbsfähigkeit im Hinblick auf die Produktivität. Von grundlegender Bedeutung sind ebenfalls Investitionen in Forschung und Entwicklung und in die Bildung (“lebenslanges Lernen”) der Gesellschaft, so dass die Qualifikationen der Arbeitnehmer ständig an die Entwicklungen der innovativen Gesellschaft angepasst werden.

Schlussendlich ergeben unsere Hauptergebnisse, dass das reale Pro-Kopf BIP, der Anteil der arbeitenden Bevölkerung, die selbstständig ist, die Größe der Schattenwirtschaft im Verhältnis zum BIP und in gewisser Weise die Einkommensungleichheit – unter minimaler Berücksichtigung anderer epidemiologischer Risiken – sehr umfassende Prädiktoren für Mortalität der Bevölkerungsgruppe der 15-64- jährigen in den hochentwickelten Industriestaaten sind. Die Länder haben verschiedene Standards in Bezug auf ihre Gesundheits- und Sicherheitspolitiken und haben unterschiedliche Möglichkeiten, deren Umsetzung und Überwachung zu finanzieren. Damit man Schlussfolgerungen über die Wirksamkeit der verschiedenen Vorgehensweisen in Bezug auf die Gesundheits- und Sicherheitspolitiken im Arbeitsleben ziehen kann, müssen weitere Forschungen betrieben werden, um den Einfluss der (richtig umgesetzten) Gesundheits- und Sicherheitspolitiken auf die Langlebigkeit des Arbeitnehmers unter Berücksichtigung von spezifischen wirtschaftlichen und kulturellen Variationen zu analysieren.

1 Introduction

(This project is intended to examine and provide empirical evidence on the connection between health and quality of life in work in all countries of the European Union, the three candidate countries and the range of other OECD countries including the United States, Canada, and Japan. This broad undertaking, involving empirical evidence for 38 countries, has involved major efforts at (1) assessment of relevant scientific literature (2) development of national and international databases and their interrelations, (3) analysis of potential risk factors involving quality in work that are plausibly related to occupational health outcomes and (4) relating the above three elements to the question of the benefits of existing and evolving policy in the public health area.

There is in addition one further consideration, which is the relation between both quality of work in life and occupational health in light of the traditional concerns of labour for adequate wages, reasonable non-wage benefits, insurance systems involving health, disability, unemployment, pensions, flexibility in work schedules and working hours, non-discrimination in hiring, firing, and promotion and some plausible minimum of employee autonomy and decisional latitude within the work process. These standard matters of labour - management negotiation and work standards are the traditional domain of labour economics and labour market studies and are thus directly relevant to the EC unit on labour and social affairs. It is thus of concern to go beyond the most traditional understanding of industrial health questions to focus additionally on matters that lie within the general arena of macroeconomics as well as the study of labour market conditions on a national and industrial level.

Background

The scientific field which concerns “occupational health” has traditionally involved two areas of research. The first may be referred to as “human factors” which deals with ergonomic characteristics of machines and work environments that impede worker productivity and well-being. The second is the field of occupational epidemiology which broadly examines the risk factors in the workplace – whether of physical, chemical or biological origin – that are important in accidental injuries, occupational diseases and, increasingly, pathologies and mortality of workers that have at least some psychological origins (including that of emotional reactions and knowledge). In addition, in recent years the field of occupational, consistent with other epidemiological fields, has been greatly influenced by the importance of risk factors that predominate in low socioeconomic occupations, but are relatively diminished in higher socioeconomic occupational groups. The combination of the new scientific emphases on psychologically generated pathologies (even involving such factors as alcohol, tobacco use, body mass index, and insufficient cardiovascular exercise) as well as features of socioeconomic status (including occupational skill level; education level; income, involving wage and non-wage benefits; and, most recently and most prominently employment instability due to economic policy and technological changes), have become some of the main themes that now dominate the research into occupational health and safety. In addition, what is beginning to strongly emerge among these new occupational health literatures is the importance of health care access – not only medicine and surgery, but emergency care and work-site health care access.

Keeping these newer scientific literatures in mind, our research in the present project has largely focussed on the impact of macroeconomic and macro-social factors that influence the micro-risk factors to health and safety as given by the most up to date scientific evidence. Clearly, the outstanding macroeconomic factor, which helps us to explain occupational morbidity and mortality differentials among industrialised countries, is real GDP per capita. The central importance of this factor is that it identifies the national wealth (as well as wealth at the firm level) that is available to the society to invest in more sophisticated technologies that are the basis of occupational safety and health as well as the health care potential for minimising serious disability and mortality among workers.

We are fully aware that the prime concern among policy makers in occupational safety and health concerns specific policy regimes that detail regulations which, when applied to the workplace, result in a minimisation of worker exposure to occupational risk. At the same time, while the policy literature in this field is of course very sensitive to this issue of regulation, it is also widely appreciated among experts that (1) technologically more sophisticated firms will evidence fewer occupational risks within the same industry offering virtually the same products or services; (2) that the degree of technological sophistication of a firm's equipment and physical plant will depend on the capacity of the firm to invest (thus, the wealthier firms will, by and large, offer safer work environments).

It is also widely appreciated among policy makers that investment in human capital, both in terms of formal education and on-the-job training, will enhance both worker health and safety, and productivity. Further, worker capacity for safe and healthy work tends to be enlarged in situations of moderate (as compared to high) work pressure, at the periods of adjustments to changes in the work process, job security, and adequate remuneration and health, unemployment and pension insurance systems.

Another important theme in the newer literature is that work stress and work dissatisfaction (which are substantially different concepts), are greatly affected by the extensiveness of social hierarchies in the work place. In other words, workers improve their job satisfaction and reduce stress levels when they tend to have greater control (autonomy) over the micro details of the work process and actually experience reasonable levels of decision latitude. It is clear that the degree of workers subordination (i.e., lack of control and decision latitude) increases greatly with the extent of administrative hierarchies in industrial organisations – whether they concern manufacturing, services or even agricultural work.

While the discussion of health was initially intended to focus on what is professionally referred to as "occupational health", we have taken the broader position of including, within the definition of occupational health, the principal sources of disability, morbidity, and mortality related to work in occupational settings.

This is a major departure from traditional occupational health in which the primary focuses have been on physical injury due to accidents, muscular and bone/joint disabilities due to ergonomic maladjustments, and occupational "diseases" such as might emanate from human interaction with chemicals and other noxious fluids and physical contaminants, as well as heat, cold and pressure.

The broader view taken today is that of a field of pathology in which a large proportion of the external causal factors lie in the realm of stress and emotional reactions. This is especially true of cardiovascular diseases where, since at least the 1930s, the “flight and fight” syndrome of cardiovascular adaptation to stress was developed by Walter Cannon. A massive literature on psychological stress and human outcomes has developed over the past 70 years and includes the field technically referred to as psychoneuroimmunology. This field entails the study of immunologic reactions to disturbances in the cognitive and emotional environment which then can be evidenced by infections, tumours, depression, as well as the more classic cardiovascular reactions.

The following factors are known to influence psycho-social work stress:

- Magnitude of work (work load): volume, speed, intensity
- Intellectual complexity of work (decision difficulty and consequences)
- Employee control of the work process
- Social relations and social support
- Employee earnings
- Job and career security
- Security of income (including retirement, health care, disability, unemployment, other welfare)
- Social status and seniority, authority of the worker
- Occupational status
- Educational status
- Extent of work hierarchy
- Person environment fit

The third emphasis on occupational outcomes that we now tend to find in ever-increasing number concerns what has been traditionally referred to as environmental health, but actually gives rise to human exposure at the point of the work setting – which makes this equally an issue for occupational disease and disability.

This very large expansion of the traditional field of occupational health, in terms of pathological outcomes, is only one of the areas in which occupational health has had to take on expanded definitions.

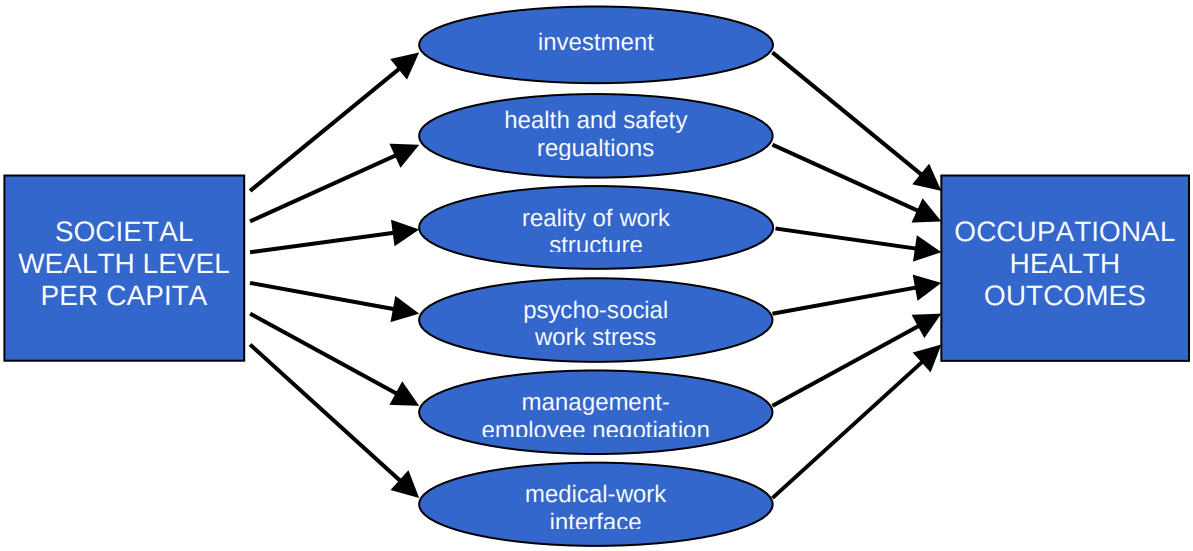
Equally important is the designation of causal factors or “risk” factors which give rise to the occupational health problems, morbidity and case-fatality- i.e., the proportion of cases of occupational illness that result in death.

In this area of elicitation of causal factors in occupational health, the field has truly enlarged in a manner that can only be understood in terms of broad conceptual classifications. Let us start first with the currently mainstream understanding of elements in the prevention of occupational health problems. These tend to be of two types. First, we have the classic short and long term epidemiological approach, which largely tends to identify elements in the physical work environment (speed of work, discomfort of ergonomic structures, chemical and particulate environment, dangerousness of physical materials, weight of objects being handled, complexity or boring nature of machine handling, physical discomfort of climate and/or pressures) and such behavioural factors as use of alcohol, other drugs, tobacco, and either hyper-mobility or insufficient exercise.

Consistent with these types of physical and behavioural risk factors many countries, as well as the WHO and the ILO have adopted extensive occupational and safety health regulations, which have tended to be monitored and respected in societies with heavily industrialised labour forces and wide-spread labour union movements. However, considerable doubt has arisen as to the degree to which such regulations are actually enforced in societies with large, segmented labour forces and minority populations and in firms which have minimal financial capital to invest in ambient environmental and ergonomic labour standards. Indeed there is evidence that it is particularly those societies with the capacity to invest in high technology equipment and skilled labour that are the most efficacious in limiting occupational health problems.

Concomitant with this classic mainstream tradition in occupational health is a research emphasis that seems to have originated within the 1980s, in which serious attention began to be paid to the epidemiology of stress-related illness – especially cardiovascular disease – as a paradigm of psychological deficits that would result from external sources of over-work, loss, anxiety and hostility. We owe a great deal here to the work of the Scandinavians, especially the pioneering efforts of scientific staff at the Karolinska Institute in Psychosocial factors at the University of Stockholm Medical Centre. Under the leadership of Lennart, Levi, Bertil Gardel and Torres Theorell, the Karolinska Group made major strides in the discovery of the effects of shift work, high speed work in assembly line processes, boring work and unemployment on accident rates, work absenteeism, and heart disease mortality. United States researchers in California and Michigan furthered this work which eventually became adopted by British epidemiologists. The net result of these efforts is that Anglo-Saxon researchers tend to dominate this field of science. Simply by expanding the occupational health risk factors and outcomes to include those that involve cardiovascular disease, the stress researchers have enlarged the area of occupational disease from a rapidly diminishing component of public health to one that is now again central to the whole public health enterprise.

Figure 4: Theoretical approaches to occupational health



2 Literature review

People spend more than a third of their working life time at the workplace. Work place characteristics, likewise material or non-material exposures – e.g., psychological distress – are considered, hence, as major determinants of health. Equally important are non-occupational health determinants, since they closely interfere with performance at work and the overall quality of life.

This multidisciplinary literature review addresses the questions, whether there is consistent scientific evidence of deteriorating mental and physical health of individuals and populations due to: (1) absolute or relative poverty; (2) major disruption of career, including unemployment; (3) insufficient educational resources; (4) psychological distress and lack of worker autonomy; and, finally, (5) lack of social capital and social support.

An extensive literature research was undertaken in the National Library of Medicine via PubMed retrieval, providing access to over 16 million citations and abstracts in the fields of medicine, public health, life sciences etc. The main selection criteria included relevance of abstracts and impact factor of publication sources (top-rated journals).

2.1 Main results

Income versus income inequality

Over the last two decades, there has been a profound debate in the epidemiological literature as to the importance and nature of relationships between income and health indicators. The theoretical foundation of these discussions refers to one of the basic concepts of social epidemiology, namely, the socioeconomic status (SES). SES includes three dimensions – income, education and occupational/skills prestige.

In a more traditional understanding, each of the SES dimensions has an independent impact on health. At the level of individuals, every single dimension is believed to minimise the potential risk factors for illness and to increase the probability of recovery or survival due to better quality of – and access to – health care. Thus, higher income enables people to consume more or better goods and services that are beneficial to health. Low income expresses, therefore, the state of an “absolute material deprivation”, in which the financial opportunities to maintain good health are quite limited.

The alternative and more recent point of view is that SES basically represents social rank, prestige or reputation. Therefore, the absolute level of wealth is less significant per se, whereas the relative position of an individual within the social hierarchy is crucial for health outcomes (Wilkinson 1992). The “relative deprivation” is perceived, when a person compares himself or herself to others in the environment. At an aggregate level, this concept is represented by income inequality indicators, such as the Gini index.

To assess an “absolute deprivation” or related concepts – such as poverty – at an aggregate level, there exist a substantial number of indicators proposed. The most widespread proxy-

measures include inflation-adjusted Gross Domestic Product (GDP) per capita, mean real per capita income, proportion of the population below a definite “poverty line” etc. In the aggregate-level studies involving multiple countries, GDP is the most commonly used indicator, since data on GDP are widely available and the technical definitions used within GDP are relatively consistent across countries.

Let us begin with the description of evidence in support of the “absolute deprivation” hypothesis. In prospective individual-level studies with large sample sizes, lower income has been repeatedly found to be a good predictor of higher mortality (e.g., Daly et al 2002; Chou et al 2004). This association persisted, when the other SES indicators have been taken into account (Daly 2002).

Additional support comes from the San Francisco study, which was designed to estimate the magnitude of health improvements resulting from a proposed living wage ordinance. A modest gain in income led to substantial health improvements (Bhatia and Katz 2001). These results were adjusted for the effects of age, sex, race/ethnicity, education, and marital status.

In aggregate-level studies with a longitudinal approach involving multivariate time-series analysis, mortality has been found to follow GDP fluctuations. Thus, economic recessions were consistently associated with deteriorating health in wealthy industrialised countries – e.g., in the USA, England and Wales, Sweden and in Western Germany (Brenner 1973; 1975; 1979; 1987; 1995 pp211–246; 2005). Vice versa, the long-term economic growth has been shown to be the central factor in mortality rate decline in the US over the 20th century (Brenner 2005).

Some scholars believe that data from aggregate-level studies are largely insufficient to discriminate between the competing hypotheses of “absolute” and “relative” deprivation. Only individual-level studies have the potential to discriminate between most of the advanced hypotheses (Wagstaff & van Doorslaer 2000). The authors reviewed the relevant individual-level studies – all on U.S. population data – and came to the following conclusion: The studies provide a strong support for the “absolute-income hypothesis” and little or no support for the “relative-income hypothesis”. Therefore, the absolute-income hypothesis, although more than 20 years old, is still the most likely one to explain the frequently observed strong association between population health and income inequality levels (Wagstaff & van Doorslaer 2000; see also Fiscella & Franks 1997).

Now, let us turn our attention to the evidence in support of the “relative deprivation” hypothesis. At the population level, income inequality has been found to affect different health outcomes – such as cause-specific mortality, infant mortality or life expectancy at all levels of income (US: Lynch et al 1998, Australia: Turrel & Mathers 2001). However, in direct comparisons between Canadian provinces or metropolitan areas, and US states or metropolitan areas, it has also been shown that Canada seems to counter the association between income inequality and mortality at the societal level (Ross et al 2000).

These results – i.e. lack of a significant association between income inequality and mortality – may indicate that the effects of income inequality on health are not automatic. They may be modified by the different ways in which social and economic resources are distributed (Ross

et al 2000; Gorey 2000; Sanmartin et al 2003). Kawachi & Kennedy (1997) argue, that the large gap between the rich and the poor in the US leads to higher mortality through the breakdown of social cohesion.

Interestingly, Jaffe et al (2005) revealed lower risks of mortality in men living in relative disadvantage to their neighbours, as compared to those living in concordance with their area. These results of the Israel Longitudinal Mortality Study – adjusted for individual income – may strengthen the argument that a wealthy surrounding might invest in facilities that protect the relatively deprived.

A large study compared health outcomes in a variety of countries and found that income inequality and characteristics of the psychosocial environment – like trust, control, and organisational membership – do not seem to be key factors in understanding health differences between the 23 wealthy and less wealthy countries, including Russia. The authors argue that the associations that do exist are largely limited to child health outcomes and cirrhosis (Lynch et al 2001). These findings largely contradict those of Wilkinson as well as those focusing largely on social capital.

In contrast, a large study from the UK found that poor socioeconomic conditions reflecting a "relative deprivation" in childhood and early adulthood independently predicted mortality in British people born in the immediate post war era (Kuh et al 2002). These results remained significant even after adjustment for income in adulthood. Important differences – beyond those accounted for by social status, income and education – have also been shown for selected specific occupations: According to a US study by Johnson et al (1999), high-risk occupations include taxi drivers, cooks, longshoremen, and transportation operatives; while low-risk occupations include lawyers, natural scientists, teachers, farmers, and "a variety of engineers".

Other researchers argue that models focussing exclusively on income as a measure of the impact of SES on mortality are not complete. Health spending and unemployment may be even more important than income growth and dispersion (Laporte & Ferguson 2003).

According to a study by Kunst et al (1998), the European countries are very similar with respect to mortality by occupational class among men aged 30-64. The authors found no evidence that mortality differences are smaller in countries with more egalitarian socio-economic and other policies. Data problems were supposed to have the potential to bias inequality estimates.

Other recent publications give hints that adjustments for ethnicity (USA) or education – both markers of early-life social circumstances – let the association between income inequality and health disappear (Pearce & Davey Smith 2003). The authors further assume across countries, that the association between current income inequality and health may or may not exist, "depending on the choice of countries and their historical, cultural, political, and economic context".

In conclusion, there is evidence in support of both absolute and relative deprivation concepts, as to their detrimental impact on health and mortality. The principal source of conceptual disagreements refers to discrepancies of results obtained in different studies. These

discrepancies can be explained by a variety of reasons beyond the reliability of the concepts themselves. They may include, for instance: (1) different measures used to represent the concepts; (2) different shapes of relationships between the particular outcome and the measure of deprivation in a given population – e.g., non-linear effects; and (3) different constellations of explanatory variables providing a control for confounding or effect modification.

Unemployment and health

The relationships between unemployment and health have been extensively studied, both with individual- and aggregate-level approaches. There is considerable evidence that being unemployed is associated with poor health and an increased risk of death, compared with being employed.

The nature of complex relationships between unemployment and health can be located in the larger context of the social selection / social causation debates. On the one hand, unemployment is likely to be responsible for the downward mobility in socioeconomic status, perceived distress, financial problems, disrupted social relationships etc – and, therefore, lead to health deterioration (social causation hypothesis). In support of this hypothesis, sufficient evidence exists to suggest that employment protects and fosters health.

On the other hand, unemployment may first of all affect sick individuals (social selection hypothesis), facilitating a further health deterioration. There is no doubt that a part of the unemployment-health association is due to a selection effect: Healthier people are more likely to be employed.

Most likely, that both social selection and social causation processes take place in the real life and determine the relationships of unemployment and health. Many researchers have tried to explore these relationships in depth. Beland et al (2002) examined the nature of contextual effects in the ways unemployment and health are related. With a multilevel analysis, the authors showed that the association of individual unemployment with perceived health is statistically significant. However, they warn against simplistic interpretations of this relationship. It can be mediated by financial strains, social support, psychosocial factors – such as stress – and macroeconomic contexts – e.g., business cycles.

The effects of unemployment in society on peoples' health may be mediated through pessimism about the future and financial strain. A survey-based comparison of young unemployed men and women showed that both genders reported more somatic and psychological symptoms during recession than boom (Novo et al 2001).

Moreover, it is not only the current economic situation, but experiences of disadvantage at any time in the life course that leads to bad health in the future. In a study by Bartley & Plewis (2002), belonging to a "semi- or unskilled social class" or being unemployed in 1971 contributed independently to an increased risk of chronic limiting illness in 1991.

In 2004, the Swedish Karolinska Institute published a huge study on unemployment and early cause-specific mortality. It is one of the most interesting studies on effects of

unemployment because of its outstanding design: Voss et al (2004) followed 20 632 females and male twins with regard to mortality from 1973 through 1996. The results from this study suggested that unemployment is associated with an increased risk of early death even after adjustment for several potential confounding factors, including socioeconomic status, lifestyle, as well as genetic and early childhood factors. In particular, unemployment was associated with increased mortality from suicide and external undetermined cause; for men, also with death from malignant neoplasms.

However, there is growing evidence, that besides experiences of disadvantage, also experiences of solidarity matter. Three studies could be identified, strengthening the public health importance of workers' organisations like unions.

A case study of the role of organized labour and smoke-free airlines illustrated the potential for successful partnerships between unions and tobacco control policy advocates when developing smoke-free worksite policies (Pan et al 2005).

An article about the workers' health movement in the Brazilian state of Sao Paulo (Sato 2004) provides examples of some of the different actions and practices that had a key role in the battle for better working conditions. Another publication focuses on Chinese factories (Chen & Chan 2004) and finds that the input of the trade union does have a significant impact on the protection of the workers' occupational safety and health.

Workers' struggles for changes in occupation policies cannot be overrated: "The worker played a primary role as the basis of every significant improvement in legislation, factory inspection, compensation, correction, and prevention. Labour unrest, protests, strikes, lawsuits, and catastrophes were vital catalysts in obtaining action" (Abrams 2001).

Education and health

Education is considered within the conceptual frameworks of absolute deprivation (Kawachi et al 1999), human capital (Becker 1993) or social capital (Baron et al 2000). Together with income and occupation, education determines the socioeconomic status. Therefore, the socioeconomic gradients in mortality are to a certain extent determined by the level of education. In the most studies, income is the strongest predictor of these gradients, followed by education. This is especially true for "preventable" causes of death – such as fatal occupational injuries (Blakely et al 2002; Steenland et al 2003; Sorlie et al 1995).

Income and education are strongly linked with each other. The better a person's education, the more likely he or she is to get a good job; or, the less likely to get or remain unemployed. On the other hand, better educational opportunities for children are provided by a higher family income, or – at least in some countries – by a higher degree of national wealth.

Dissimilar to income or occupational prestige, education is unlikely to alter after early adulthood. Therefore, education can be considered as an index of socioeconomic circumstances in early life. In a prospective observational study carried out in Scotland cardiovascular disease was the cause of death most strongly associated with education (Davey Smith et al 1998).

Johnson and colleagues (1999) analysed data from a huge national cohort in the United States (380 000 persons, aged 25-64) and found that mortality differences obtained for social status groups of specific occupations are almost completely accounted for by adjustments for income and education. The same was true for a study from Italy: Education and income mostly explained the mortality differences by social class in men, while income showed the highest contribution in women (Mamo et al 2005).

In longitudinal designs, differences in total and cause-specific mortality have been examined in multiple countries in relation to the educational level. Seven countries provided data from 1980 to 1990: the United States, Finland, Norway, Italy, the Czech Republic, Hungary and Estonia. Except for breast cancer, higher mortality rates among lower-educated men and women were found for most causes of death. Among men, these differences were even larger (Mackenbach et al 2003; 1999).

Similar results stem from an analysis of two American Cancer Society cohorts (1959-96). Temporal trends showed increasing mortality differences by education for coronary heart disease, diabetes, chronic obstructive pulmonary disease and lung cancer (Steenland et al 2002). Education accounted for the frequency of cancer screening examinations – or for the stage of cancer at time of diagnosis (Merkin et al 2002).

According to Marshall et al (1999), cancer occurrence during working life is strongly associated with SES measures, but they did not specifically control for education per se.

Regarding not mortality but disability pensions, Krokstad et al (2002) could demonstrate that education was even a stronger predictor of disability pension than medical factors.

The pathways linking education and health are very complex. It is commonly believed that the more educated a person is, the better he or she is informed about health hazards and ways of risk management, including the use of health care facilities. People enjoying better education and a better social standing possess internal sources of pride and self-respect, as well as external sources of esteem from others.

It is very plausible that a person’s education accounts a lot for the kind of job he or she gets. The more formal education a person has, the more likely he or she will get a job with high decision latitude or autonomy; communication skills are also likely to be positively related to education. Therefore, education might be closely linked with job strain or social support.

Burden of psychological distress

Psychological stress – not only due to occupational strains – is widely discussed as a modern day hidden epidemic. Its outcomes and related co-morbid conditions are responsible for a large proportion of disability worldwide. The World Health Organisation (WHO) Global Burden of Disease Survey estimated that mental diseases, including stress-related disorders, will be highly prevalent and will become the second leading cause of disabilities by the year 2020 (WHO 1996).

It has been consistently demonstrated that individuals with stress and related disorders experience impaired physical and mental functioning, more work days lost, increased impairment at work and a high use of health care services. The disability caused by stress is just as great as the disability caused by workplace accidents or other common medical conditions – such as hypertension, diabetes and arthritis (Kalia 2002). Therefore, the problem of early recognition and management of stress is extremely relevant.

Stress-related disorders have a considerable negative economic impact. In the United Kingdom, the Mental Health Foundation reports that stress costs British industry 3 billion British pounds annually (The Mental Health Foundation 2001).

In France, 1.3-1.7 percent of the working population was affected by illnesses attributable to work-related stress in 2000. These illnesses included cardiovascular diseases, depression, musculoskeletal diseases and back pain. Work-related stress cost the French society between Euro 1 167 million and Euro 1 975 million – or 14.4-24.2% of the total spending of social security occupational illnesses and work injuries branch (Bejean & Sultan-Taieb 2005).

In the United States, stress-related disorders cost the nation more than 42 billion dollars each year. More than half of that is due to the repeated use of health care services. People suffering from stress-related illnesses are 3 to 5 times more likely to visit the doctor and 6 times more likely to be hospitalised than non-sufferers. Approximately 43% of these people are depressed or have alcohol or substance abuse problem (Kalia 2002).

In addition, there are sunk costs of stress-related disorders, which include substantial losses of human lives. In 2000, more than 2 300 deaths cases in the French working age population have been attributed to occupational stress (Bejean & Sultan-Taieb 2005).

Psychosocial stress is regarded in the epidemiologic literature as a key factor in the transition mortality crisis. This epidemic upsurge in mortality occurred recently in the former socialist countries of Central and Eastern Europe, including the new Member States of the European Union – e.g., Estonia, Latvia and Lithuania. The estimates of excess deaths oscillate around 3 million people during the period 1989-1996 (Cornia 2000 p63).

In all transitional countries, mortality fluctuations are largely attributed to changes in cardiovascular and violent death levels – i.e. stress-related conditions. The major mortality fluctuations were concentrated around the most difficult years of important socio-economic changes. First of all, the mortality crisis affected working age population – particularly men. The underlying causes of stress are related to large unanticipated changes – like unemployment and reallocation of labour under difficult circumstances, migration and shifts in social hierarchies (Cornia 2000 p77-80).

Major fields of stress research

Since stress is responsible for a variety of health outcomes and economic losses, a careful examination of its causes, mechanisms and consequences is extremely important. There are several approaches to studying stress.

The biological approach deals with the investigation of neuro-endocrine reactions which develop in the course of stress. Hans Selye (1985) laid the foundation for biological stress research. The scholar identified the major stages of stress reactions and the most important biological stress markers. Recently, signs of abnormal functioning of neuro-endocrine structures responsible for stress management have been reported for patients with posttraumatic stress disorders (Wessa et al 2006), chronic fatigue syndrome (Roberts et al 2004) and uni- or bilateral lesions of the hippocampus (Buchanan et al 2004; Wolf 2005). These signs include, for instance, blunted cortisol awakening response. Therefore, cortisol – together with other stress hormones and proteins – is regarded as an important biological marker of stress (for further details see Annex II).

Biological reactions to stress involve immune changes, since almost all immune cells have receptors for one or more stress hormones (for further details see Annex II). Immune changes due to chronic stress are assumed to represent one of the pathways linking stress with cancer or atherosclerosis. There are, however, substantial differences in the basic patterns of immunological stress response. Some individuals are prone to immune hyper-reactivity, a low grade chronic inflammation and atherosclerotic complications. The others are more susceptible to an immune suppression – expressed, for example, by a decreased activity of natural killer cells – which is discussed as one of the primary mediators of the tumour-enhancing effects of stress. Researchers are looking for specific biological markers to stratify adequately individuals with a chronic stress. However, a definite systematic approach has not been yet elaborated (Vale 2005).

Stress is also studied in relation to genetic changes (see Annex II). Poor immune function might have consequences at the molecular level in terms of the speed and quality of deoxyribonucleic acid (DNA) repair. These mechanisms are assumed to mediate an increased cancer risk (Kiecolt-Glaser et al 1985; Cohen et al 2000; Reiche et al 2004).

Further, stress is discussed in the context of neuro-anatomic changes, related cognitive functioning and aging. It has been shown that different types of stressful experiences decrease brain cell proliferation (Cameron & Gould 1994), as does normal aging (Cameron & McKay 1999). In a recent study, Epel and colleagues (2004) provided evidence that psychological stress is significantly associated with accelerated aging.

The epidemiological approach examines psychosocial stress as a risk factor for various health outcomes. In Annex II, epidemiological studies are reviewed for three groups of major “modern killers” in the industrialised countries – cardiovascular diseases, cancers, as well as mental health and behavioural problems.

An additional approach examines stress in the occupational context. Currently, it represents a broad research field characterised by a variety of theoretical schools, as well as by multidisciplinary perspectives. Since 1980s – specifically in the “mini-environment of the workplace” (Syme 1988) – concepts of control and participation have become central (Karasek & Theorell 1990; Banduara 1995; Yen & Syme 1999). This focus offers substantial possibilities of intervention and is, therefore, very promising.

Occupational stress and job satisfaction

This section presents the main models of occupational stress and indicates how they are linked to structural unemployment. Let us start with the basic definitions in this field. Job satisfaction and occupational stress are often discussed as interchangeable terms. In fact, the two terms are based on two distinct concepts. The basic difference is that job satisfaction is only related to the individual self-perception, while many aspects of occupational stress go beyond self-perception and can be measured even at aggregate level.

In an occupational health context, sources of stress include poor working conditions, relationships at work, an unclear role in the organisation, long hours, organisational climate, and – last but not least – lack of job security. It has been argued that economic recession and hence high unemployment rates create a climate of uncertainty, resulting in increases of absenteeism due to rising sickness. Noteworthy, absenteeism – especially the short-time one – does not always reflect disease (Vahtera et al 2004; Kivimaki et al 2003a). Equally true is the opposite: Decreasing absenteeism does not necessarily mean an improvement in workers' health status. It has been observed that the ongoing recession is accompanied by decreases of short time absenteeism from work, since people are frightened to loose their jobs (Markham & McKee 1991). Already among young adults, as demonstrated by Hannan et al (1997), unemployment has the most significant influence on the levels of psychological distress. The impact of unemployment further increases when combined with feelings of lack of control, and especially, in this context, when the responsibility of employment was attributed solely to structural or political factors.

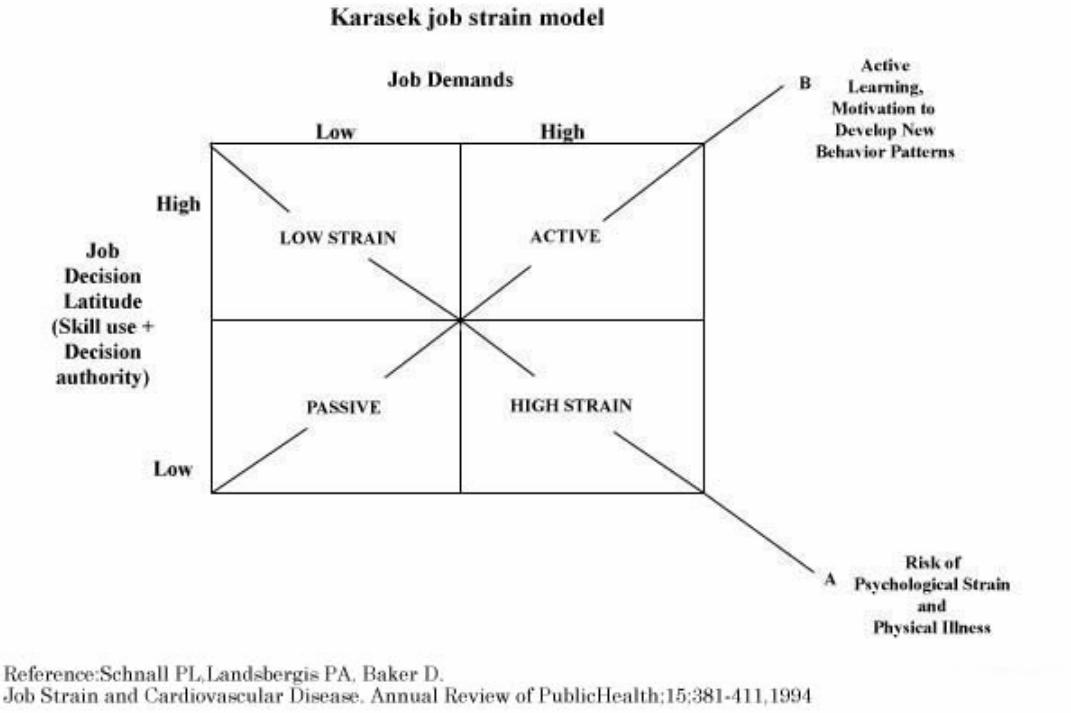
Another argument that strengthens the role of unemployment in stress production is the fact that reemployment, especially for those moving into permanent employment, leads to a reduction of distress (Bjarnason & Sigurdardottir 2003).

Reynolds (1997) has noted that in addition to stress induced by job insecurity itself, the effect of unemployment on stress could also result from greater competition.

There have been many attempts to describe and measure key determinants of occupational stress. Unfortunately, it is difficult to establish a simple and feasible concept that can be applied for all kind of work settings.

One model of job stress developed by Robert Karasek has highlighted two key elements of work stressors. Karasek's "job strain" model (Figure 5) states that the greatest risk to health from stress occurs to workers facing high psychological workload demands or pressures combined with low control or decision latitude in meeting those demands. Job demands means that workers feel that they are working very fast or very hard or do not have enough time to get the job done. Job decision latitude is defined as both the ability to use skills on the job and the decision-making authority available to the worker. In the Maastricht cohort study for example, decision latitude was one of the strongest predictors for sickness absence of at least one month (Andrea et al 2003; see also Vaananen et al 2003 and Ariens et al 2002). Decision latitude does not only work as a "metaphor" or proxy for autonomy, but also for organisational justice, both at individual and work unit level (Elovainio et al 2004).

Figure 5: Karasek's job strain model



Karasek's model emphasizes another major negative consequence of work organisation; how the assembly line and the principles of Taylorism, with its focus on reducing workers' skills and influence, can produce passivity, learned helplessness, and lack of participation. Thus, this model provides a justification for efforts to achieve greater worker autonomy as well as increased workplace democracy.

The biggest cohort study to support Karasek's model was designed to prospectively examine the relation between psychosocial work characteristics and changes in health related to quality of life in a cohort of working women in the United States (Cheng et al 2000). Low job control, high job demands, and low work-related social support were associated with poor health status at baseline as well as greater functional declines over the four year follow up period. Examined in combination, women with low job control, high job demands, and low work related social support had the greatest functional declines. These associations could not be explained by age, body mass index, co-morbid disease status, alcohol consumption, smoking status, education level, exercise level, employment status, or marital status. Similar results could be demonstrated by Schrijvers et al (1998).

The issue of work time control has to be stressed: Especially in women, work time control is an independent predictor of health (Ala-Mursala et al 2002). In a study of Swedish hospital employees in the 1990s, increasing work demands were accompanied by deteriorating mental health, and decreasing time to plan work showed the strongest association with increasing long-term sick leave (Petterson et al 2005).

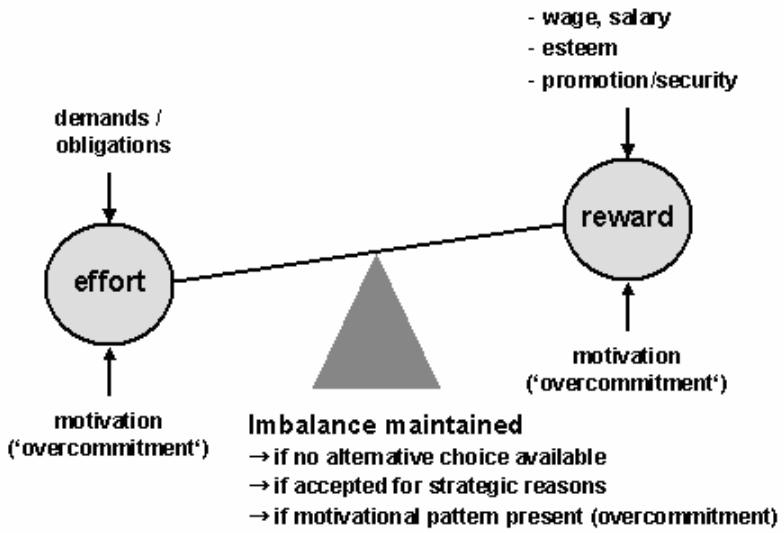
Another widespread model is Siegrist's effort-reward imbalance model (Figure 6). This model claims that failed reciprocity in terms of high efforts spent and low rewards received is likely

to provoke recurrent negative emotions and sustained stress responses in exposed workers. A major specification of this theoretical perspective concerns the work role, and in particular its contractual basis.

A cross-sectional analysis (Niedhammer 2004) revealed a significant association of effort-reward-imbalance with self-reported health for both genders. When studied as separate variables, reward remained significant for both genders, while effort was a significant factor for men only. It should be mentioned here that poor self-reported health is a well established predictor for mortality and disability (Mansson & Rastam 2001; Sundquist & Johansen 1997; Miilunpalo et al 1997; Idler & Benyamini 1997).

Despite substantial evidence for the validity of both models (e.g., Baker et al 1996; de Jonge 2000; de Lange 2002; Kivimaki et al 2002), difficulties arise in trying to adopt universal measures for different types of jobs. Bliese & Jex (2002) have suggested a multilevel perspective that can be incorporated into occupational stress research. This seems to be useful, because there may be cases in which a group-level intervention may be far more effective than focusing on individuals.

Figure 6: Siegrist's effort-reward-imbalance model



***Source*: University of Düsseldorf, Medical Sociology**

Job satisfaction is not only a variable that influences work-related health; it also serves as an antecedent of selection from contingent to permanent employment. Thus, it may work as a possible confounder: The less satisfied people are with their job, the more likely they will remain in a fixed term job – which is at higher risk of unemployment. In a cohort study on hospital staff, Virtanen M and colleagues (2002) could show that job satisfaction predicted a permanent job contract with an odds ratio of 1.86. Respectively, receiving a permanent job

contract after fixed term employment is associated with job satisfaction (Virtanen M et al 2003).

Interestingly, another Finnish study (Virtanen P et al 2002) found that the association of low perceived security with psychological distress was significantly stronger in permanent employees than among fixed term and subsidised employees. These findings may indicate a higher importance of perceived security among employees with a permanent contract.

While occupational stress predicts unemployment, self-perceived stress increases further with the onset of unemployment (Leino-Arjas et al 1999).

Sverke and co-authors (2002) performed a meta-analysis on job insecurity and could show a strong and significant relationship between job satisfaction and job insecurity. They also highlight the need for consensus on the measurement of job insecurity and call for a multidimensional measure reflecting both threats of imminent job loss and fear of losing important job features. Perceptions of threat to continued employment have important empirical associations with employees' job attitudes, organisational attitudes, and health.

There is also evidence from laboratory experiments (Probst 2002) and survey data (Grunberg et al 2001), that persons faced with the threat of layoffs violated more safety rules than controls. Those threats of layoffs might differently affect people who end their job anyway after a fixed period and have already adapted to changes of work or worksite, or permanent employees who for years have not developed strategies of coping with job loss or job change. In addition, there is also evidence that moving from temporary to permanent employment is associated with a lower risk of death than remaining continuously in permanent employment (Kivimaki et al 2003b).

This idea is supported by Strazdins et al (2004). The authors introduce a new way of looking at work stress by combining job strain with job insecurity. This combination is increasingly prevalent in contemporary economies. Those reporting both strain and insecurity showed markedly higher odds for mental and physical health problems (depression: odds ratio 13.88, anxiety 12.88, physical health problems 3.97 and poor self-rated health 7.12). Job strain and insecurity showed synergistic associations with health, and employees experiencing both problems could be at heightened health risk. Comparable results were published by D'Souza et al (2003). In an analysis of a representative sample of the European Union total active population (aged 15 years and older), high job demands, low job control, "and high strain and passive work" were associated with higher work related sickness absence. As the authors point out, the risks were more pronounced in men compared with women, and in non-permanent compared with permanent employees (Gimeno et al 2004).

Another Finnish study investigated the effects of workplace bullying. Some specific forms of bullying were the most clearly connected with all the stress reactions measured in the study. They include judging a person's work unjustly or in an offending manner, restricting a person's possibilities to express his or her opinions, and assaulting one's private life. Interestingly, not only the targets of bullying, but also bystanders, suffer when someone is bullied in the workplace (Vartia 2001).

In a large NHS study from the UK, staff who had been bullied had significantly lower levels of job satisfaction, higher levels of job-induced stress, depression and anxiety (Quine 1999). Powerlessness or lack of control over destiny – which in our societies is closely related to non-having a job – emerges as an important risk factor for a disease in general. Particularly, this is true for occupational health (see also Wallerstein 1992). For the workers of the U.S. chemical industry, span of control and level of empowerment predicted one third of the variance in safety measures (Hechanova-Alampay & Beehr 2001).

Social capital and social support

The workplace has been shown repeatedly as an origin of health inequalities (Vahtera et al 1999). In a modern occupational context, multiple exposures represent a set of conditions that people experience hour by hour, day by day over the course of their lives. This set of conditions can be called a meta-exposure: The way in which work is organised produces a multiplicity of physical, chemical, psychosocial, and cultural exposures that workers encounter as a totality in actual work contexts (Gustavsen 1991 pp 225-239). Many models have been applied to understand this totality.

Richard Sennet (2006) argues that the erosion of social capitalism has produced a new form of inequality linked with social isolation, in which social capital and loyalty, informal trust and accumulated knowledge decrease. For occupational safety, accumulated knowledge is a crucial value that goes hand in hand with organisational form of social networks.

A comprehensive view has been provided by Johnson & Hall (1996). The authors envision the workplace as a social context formed by larger political, economic, and social forces. Modern industrial societies are embedded in political and economic processes that influence the character of the whole occupational field. Presently, work is undergoing a process of a “permanent revolution”, in which “the intensity and rate of change itself has become one of the most significant stressors to which workers are now exposed”.

We have already described the demand-control model. In many studies, control over the work process is represented by measures of autonomy. Other investigators refer to the vertical structure of the work process and apply the less subjective variable of hierarchy. On the individual level, further research has expanded the demand-control model by the protective measure of social support. Social networks and social support are unexpectedly important for both mental and physical health. In the field of social epidemiology concern about the individual-level effects has been well established under this conceptual label, long before a more recent interest in the term social capital, which is typically used to refer only to aggregate-level effects.

Social capital has primarily been used in the fields of sociology and economics. It describes the patterns and intensity of networks among people, as well as the shared values and sanctions, which arise from those networks. Definitions of social capital vary, but the main aspects include citizenship, neighbourhood, social networks and civic participation. There are different aspects of social capital. Therefore, measuring the level of social capital in communities can be complex. It is commonly focused on levels of trust, membership (in clubs, social or religious groups), networks and frequency of social contact.

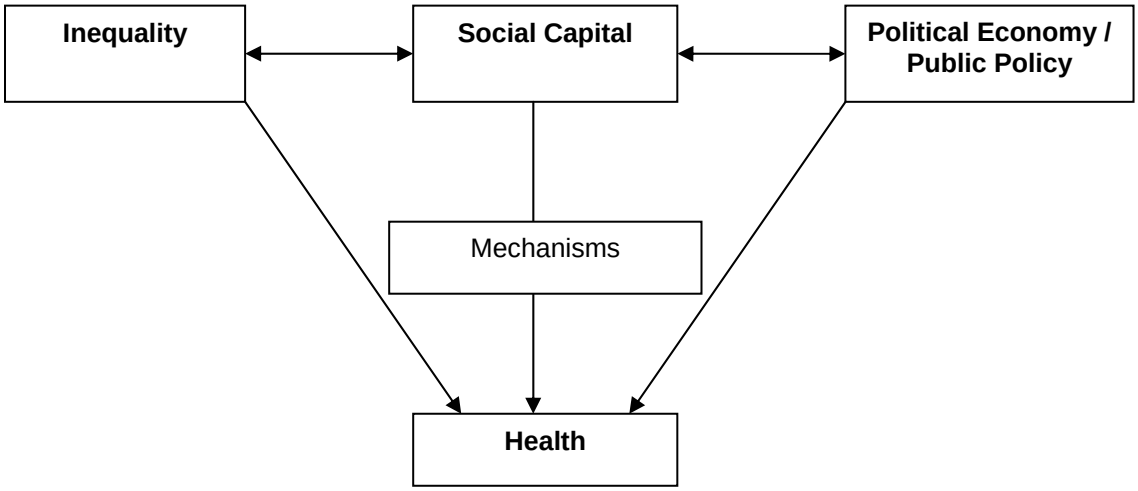
According to Putnam (2000), mortality rates are powerfully affected by social capital. Although the origins are not yet clear, Putnam brings forward the statement that the prime candidate is social isolation.

Social networks can have effects on individuals inside the social networks, as well as aggregate effects on outsiders. Not only can social ties provide social support that enhances individual health – broader social networks may also enhance the effectiveness of public health provision. Here, in accordance with Putnam, the term will be used in this broad sense, but it has to be stressed that most social epidemiologists use it for aggregate measures only, while social support is used for the individual level.

Figure 7 illustrates how social capital interacts with political economy and inequality. That political economy or public policy have influences on health is intuitively clear. It has been argued above that socioeconomic inequality has influences on health as well. A positive and robust relationship also exists between measures of equality – for example, income distribution – and measures of social capital. Some scholars argue that the arrow should run from inequality to social capital, as hard reality of income distribution translates to the softer realities of social capital (Marmot & Wilkinson 1999). Putnam (2004) argues that both political public policy and inequality could – to a certain extent – result from social capital.

Three approaches to Social Capital Theory can roughly be described using Figure 7. First, according to Szreter & Woolcock (2004), a “social support” perspective argues that informal networks are central to health. This is illustrated by the central arrow running from Social Capital through Mechanisms to Health. Second, an “inequality thesis” claims that widening economic disparities have eroded citizens’ sense of social justice and inclusion. This thesis is depicted by the arrow following from Inequality to Social Capital to Health. Finally, a “political economy” approach means that the exclusion from material resources – mediated socially or politically – is the primary determinant of poor health outcomes. This is shown by the arrow from Political Economy through Social Capital to Health. All three approaches share the final arrow running through “Mechanisms”. Central to this understanding is the concept of perceived stress. At the individual level, social support reduces perceived stress and is connected to the existence of social networks.

Figure 7: How social capital interacts with political economy and inequality



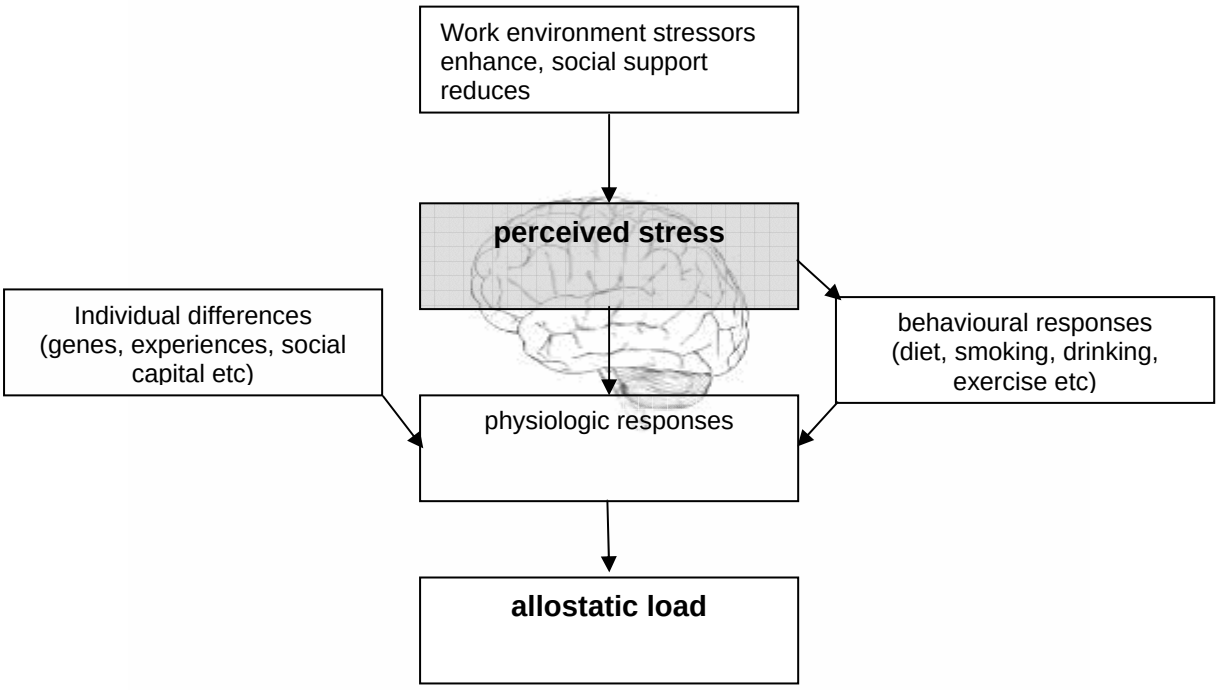
***Source*: adapted from Putnam (2004)**

Debate goes on whether at the macro-level social capital is really a new and independent variable, or if it is just fogging established concepts of social class: Pearce and Davey Smith (2003) propose a “neomaterialist” view against the “indirect” social capital theory, hence focusing on the arrow running directly from Political Economy to Health.

However, there is a growing body of evidence today, that the broad and distinct fields of macro-sociology and micro-medicine or -biology are interlinked much more closely than it had been assumed in the more behaviour-oriented era. Differences in access to social support translate into individual physiological differences. Research in the fields of psychoneuroimmunology and neuroendocrinology has begun to map out the mediators and mechanisms by which the availability of social support and other environmental conditions might influence individual health (e.g., Berkman 1995; Berkman & Kawachi 2000).

McEwen (1998, 1999) introduced the term of allostatic load (Figure 8) to describe stress response. Stress perception is enhanced by environmental stressors or reduced by social support (Singer & Ryff 1999). It opens out into a physiologic response, which further cumulates into an individual “storage” – the allostatic load. Physiological response is mediated by individual differences (genetic predisposition, social capital, experiences etc) or behavioural differences (e.g., smoking, exercise). The allostatic load has major impacts on health. Outcomes like insulin resistance, abdominal obesity, atherosclerosis, hypertension, or immune suppression have been described in detail (McEwen & Seeman 1999). In an experimental study (Rissen et al 2000), perceived distress had influences on muscle activity, which is seen as an explanation for the high prevalence of musculoskeletal disorders associated with stressful work.

Figure 8: Development of allostatic load



***Source*: adapted from McEwen & Seeman (1999)**

The role of social capital has been shown both on a macro and micro-level. Kawachi and colleagues (2004) provided a very comprehensive list of ecological and multilevel studies, showing the different measures that are used to estimate the amount of contribution of social capital to health.

A highly significant inverse relation with age-adjusted, all-cause mortality could be demonstrated with aggregated measures of levels of interpersonal trust, norms of reciprocity, and density of associational membership across the states of the USA (Kawachi et al 1997). This association remained even after controlling for household poverty rates. Corresponding results could be shown (Kawachi et al 1999a) in a multilevel study of the relationship between US-state level social capital and individual self-rated health, controlled for the most important confounders – e.g., health insurance coverage, smoking status, overweight, socio-demographic characteristics, household income level and educational attainment.

Further, labour unions and comparable social institutions play a major role in stimulating citizens to participate in micro- and macro-political decision-making, in turn resulting in maintenance of social control and healthy norms (Kawachi 1999). This form of participation is probably plausible for occupational settings.

From a different angle, Wilkinson (1999) describes how different positions within a given hierarchy affect HDL/LDL ratios (high/low density lipoprotein-cholesterol), central obesity, glucose intolerance, atherosclerosis, basal cortisol levels and cortisol responses.

Perceived stress is responsible for the major contributions to mortality – above all, via cardiovascular diseases. It is also accused for long term sickness absence (Henderson et al 2005). If hierarchies in society and working life are a major cause of perceived stress, then more egalitarian societies and work settings must result in both decreased mortality and long term sickness absence (compare Theorell 1999). However, social capital in a given setting has been shown to be inversely related to the degree of hierarchy (Kawachi 1999; Wilkinson 1999).

There are a growing number of studies from different OECD countries to support these ideas. Penninx et al (1997) examined 2928 non-institutionalised people from Amsterdam (55-85 years) in the early 1990s. After controlling for age, sex, chronic diseases, use of alcohol, smoking, and self-rated health, it turned out that fewer feelings of loneliness (social support) and greater feelings of mastery (control) were still directly linked with reduced mortality. In an additional stratified analysis, the level of perceived social support was inversely associated with mortality. For men, the position in the occupational hierarchy was correlated with self-perceived health, even after adjustment for baseline health, health behaviours and psychosocial work exposures (Mustard et al 2003).

The role of social networks as predictors for mortality risk has been successfully demonstrated in middle aged men and women in Japan (Iwasaki et al 2002) and Hungary (Skrabski et al 2003). In the latter publication, including more than 12.000 individuals, all of the social capital variables were significantly associated with middle age mortality.

Rosengren et al (1998) followed a random sample of a Goteburg male population (1016 men who were 50 years at baseline) for 12 years. In this population, that both emotional support and social activity were significantly inversely correlated with all-cause mortality. In Norway, 1010 persons were followed for 17 year from 1976 onwards. After controlling for socio-demographic and biological factors, low social participation and external locus of control were associated with increased mortality (Dalgard & Lund Haheim 1998).

In an ecological study from Saskatchewan (Canada), income inequality was positively, and social capital was negatively related to mortality (Veenstra 2002).

Other authors cast doubts on the importance of social capital. In an econometric model of population health for 19 OECD countries, standard indicators of social capital – i.e. proportion of people who say that they generally trust other people, or membership in voluntary associations – was insignificant. A significant and positive impact has been obtained for income per capita and the proportion of governmental health expenditure (Kennelly et al 2003). This is largely supported by the study of Lynch (2001), who found on a macro-level that income inequality and characteristics of the psychosocial environment – like trust, control, and organisational membership – do not seem to be key factors in understanding health differences.

How is social support assumed to work? Probably, it is not so much that social support stops a person getting sick, but helps him or her to recover when he or she does get sick. This notion is important for long term absenteeism and for the development of chronic diseases – mainly by protecting against stress (Halpern 2005 pp73-112).

On the individual level, there is some evidence that social support at work influences health outcomes. Thus, a Japanese cohort study found perceived job stress to be “causally” related to mental health. The item “poor relationship with superior” showed the largest adjusted hazard ratio (Shigemi et al 2000). Insomnia in shift workers was independently associated to social support at work and job strain (Nakata et al 2001; Fujita & Kanaoka 2003). A longitudinal study from the Netherlands revealed positive changes in perceived social support at work to diminish fatigue, emotional exhaustion and psychological distress (Janssen & Nijhuis 2004).

The presence of control and social support at work was also found to protect US-physicians from developing job dissatisfaction and psychiatric distress (Johnson, Hall et al 1995). However, in a prospective cohort study on 6000 public sector employees from Finland, a similar association disappeared in logistic regression after adjustment for sociodemographic background factors, and hence only partially supported the hypothesis of work-related social capital as a health resource (Liukkonen et al 2004). Partial support also stems from a medium-sized cross-sectional study on German industrial workers, where job demands corresponded more to allostatic load than social support at work (Schnorpfeil et al 2003).

For Danish employees, the influence of social support at the workplace on musculoskeletal symptoms even exceeded that of physical exposures (Feveile et al 2002). Similar results stem from a prospective cohort of French workers. Back pain leading to lost work days had a prevalence of 4.6%, both in male and female U.S. industry workers (Guo et al 1999).

High job strain and low co-worker support were important factors for work injuries in Japanese female blue-collar workers (Murata et al 2000). In Australia, job autonomy and communication positively predicted safe working (Parker et al 2001). The extent to which people are treated with justice in workplaces seems to predict their health independently of established stressors at work (Kivimaki et al 2004). Justice is seen as an important aspect of social support, especially in the work environment. However, analysing the same Whitehall II (UK) data, Kuper and Marmot (2003) found that the effect of job strain on coronary heart disease was not modified by social support at work.

In a huge cohort of middle aged employees of France’s national gas and electricity company (GAZEL study, n=20.000), quality of the work environment – including social support at work and social relations outside the work context – independently affected sickness absence over an extended period of time (Melchior et al 2003). In the Netherlands, high supervisor support was the most predictive variable on return to work after sickness (Janssen et al 2003).

Hence, on the individual level, the majority of the literature suggests that social support positively influences health and negatively influences cause-specific mortality. Social support at the workplace seems to work independently from job strain variables. In addition to health outcomes, social support also seems to influence long term absenteeism and productivity (Eriksen et al 2003; Michi & Williams 2003; Baruch-Feldman 2002; Wickstrom & Pentti 1998), both being not only of public health, but also of economical relevance.

2.2 Conclusions

The evidence from the literature suggests that high national wealth, low income inequality, good educational resources, low unemployment rates, low inequality, low hierarchy, low (work) stress, high internal control, high social support are crucial factors for good overall health, as well as for good occupational health. Table 1 summarises the evidence for specific groups of diseases and causes of death. The details can be found in Annex I and Annex II.

Table 1 Summary of main findings, effects of variables, independently explaining SES differences with respect to occupational health

outcomes\due to influence	income (inequality)*	education	unemployment	stress	control	social support
mortality	++	- -	++	++	- -	- -
neoplasm	++	-	(+)	(+)		
chronic obstructive pulmonary diseases (COPD)	+	-	(+)	(+)		
wounds & injuries		- -	+	++		- -
diabetes II		-		(+)		
infant mortality	+ +	- -	+			
cardiovascular diseases (CVD)	++	-	++	++	- -	- -
substance related disorders	+		++	++	- -	- -
depression &mental disorders	(+)		++	++	-	- -
suicide	(+)		++	(+)		- -
HIV/AIDS	++	- -	++	(+)		- -

Legend:

++	strong evidence from the literature for a positive association
+	clear support for a positive association, but few publications
(+)	some support for a positive association, but few publications
- -	strong evidence from the literature for a negative association
-	clear support for a negative association, but few publications
(-)	some support for a negative association, but few publications
no entry	no support for an independent association, or no relevant literature found

*most of the associations reported from the literature within the time span used (1995-2005) are with respect to income inequality rather than absolute income (especially on aggregate levels), so the association, if published, will be positive.

2.3 References

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3 Material and methods

3.1 Statistical analysis

General approach

Here we present in short our general attitude or philosophical approach toward data analysis and statistical modelling.

We know that data are far from perfect for several reasons, especially when we use socio-economic data for international comparisons. It is not only that data are crude approximations of the real phenomena that we want to describe. Differences with regard to national cultural and institutional settings may generate variables that are labelled similarly at an international level but which describe in truth completely different real phenomena in different countries.

Statistical models are “wrong” by their very definition as crude abstractions and usually rely on numerous mathematical assumptions which cannot be tested in every detail.

Being aware of these general limitations that we have to face when we do empirical analysis based on non-experimental, observational data, we need a strategy to validate our results and conclusions. One practical solution is to accept as major general guidance the coherence of overall results. We should not rely on isolated statistical evidence based on triple star p-values which can also arise as an artificial result from intensive data mining. What we really need is something different: To derive right conclusions we need *coherent empirical evidence* from different sources. Such different sources can be:

1. Different publications/studies
   For example: epidemiologists speak of ecological fallacy to describe the fact that relationships found with aggregated macro data may not have a counterpart when one uses analogous micro data from individuals. It is important when we do modelling with aggregated macro data, that we have references that confirm our results with an approach based on micro data.

2. Different approaches of modelling
   For example, if we have a finding based on pure cross sectional analysis we would like to have analogous results from an approach that is based on time series analysis with distributed lag modelling as the cross sectional snapshot analysis may reveal only parts of the truth

3. Different sources of data
   In addition, one should use different sources of data, when these sources are available.

With regard to data analysis, the appropriate statistical method will depend on the data. In general, it does not make much sense to use very sophisticated statistical or econometric

models on weak data that are invalid, incomplete or non-comparable. Of course comparability of data is an issue that cannot be solved by inspection of the data alone. Comparable data have to be derived by applying standardized methods for data collection. When the same standards are not applied, any comparison may be invalid even when the data are complete and matching.

After this general and more philosophical introduction, we outline in short the more precise approach of statistical modelling within the project.

Statistical methods

Data validation
The data that are used in this project are all from secondary sources. We can assume that the data have been intensively screened for errors. Nevertheless, when the data were converted from their proprietary data sources to project databases they were screened again by visual inspection of the numbers and by plotting the data to identify implausible data.

Main data analysis
The fundamental aim of our research was to derive a coherent image from different sources of information and different kinds of statistical modelling.
The statistical methods that can be applied to the data depend on the characteristics of the data. The fundamental data structure that we are working with are observations of different variables in up to 38 countries (25 EU member states, 3 candidate countries and 10 additional OECD countries), for special extended types of analysis up to 46 countries were included. The maximum time span covered the years from 1960 to 2002. It can not be expected that the data will be complete with regard to the coverage of country and time. This will make it necessary to restrict different kinds of statistical analysis to different country groups and time spans, e.g. some survey data (European Survey on Working Conditions, European Quality of Life Survey) will only be available for a subset of the EU member states and a single year.

The weakest form of statistical analysis that we can did was to plot the data in order to identify trends and to do some elementary comparative graphical analysis. Even with in-complete and non-matching data this can provide some useful insight, e.g. when we looked at data from the International Labour Organisation (ILO) on work related accident rates.
A statistically more meaningful analysis requires that we use a model that allows us to analyse the impact of an independent variable on a dependent variable while controlling for the effects of other variables. To achieve this goal we used different types of regression analysis:

- *cross-section regression models*

  With a pure cross-section regression approach for one point in time, i.e. a single year, observations from different countries for several variables are used in regression analysis. When not enough observations for countries are available, it is even possible to use observations from different subsequent years in one regression, e.g. within a time

neighbourhood of ± 2 years. Cross-section regression models were the main statistical instrument that was used within the study. To validate model assumptions intensive model specification tests were run which is documented in a separate annex.

- *pooled cross-section time-series regression models*

  When the time span of observations covers not a single year but several years it will be possible to use this additional information. Unfortunately the application of pooled cross-section time-series analysis was unexpectedly very limited. The reason for this was, that variables of which importance we have become aware only during the course of the project, like data on the shadow economy or the Gini coefficient, are even not available for a continuous short time span of several years for a sufficient large number of countries.

- time-series *regression* models

  When observations are available for a considerable time span, then time series regression models can be applied. Of enormous relevance are time series regression models that use distributed lag modelling to analyse the cumulated impact of an independent variable over several years on a dependent variable. It has to be pointed out that this kind of analysis can provide much deeper insight as non-contemporaneous dependencies are also taken into account. This can be contrasted to pure cross-section analysis which is just a kind of snapshot analysis. Whenever possible, both approaches should be applied to derive a more coherent insight. As most of our variables had not the necessary number of observations for doing time-series regression analysis with distributed lag modelling, this approach was only used to analyse the impact of Gross Domestic Product (GDP) and unemployment on mortality.

- *Exploratory data analysis*

The aim of such a study would be to identify specific patterns or specific structures that cannot be revealed by our more standard analytic approach. Experimental cluster analysis and experimental factor analysis were used in our project. The results up to the end of the project provided no clear insight and were of limited coherence.

3.2 Data sources and quality

The majority of the work effort in this project has been devoted to analysis of the availability and quality of data sources. The basic issue has not been a principal lack of integrity in any given database. Indeed, each of the international databases, including Eurostat, has developed with very considerable financing and attention to quality in detail. The major problem that we have encountered for the purpose of analysis in this project has been the occasional lack of comparability across countries as to the quantitative estimation and meaning of the data that have been assembled. This point is of course crucial for our project, since it requires our ability to do quantitative analysis that will have reasonable validity and reliability among industrialised countries. This has not been a major problem when dealing

with mortality (even for major causes) or for international databases dealing with macroeconomic or labour market conditions, or even conditions at the workplace.

It has been a serious problem, however, where the intention was to examine conditions of work, cross-sectionally or over time, in European countries based on harmonized administrative data from different national data sources. In this regard, the most difficult problem has been with respect to identification of fatal and non-fatal accidents within European Union countries. A report from the 'Instituto Nacional de Seguridad e Higiene en el Trabajo' for Eurostat (INSHT 2004) provided considerable background information on national differences with regard to the reporting systems and institutional pecularities. Differences of reporting systems, which can be divided up mainly in insurance based systems and 'labour inspectorate systems', coincide with different levels of financial incentives induced by workers' compensation systems. Our analysis confirmed not only a distorting effect of financial incentives on reporting levels for non-fatal accidents but also for reporting levels of fatal accidents. An index has been developed whereby the extent of better employee remuneration on work accidents in comparison with non-work accidents (e.g., health insurance, sickness and disability compensation, etc.) tends to result in a considerably higher rate of reporting of non-fatal and fatal accidents. These findings may ultimately pose great difficulties in the use of these data as outcomes in health and safety risk factors or in factors resulting from job stress and lack of job satisfaction. On the other hand, based on the higher estimate of accidents reported as a result of employee compensation, it may be possible to develop correction methodologies that will improve the international comparability of these data. Alternatively, it may also be possible to perform time-series analyses within countries, since it does not appear in the first instance that, over time, employee compensation would affect accident reporting within individual countries. But it can not be excluded that institutional changes that affect the patterns of financial incentives also have a distorting effect over time.

Very considerable effort has gone into assessing the content and validity of data available from European (especially Eurostat) sources. Additionally time consuming, however, was the examination of these issues in the context of availability of internationally comparative data for the same points in time.

The following data sources have been investigated for this project:

WHO	WHO Mortaliy Database
HFA-DB	European Health for All Database (WHO Europe)
OECD Health	OECD Health Data 2004
EWCS	European Survey on Working Conditions 2000/2001 (Eurofound)
EODS	European Occupational Disease Statistics (Eurostat)
ESAW	European Statistics on Accidents at Work (Eurostat)
ECHP	European Community Household Panel (Eurostat)
LFS	Labour force survey (Eurostat)
CVTS	Continuing Vocational Training Survey (Eurostat)
ICT	Information Communication Technology Surveys (Eurostat)
NSI	National Statistical Institutes (Eurostat)

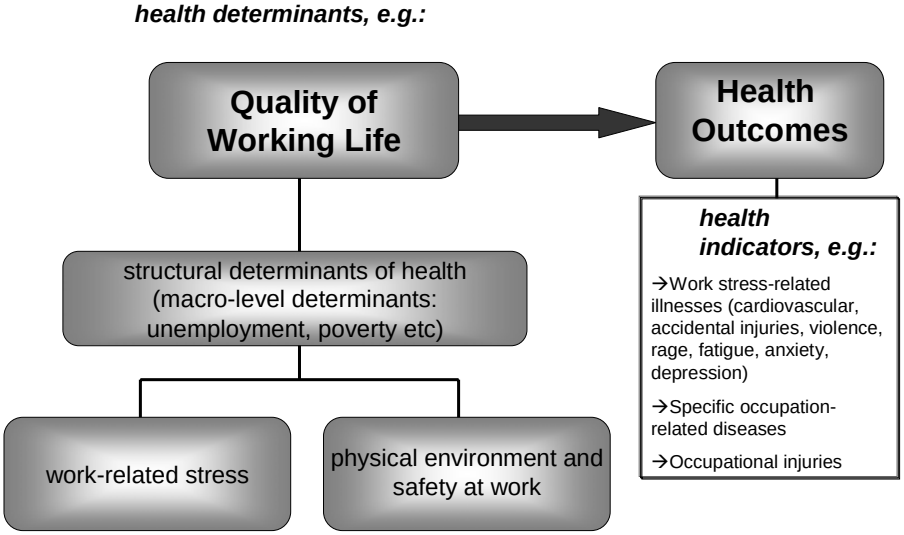
EITO	European Information Technology Observatory (Eurostat)
BCS	Business and Consumer Survey of the The Directorate General for Economic and Financial Affairs (Eurostat)
LABOURSTA	ILO Labour Statistics
KILM	KILM: Key Indicators of the Labour Market, 3rd Edition (ILO)
WDI	WDI: World Development Indicators 2004 (World Bank)
OECDL	OECD Labour Force Statistics
OECDP	OECD Social Expenditure Database
OECDS	SourceOECD
OECDF	OECD FACTBOOK 2005
UOE	Joint UIS (UNESCO Institute of Statistics)/OECD/Eurostat questionnaires on education statistics
Maddison	Angus Maddison, The World Economy: Historical Statistics. OECD 2003
Schneider	Prof. Friedrich Schneider, Linz
FAO	FAO: Food and Agriculture Organisation (UN)
USDA	USDA: United States Department of Agriculture

3.3 Quality of Working Life Indicators – A Conceptual Multilevel Framework

This chapter presents our conceptual multilevel framework for investigating the influence of Quality of Working Life indicators on health-related outcomes and labour productivity. It has been developed on the basis of the key ideas existing in the modern epidemiological literature with respect to the impact of quality of working life on health. First of all, these ideas concern the issues of *health determinants* which represent factors that have been identified to have either positive or harmful effects on health.

There is a substantial body of epidemiological evidence linking health outcomes with various aspects of work-related stress and the physical environment and safety at work. Another important piece of research concentrates on the relationships between the so-called structural determinants of health – e.g., poverty and unemployment – and health outcomes. Since all these determinants can be viewed within the general quality of working life concept, the overall state of epidemiological evidence targeted on health outcomes can be depicted as follows (Figure 9):

Figure 9: Epidemiological evidence linking health outcomes and aspects of quality of working life



In 2001, the Commission of the European Communities[1] formulated a broad approach to quality in work, covering both the characteristics of individual jobs and the characteristics of the wider work environment including how the labour market works as a whole. This approach introduces ten aspects (dimensions) of quality in work which can be easily understood and, therefore, represent a good practical tool to address quality in work as a full. Following this document, an agreed list of indicators has been published.[2]

Table 2 cites the suggested list of quality in work dimensions.

Table 2: Quality in Work Dimensions Suggested by the Commission of the European Communities

(i) Intrinsic job quality Jobs ought to be intrinsically satisfying, compatible with a person's skills, abilities and expectations, and provide appropriate levels of income.
(ii) Skills, lifelong learning and career development People ought to be able to develop their potential abilities and appropriate support for life-long learning.
(iii) Gender equality Labour markets should offer equal opportunity for men and women in terms of life-time careers, including equal access to employment and supervisory functions, and equal pay for work of equivalent value to the society.
(iv) Health and safety at work It has to be ensured that working conditions are safe, healthy and supportive – in both physical and psychological terms. Exposure to risks and stress at the working place, accidents at work and occupational diseases have to be reduced.
(v) Flexibility and security An appropriate balance between flexibility and security of employment and work relationships is called for to encourage positive attitudes to change at the workplace and in the labour market. This requires appropriate support for those who lose their jobs or are seeking an alternative, as well as encouragement for the full use of abilities and flexible career choices through appropriate support for occupational and geographical mobility.

[1] COM (2001). *Employment and social policies: a framework for investing in quality*. 313 final, 20.06.2001
[2] *Indicators of Quality in Work*, Report by the employment Committee to the Council, 14263/01, 23.11.2001.

(vi) Inclusion and access to the labour market Labour markets should offer access to all, including those entering the labour market for the first time or after a period of unemployment or inactivity, and allow them to stay in the labour market.
(vii) Work organisation and work-life balance Working arrangements, especially those concerning working time, and support services should allow an appropriate balance between working life and life outside work.
(viii) Social dialogue and worker involvement All workers should be informed about and involved in the development of their companies and their working lives.
(ix) Diversity and non-discrimination All workers should be treated equally without discrimination in terms of sex, age, disability, ethnic origin, religion or sexual orientation.
(x) Overall work performance High levels of labour productivity and high living standards across all regions of the Community should be aimed at.

Taking the advantage of this practical tool, we integrated its components in our conceptual framework elaborated for the purposes of the current project (Tender No. VT/2004/36). However, our conceptual framework does not "duplicate" the approach to quality in work, available in the documents cited. We have tried to substantially enrich the substance by emphasizing the issues related to the "established" determinants of health – e.g., work stress – as well as by "getting granular" on health-related outcomes.

Our intent is to bring together the aspects (dimensions) of quality in work – as elaborated in the document cited – and the existing literature on health determinants and health outcomes. Further, we will test the relationships of quality in work indicators with health-related outcomes and labour productivity in the national settings. This approach can shed the light on the nature of health differences existing across countries analysed. To be able to perform such tests, we need to know which quality in work indicators are practically available and suitable for the purposes of modelling of health-related outcomes and productivity.

The essential objectives of the conceptual framework can be summarised as follows:

(1) to serve as a general frame of reference for a comprehensive literature review,

(2) to guide a systematic work on the econometric modelling of health-related outcomes and labour productivity in the member states and candidate countries of the European Union, as well as in the rest of OECD countries, and

(3) to assist in the work on the further development and use of quality in work indicators (totality of aspects of working life), which have the strongest impact on health-related outcomes.

This framework is structured along two approaches (Figure 10). The micro-level approach – depicted as an ellipse – considers quality in work from the perspective of the individual. To a substantial proportion, its indicators are represented by the individual-level data.

The macro-level approach describes the perspective of the national economy and the society and deals mostly with aggregate-level data, although individual-level data can be very useful

for some indicators. This approach is depicted as a scheme background in two colours: (A) grey for the wider labour market context and (B) aquamarine for social and political context.

Each approach is constituted by several dimensions, which do not necessarily exactly match those suggested by the Commission Communication. Some of them are in close agreement with those cited above; the others – like work-related stress or physical environment and safety at work – are given in our conceptual scheme in a greater detail. The table of correspondence (Table 3) provides an overview of "crosswalks" between the dimensions of our conceptual framework and those mentioned above.

Wherever possible, we indicated the basic data sources which contain statistical information on the particular indicators – elements of our dimensions. The abbreviations of the basic data sources are given in the scheme in parenthesis. They are explained as follows:

CLFS	Community Labour Force Survey
CVTS	Continuing Vocational Training Survey
EB	Eurobarometer Survey on ICT and employment, November 2000
ECHP	European Community Household Panel
EODS	Project on European Occupational Disease Statistics
ESA95	National account (domestic concept, quarterly data)
ESAW	European Statistics on Accidents at Work Project
ESWC	Third European Survey on Working Conditions 2000
ILO-LABOURSTA	International Labour Organisation (Database on Labour Statistics)
KILM 2003-2004	Key Indicators of the Labour Market
NLFS	National Labour Force Survey
LFS	Labour Force Survey
WDI 2004	World Development Indicators
OECD 2004	Organisation for Economic Co-operation and Development, Health Data
NSI	National Statistical Institutes

Table 3: Correspondence between the quality in work dimensions of COM (2001) and the TUB (2005) dimensions for quality in work and health-related outcomes

Quality in Work Dimensions (COM 2001)	Quality in Work Dimensions And Health-Related Outcomes (TUB 2005)
(i) Intrinsic job quality	Job satisfaction → Dimension 3
(ii) Skills, lifelong learning and career development	Education / Training → Dimension 3(A)
(iii) Gender equality	Gender equality → Dimension 2(B)
(iv) Health and safety at work	Physical environment and safety at work→Dimension1 Work-related stress → Dimension 2 Health-related indicators → Outcomes
(v) Flexibility and security	Access to employment → Dimension 1(A) Social protection systems → Dimension 1(B)
(vi) Inclusion and access to the labour market	Access to employment → Dimension 1(A) Advancing to higher paid employment / active labour market policies (ALMP) → Dimension 5(A/B)
(vii) Work organisation and work-life balance	Work and life balance, flexible arrangements, hours worked → Dimension 4(A/B)
(viii) Social dialogue and worker involvement	Social dialogue and workers' rights → Dimension 2(A)
(ix) Diversity and non-discrimination	Diversity and non-discrimination → Dimension 3(B)
(x) Overall work performance	Labour productivity → Outcomes

Within the ***micro-level approach*** we identified four dimensions which are related to the intrinsic job characteristics: (1) physical environment and safety at work, (2) work-related stress, (3) job satisfaction and (4) work and life balance.

The first dimension – *physical environment and safety at work* – is included in the dimension (iv) suggested by the Commission (Health and safety at work), together with work-related stress. It may be further subdivided into the following domains and elements, which are not indicated by the scheme:

- → Ambient environment
  - Noise
  - Temperature conditions (heat / cold)
  - Air humidity
  - Light intensity
  - Sanitary conditions
- → Ergonomic environment
  - equipment that is ergonomically suitable to human physiology
  - "man-machine-interaction"
- → Safety
  - Dangerous substances
  - Risky conditions (working at height)
  - Availability of protective equipment

The second dimension – *work-related stress* – is much more complex. It can be basically defined as a pattern of reactions that occurs when workers are presented with work demands which are not matched to their knowledge, skills or abilities, and which challenge their ability to cope.[3] It may include the following domains covering:

- → time pressure or amount of work (quantitative demand)
  - working at high speed
  - lacking control over speed
  - work to tight deadlines
  - overtime, long working hours
- → flexibility required (flexibility demand)
  - unforeseen interruptions of work
  - lacking ability to choose the order of tasks
  - lacking ability to determine methods of tasks fulfilment
  - unusual working hours
- → difficulty of the work (cognitive demand)
  - monotony
  - no opportunity to learn new things
  - no assistance when required
  - solving unforeseen problems at one's own
  - complex task
  - unrealistic targets
  - overlapping tasks
  - high attention and concentration
- → empathy required (emotional demands)
  - emotionally demanding situation
    - o physical violence at work place
    - o intimidation / mobbing at work place
    - o sexual discrimination at work
    - o unwanted sexual attention at work

[3] European Foundation for the Improvement of Living and Working Conditions (2005). *Work-related stress*. Dublin. EF/05/127/EN, p2.

    - o age discrimination at work
    - o other forms of discrimination (disability, ethnicity, nationality etc)
  - hiding emotions / negative feelings (e.g., anger)

→ social support need

  - lacking ability to receive social support / encouragement from co-workers
  - criticism in front of colleagues

→ promotion /career /reward (reward demand)

  - lacking career opportunities
  - lacking appreciation by management /colleagues /society
  - lacking autonomy at work

→ stability demand

  - job insecurity

→ income demand

  - low income.

The third dimension – *job satisfaction* – may include elements like satisfaction with financial situation, with job itself etc. These issues are basically described as "intrinsic job quality". ECPH provides indicators of "satisfaction" by level of education, age, sex, source of income, type of contract etc.

The next dimension (4A/B) – *work and life balance* – can be considered both from the perspective of the individual and from the standpoint of ***macro-level approach***, as indicated by the block which overlaps with ellipse. At the same time, this dimension is located both within (A) Wider Labour Market Context and (B) Social and Political Context. For instance, flexible working arrangements enable the individuals to fulfil their social and family obligations – first of all, bringing up children. Therefore, it is difficult to place this dimension into one definite contextual area. KILM and LFS are the essential data sources, providing information on hours worked (KILM) or proportion of employees working part-time, as well as on differences in employment rates without the presence of any children and with presence of children aged 0-6, by sex (LFS). Further indicators may include number of employees who left their last job for family responsibilities or for education purposes no more than 12 months ago who return later to work but are currently not available for work (for the same reasons why they left their last job) as a % of all employees by gender (LFS). National sources present data on children cared for (other than by the family) as a proportion of all children in the same age group.

Within the Wider Labour Market Context (A), the first dimension relates to *access to employment*, which can be assessed through employment and unemployment rates, long-term unemployment, status in employment (self-employed, salaried workers, family workers), mobility between sectors and occupations, transitions between employment, unemployment and inactivity.

The second dimension – *social dialog and workers' rights* – includes indicators of strikes and lockouts, working days lost in industrial disputes, as well as rates of days not worked. ILO-LABOURSTA provides these data by economic activity. UNECE, ILO and EUROSTAT[4] also

[4] UNECE, ILO, EUROSTAT (2005). *Quality in work. Dimensions and indicators in the framework of the European employment strategy*. Working paper No.2: 2 May 2005.

recommend assessing this dimension through measuring employee representation and involvement, the percentage of employees covered by collective agreements, the proportion of employees with recognised worker representation, the coverage of works councils and other forms of representation and involvement; and trade union density.

Dimension 3(A) *education/training* is basically represented by KILM indicators on educational attainment and data on percentage of the workforce participating in job-related training provided by CVTS. In addition, LFS indicates percentage of working age population participating in education and training by gender, age groups, working status and educational level achieved. The Eurobarometer survey on ICT and employment (November 2000) gives information on computer users with and without job-related computer training (assessed as share of the workforce, employing computers at home and/or at the workplace for work purpose).

The OECD-indicators of dimension 5(A/B) deal with *active labour market policies (ALMP)*, *advancing to higher paid employment*. This dimension is related to labour market situation. However, ALMPs are impossible without norms and political regulations in a given country. Therefore, this dimension can be considered within two contextual areas – (A) Wider Labour Market Context and (B) Social and Political Context.

Social and Political Context (B) is represented by three further dimensions: social protection systems (1B), gender equality (2B) and diversity and non-discrimination (3B).

The OECD-indicators of *social protection systems* comprise social transfers and different kinds of benefits (old age, sickness and disability, unemployment benefits etc), which can be measured, e.g., as public expenditures per capita.

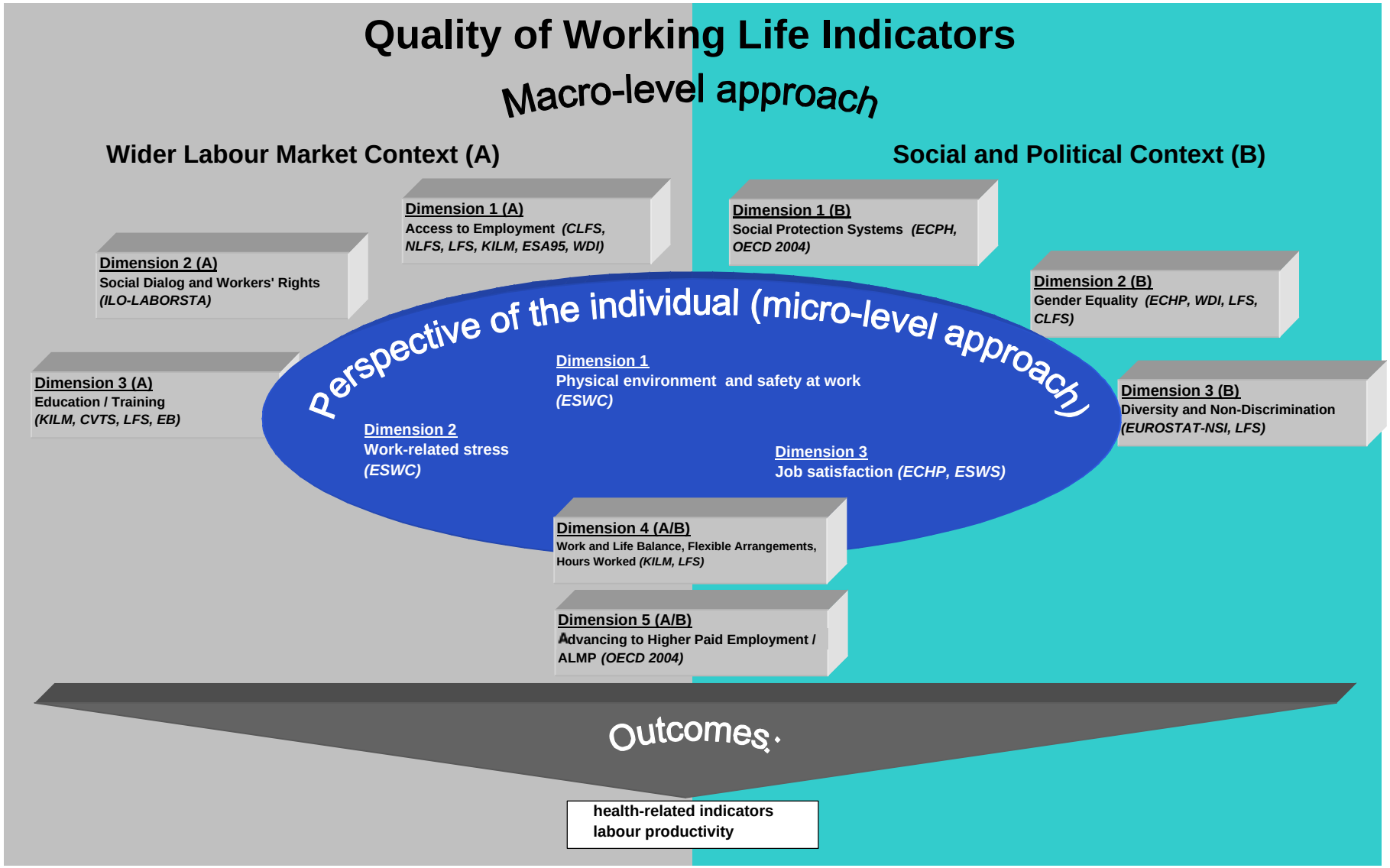
The essential indicators of *gender equality* include gender pay gaps and employment segregation (the latter by sectors and occupations, as given by LFS).

Diversity and non-discrimination is a very broad field in a societal context. EUROSTAT-NSI covers data on age discrimination (employment and active population in the age of 55-59 years). LFS comprises information on employment rate gap of 55-64 year olds. Among the further indicators recommended by UNECE, ILO and EUROSTAT are the following types of data from the national sources:

- → the gap between the employment and unemployment rates for ethnic minorities and immigrants, taking into account the distinction between low and high level qualifications, as compared with the overall rates, as well as

the gap between the employment and unemployment rates for disabled people, taking into account the distinction between low and high level qualifications, as compared with the overall rates.

Figure 10: Conceptual multilevel framework for investigating the influence of Quality of Working Life Indicators on health-related outcomes and productivity



4 Accidents at work

4.1 Background

The European Statistics on Accidents at Work (ESAW) reports for the year 2002 ca. 4.5 million accidents at work with more than 3 days of absence of work in the EU15 countries and ca. 4 800 fatal accidents at work. For the United States the Bureau of Labour Statistics reports 4.1 million injuries at work and ca. 5 500 fatal accidents at work.

The enormous social relevance of these numbers on accidents at work becomes evident when one looks at the direct and indirect outcomes of accidents at work.

The outcome of an accident at work is often evaluated with a focus on direct economic costs and duration of work disability. But the overall social consequences of an occupational injury are more complex (Dembe 2001): These indirect economic and social consequences also have to be taken into account. The impact of a work injury has not only effects on the physical status which can be described by impairment, disability, pain and problems with standard activities of daily living. Other consequences are e.g. diminished productivity, reduced wages, unemployment or retraining. The psychological and behavioural responses comprise stress, depression, anger, stigmatization, isolation, violence, suicide or a switch to unhealthy behaviours, e.g. smoking or other drug abuse. Other social effects relate to medical care utilization, household tasks, interpersonal communication, family relationships, sleep/sexual disruption, divorce, community involvement or discrimination.

A subgroup where the consequences of a work injury may be especially severe are older workers (Pransky et al. 2005): It is documented that older workers have more severe injuries, higher fatality rates, longer length of disability and more residual health problems. In addition older workers may experience an adverse outcome that is unique to them, i.e. health related early retirement. The consequence when workers leave the workforce due to health problems are a much higher risk to become impoverished compared to those who leave the workforce at usual retirement age in good health.

The comparison of international data on accidents at work is a special task as nearly all countries have not only different national reporting systems but in addition have different liability rules and compensation systems which have their own impact on accidents at work and the related reporting. We use data from the European Statistic on Accidents at Work (ESAW) to describe trends with regard to accidents at work in the EU15 countries and Norway. The data that are included in ESAW are harmonized data. Eurostat harmonizes the data from the different national sources with the aim to make these data comparable as possible between the countries. Data comparability is a great issue for international comparisons. There is a report available that was prepared by the Instituto Nacional de Seguridad e Higiene en el Trabajo (INSHT) for Eurostat. This report (INSHT 2004) provides background information on the national reporting system and will allow us to analyse in more detail the problem of comparability of data.

For countries that are not covered by ESAW we reviewed data from the International Labour Organisation (ILO). These data are not harmonized and allow no direct comparison between different countries. We outline only shortly on actual time trends that can be seen in these data.

4.2 The European Statistics on Accidents at Work (ESAW)

Background and aims

We refer to Eurostat (2001, p11) which describes the background and aims of ESAW:

The Framework Directive on Health and Safety in the Workplace (Council Directive 89/391/EEC 1989) requested the Commission to proceed with the harmonisation of data on accidents at work. On this basis, the ESAW project was launched in 1990, aiming at harmonised data on accidents at work for all accidents entailing more than three days' absence from work. A "Methodology for the Harmonisation of European Occupational Accident Statistics" was published in 1992 by Eurostat and DG Employment and social affairs. The ESAW project has been an integral part of the framework programme for priority actions in the field of statistical information 1993 to 1997(Council Decision 93/464/EEC 1993).

In addition the Council Resolution 95/C 168/01 furthermore calls upon the Commission: "to complete the work in progress on harmonising statistics on accidents at the workplace...". The Programme concerning Safety, Hygiene and Health at Work (1996-2000) also foresees the continuation of the implementation of this project.

Furthermore, the European Community Statistical Programme 1998-2002, which defines the main fields and objectives of the community statistics, foresees the establishment of consistent series of data on a European level in order to provide the means for the monitoring of health and safety at work and the efficiency of regulation in this field (Council Decision 99/126/EC).

The aim of the ESAW project is "to collect Union-wide comparable data on accidents at work and establish a database." Comparable data on work accidents are a prerequisite for monitoring trends in health and safety at work in the Union and for promoting accidents prevention both at Community level and in the individual Member States. The goals are to provide data on high-risk groups and sectors and indicators on both the causes and the socioeconomic costs of accidents at work. Consistent series of data should be established to provide the means for the monitoring of health and safety at work and the efficiency of regulation in this field.

Definitions and methods

The general aim was to compile a methodology which was detailed enough to be effective but also at the same time was not to complex, both as whole and for each individual variable, so that this statistical system would be easy to implement.

Basic concepts

An accident at work is defined as "a discrete occurrence in the course of work which leads to physical or mental harm". This includes cases of acute poisoning and wilful acts of other persons, as well as accidents occurring during work but off the company's premises, even those caused by third parties. It excludes deliberate self-inflicted injuries, accidents on the way to and from work (commuting accidents) and accidents having only a medical origin and occupational diseases. The phrase "in the course of work" means whilst engaged in an occupational activity or during the time spent at work. This includes cases of road traffic accidents in the course of work.

In accordance with the Framework Directive (1989), all cases of accidents at work leading to an absence of more than three days are included in the ESAW data. But whereas the Framework Directive (1989) defines more precisely these days of absence as working days of absence, for practical reasons ESAW follows the most common practice in the Member States, which is to use calendar days in calculating the number of days with an absence from work.

A fatal accident is defined as an accident which leads to the death of a victim within one year of the accident.

In practice the majority of the Member States send the cases of fatal accidents at work as these are counted in their national statistics. In fact, the majority of the accidental deaths occur either immediately at the time of the accident, or within a few days or a few weeks after the accident.

Additional information is collected that comprises the following variables (in parentheses: source for classification):

- economic activity of employer (NACE)
- occupation of the victim (ISCO-88)
- age and sex of the victim
- type of injury (ESAW/ILO)
- part of body injured (ESAW/ILO)
- geographical location (NUTS)
- day and time of accident
- size of enterprise (FTE number of employees, ESAW groups)
- employment status of the victim
- days lost

From 2001 onwards phase 3 of ESAW is gradually implemented and in addition to the variables above it includes information concerning the circumstances and events leading to the accidents.

Coverage of economic activities

Within the different national systems not all sectors of economic activities are covered, although for most of the private economic activities data are available. When comparable data shall be derived, it is necessary to restrict the data collection to selected sectors and branches for which comparative data are available. Using the NACE scheme to classify economic activities, ESAW collects data for the so called 9 common branches:

- A agriculture, hunting, forestry
- D manufacturing
- E electricity, gas and water supply
- F construction
- G wholesale and retail trade and repairs
- H hotels and restaurants
- I transport and communication
- J financial intermediation
- K real estate, renting and business activities

In 2002 the number of workers in all NACE sectors was 160.8 million (Eurostat: LFS, EU15), the number of workers in the 9 common branches was ca. 112.0 million, i.e. ca. 70% of the total number of workers are covered by the 9 common branches.

Coverage of specific type of accidents

Ireland and United Kingdom are not in a position to provide data on road traffic accidents in the course of work. The lack of coverage for this type of accidents has a significant impact on the national numbers of fatalities. For this reason ESAW data for fatalities is only presented excluding road traffic and transport accidents in the course of work when they are broken down by Member States.

Commuting accidents are defined as any accident which occurs during the normal journey between the home, the place of work and the usual place where meals are taken. Commuting accidents are also covered by the ESAW data collection, but this is implemented as a separate sub-project and the data are also reported separately.

Indicators, corrections and standardisation

From the collected data two main types of indicators on accidents at work are calculated:

- numbers of accidents
- incidence rates.

Incidence rates relate the number of accidents to the reference population of persons in employment (persons exposed to the risk of accident at work). The incidence rate as defined by the ESAW methodology is the number of accidents at work per 100 000 persons in employment. The reference population is established from the data of the Labour Force Survey. From an epidemiological point of view an incidence rate should relate the number of accidents to the working hours of the reference population. This approach would describe more precisely the relevant exposure as time under risk and therefore adjust for differences, e.g. with regard to different working hours or differences with regard to part-time employment.

Incidence rates are provided for the economic activities covered in the ESAW data by all Member States, i.e. the 9 common branches (see above). Incidence rates can be calculated for Europe, a Member State, or any sub-population breakdown according to one or more of the variables above characterising the victim of the accident (economic activity, age, etc.). Separate incidence rates are calculated for fatal accidents and accidents leading to more than 3 days' absence. Furthermore, an additional incidence rate is calculated for fatalities at the European level, which excludes road traffic accidents, in order to provide comparable incidence rates for all Member States. This is due to the fact that road traffic accidents in the course of work are not recorded as accidents at work in a few Member States. Fatalities caused by road traffic accidents represent an important share of the number of fatal accidents. For this reason, comparisons of national incidence rates for fatalities would introduce a serious bias without this adjustment of the rates. This applies also to accidents on board of any means of transport during a journey in the course of work, which are also excluded from this adjusted rate of fatalities. It should be noted that only this adjusted incidence rate on fatalities is used for the breakdown by Member States.

For the Member States where the accidents at work with more than 3 days' absence are only partly reported, reporting levels are estimated mainly by breakdowns by branches of economic activity for these Member States. On the basis of these reporting levels Eurostat correct the submitted data on the accidents and deduce from it an estimate of the number of accidents at work occurred. These corrections concern especially data from Member States which have a reporting system that is based on a labour inspectorate system and not on an insurance bases system where the reporting level can be assumed to be 100%. This problem will be discussed in more detail below.

The risk of becoming a victim of an accident at work is strongly dependent on the type of economic activity, outdoor construction workers or workers in agriculture have a much higher risk than workers at an office place, e.g. in financial mediation.

For this reason the industrial structure of a country will influence its total frequency of work accidents depending on the share of high-risk sectors. For example, a country where high risk branches like agriculture, construction or transport represent a higher share of the total workforce compared to another Member State, but with the same frequency of accidents for each branch, the first Member States would have a higher total national incidence rate. To correct for this effect a "standardised" number of accidents at work per 100 000 persons in employment is calculated per Member State by giving each branch the same weight at

national level as in the European Union total (“standardised” incidence rate). This standardisation method is used in current ESAW publications on accidents at work.

4.3 National data comparability

The ESAW data are based on administrative sources in the Member States. The successful harmonization of ESAW data depend on the operative reporting procedures, the possibility of modifying these or adapting their data to ESAW concepts and specifications.

The main sources of unsolved data comparability problems are associated with the items given below:

- national reporting systems
- coverage of the self-employed (and family workers)
- compensation systems.

These three items are not independent of each other but have an intertwined impact on the under- or over-reporting of accidents at work.

Other comparability problems are related to: coverage by type of accident (especially road accidents), working hours, part-time employment, age and sex and business cycles.

National reporting systems on accidents at work in the EU15

Mainly, two types of reporting procedures can be identified in the various Member States of the European Union. The insurance based systems, which can be found in 10 Member States, have reporting procedures mainly based on the notification of the accidents to the insurer, public or private according to the case. On the other hand the reporting procedures of the five other Member States (Denmark, Ireland, the Netherlands, Sweden and the United Kingdom) are mainly based on the legal obligation of the employer to notify the accidents to the relevant national authorities, which is often the National Labour Inspection Service. Norway, which also provides data to Eurostat, belongs to the latter group. In the insurance based systems, the supply or the refunding of care benefits and the payment of benefits in cash (daily subsistence allowances, rents where applicable, etc.) resulting from accidents at work, are conditioned in its report to the public or private insurer. Additionally, in a number of these countries, the benefits thus paid under the accidents at work insurance legislation are higher than in the case of non-occupational accidents. Thus, there is an economic incentive for the employer and the employee to notify an accident at work in the insurance-based systems. Due to these various factors, the reporting levels for accidents at work are in general very high in the insurance based systems and considered to be about 100 percent (with the exception of self-employed workers).

One important question that will be discussed below is, when the benefits paid under the accidents at work insurance legislation are higher than in the case of non-occupational

accidents may this cause an over-reporting of accidents at work in countries when it is possible to declare of non-occupational accidents as accidents at work?

The five other Member States and Norway have in general a system of universal social security ‘coverage’. In such systems the benefits provided to the victim of an accident at work are not depending on a preliminary reporting of the accident, except for the specific benefits paid for the most serious accidents (rents for permanent disability, etc.). Consequently, the economic incentive for notifying accidents at work is not very strong in the non-insurance based systems. Nevertheless, there is a legal obligation for the employer to notify an accident at work. In practice only a part of work accidents are actually reported and the systems based on the employers liability to notify work accidents to the authorities have only a medium reporting level usually ranging from 30 to 50 percent on average for all branches of economic activity taken together. It has to be pointed out in addition, that in these countries there is nearly no economic incentive to report non-occupational accidents as accidents on work.

As already mentioned above, for the Member States that have not an insurance based system corrections for the reported raw accident numbers are calculated. Eurostat estimates the number of accidents occurred from the numbers of cases reported and detailed reporting levels (break down mainly by branch of economic activity).

We illustrate the difference between the national reporting systems by adding two figures which compare accidents rates for the year 2001:

In Figure 11 the mean standardized rate of non-fatal accidents for the 6 non-insurance countries is compared to the mean standardized rate of the 10 countries that are under an insurance based system. The countries with non-insurance based reporting systems have an average of 2 520 non-fatal accidents per 100 000 workers; this average increases by a factor of 1.7 to 4 197 for the countries with an insurance based reporting system.

When we compare the mean standardized rates for the fatal accidents, a similar striking difference can be found (Figure 12): The countries with non-insurance based reporting systems have a mean standardized rate of 2.0 which increases by a factor of 1.85 to 3.7 for the countries with insurance based reporting systems.

Whereas the difference for the non-fatal accident rates could to some extent be explained by inappropriate adjustment for underreporting through Eurostat it is not clear why there is also a similar difference in the case of the fatal accidents.

Figure 11: Non-fatal accidents by reporting system

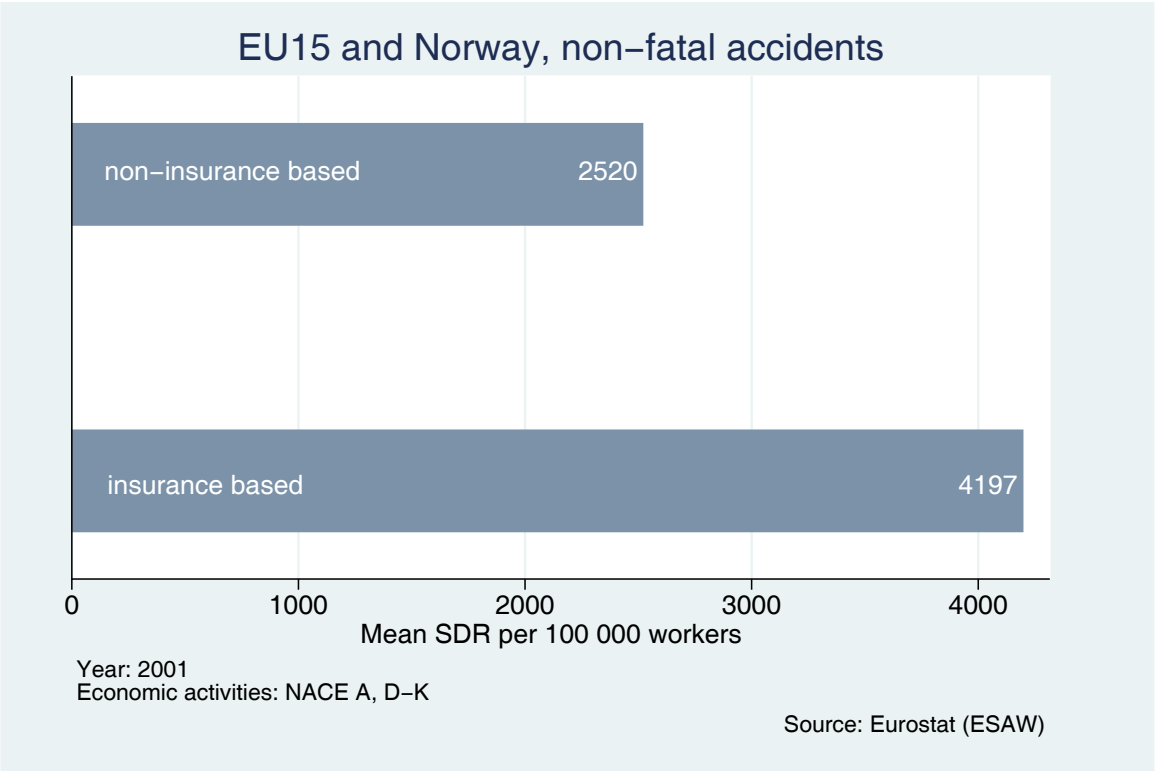
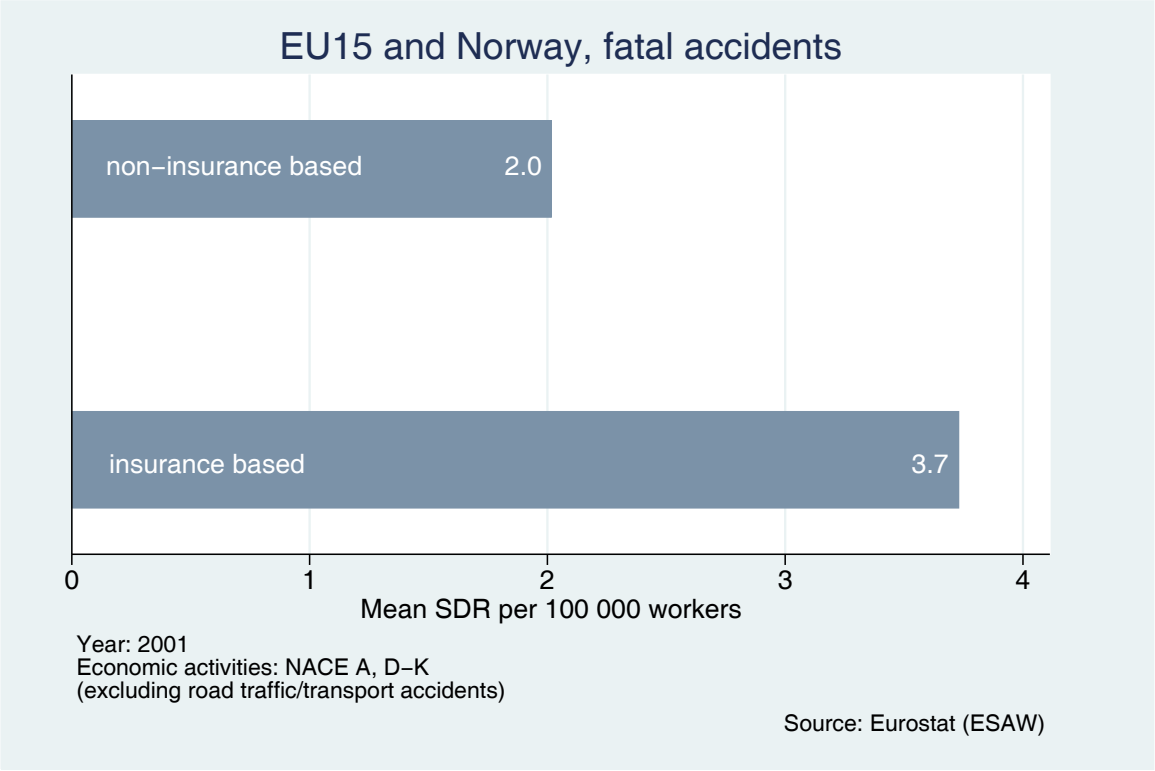


Figure 12: Fatal accidents by reporting system



Coverage of self-employed workers and family workers

Employees are fully covered in the reporting systems of the EU15 countries and Norway. This is not true for self-employed workers or family workers. Only 5 from 16 reporting countries (DK, IT, LU, AT SE) have full coverage of self-employed persons (Eurostat 2001, p25). The United Kingdom has full coverage of self-employed workers with the exception of Northern Ireland. All other countries have only partial coverage of self-employed persons. The situation for family workers is very similar. It can be assumed that incidence rates of working accidents for self-employed workers are different in comparison to employed persons: It is reported that self-employed workers have a lower incidence rate of non-fatal accidents but a higher incidence rate of fatal accidents. In addition the proportion of self-employed workers is different not only form country to country but also between different sectors of economic activities.

Table 4 describes the percentage of self-employed in every NACE sector and member state. NACE sector A (agriculture, hunting, forestry) has in all countries the highest proportion of self-employed workers. NACE sector E (electricity, gas and water supply) has no self-employed workers in any Member State. Especially in some 'high risk' sectors like NACE F (construction) or NACE I (transport) there are great differences between countries. The proportion of self-employed varies in the construction sector from 37% in Italy and 0% in Luxemburg. In the transport sector the proportion of self-employed workers varies between 26% in Greece and 0% in Luxemburg. Luxemburg has the lowest overall (NACE A, D to K) proportion of self-employed workers (7%) and Greece the highest (43%).

Table 4: % of self-employed in employed population, adapted from INSHT 2004.

	BE	DK	DE	GR	ES	FR	IE	IT	LU	NL	AT	PT	FI	SE	UK	EU-15
NACE																
A	57	48	41	94	53	62	79	53	100	50	78	83	71	62	47	60
D	5	3	4	23	11	4	8	15	0	4	4	12	6	6	5	7
E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F	20	16	14	32	19	18	27	37	0	17	6	25	19	21	34	23
G	26	12	13	46	28	13	15	45	13	11	10	35	14	15	11	20
H	33	13	21	35	24	19	14	35	0	16	19	30	12	18	9	21
I	5	5	7	26	22	4	19	16	0	6	6	12	12	10	12	11
J	11	0	10	9	7	3	0	13	0	0	4	0	0	0	3	7
K	23	18	20	45	21	11	18	42	19	17	18	24	13	17	18	21
TOTAL	16	11	11	43	22	12	20	30	7	12	13	31	16	14	13	17

The fragmentary, partial inclusion of self-employed workers accidents has to be regarded as a severe data comparability issue.

Compensation systems for accidents at work in the EU15

The complexity that is behind the topic of different compensation systems will be described based on paper of Parsons (2002) who analyses liability rules, compensation systems and safety at work in Europe.

Comparison of work accident compensation systems is a field where the confluence of different labour laws, tort laws and social security laws are to be evaluated within the complex interplay of different types of security systems. These systems include in varying, in varying combinations from one country to another, commercial and social insurance, first-party and third-party covers and an array of public, semi-public and private insurance carriers.

A fundamental fact is:

> "In fact, in Europe no two systems for compensating work injuries are the same."

Historically, there are three main phases in the development of work injury compensation systems:

1. A "common law" period, when work injury compensation, to the extent that it was available at all, was governed by the ordinary principles of tort law.

2. A period of employers' liability law, when the common law was modified or replaced by more specific tort-based rules imposing liability upon the employer.

3. A period of workers' compensation law, either in addition to or in substitution for employers' liability law. This workers compensation law was also, in some cases, effectively an insurance law.

The pressure generated by social reformers and increasingly powerful labour unions moved governments to act, persuading them to introduce systems that gave priority to injuries which where inflicted in the workplace. The preferential treatment of work injury victims, even when not convincing or outdated were justified for example by:

- The high value which society places on work.

- The fact that employees are obliged to obey their employers and the latter have ultimate control over conditions in the workplace and matters of safety.

- The need to provide and incentive for people who carry out dangerous but essential work, such as mining.

In most Member States the national compensation for work injuries is more "generous" than for injuries of non-occupational origin. The results from an actual survey on 'National Declaration Systems of Accidents at Work' which also covers these differences with regard to compensation systems are reported by INSHT (2004). Four aspects were taken into account:

1. Are sick benefits better for work injuries?
2. Is health care better?
3. Is health expenditure better (cheaper) for the injured person?
4. Are sick benefits cheaper for the employer?

The answers are summarized in Table 5. From the answers an overall compensation rating was calculated as a sum of answers with 'Better' so that the compensation rating ranges from 0 to 4.

Table 5: Differences in compensation of work accidents among Member States

Member State	Sick pay	Health care	Health expenditure	Cost for employer	Compensation Rating
AT	ND	Better	Better	ND	2
BE	ND	ND	Better	Better	2
DE	ND	Better	Better	ND	2
DK	ND	ND	ND	ND	0
ES	Better	Better	Better	Better	4
GR	Better	ND	ND	Better	2
FR	Better	ND	Better	Better	3
FI	ND	ND	ND	ND	0
IT	Better	ND	ND	ND	1
IE	ND	ND	ND	ND	0
LU	ND	ND	Better	ND	1
NL	ND	ND	ND	ND	0
PT	Better	Better	Better	ND	3
SE	ND	ND	ND	ND	0
UK	ND	ND	ND	ND	0

Six countries (Denmark, Finland, Ireland, Netherlands, Sweden and United Kingdom) report no differences with regard to the four questions. With the exception of Finland these countries also have a non-insurance based reporting system for accidents at work. Spain is the only country where work injuries provide better benefits with regard to all of the four aspects that were taken into account.

For the purpose of statistical analysis the compensation rating provided by INSHT is aggregated to a working accident compensation score with three subgroups: low, medium and high. To the 'low' score group belong all countries for which the compensation rating equals 0, the 'medium' score group covers all countries for which the compensation rating is equal to 1 or 2 and the 'high' score group covers all countries with an compensation rating of 3 or 4.

The association between the work accident compensation score and non-fatal and fatal incidence rates of accidents at work is analysed for the year 2001 by means of a simple dot plot to which an exploratory regression line with 95% confidence interval is added. Figure 13 shows that there is a strong positive association between the work accident compensation

score and the non-fatal incidence rate. A similar but less pronounced relationship is found for the relationship between the fatal incidence rate and the score (Figure 14).

Figure 13: Non-fatal accidents and work accident compensation score

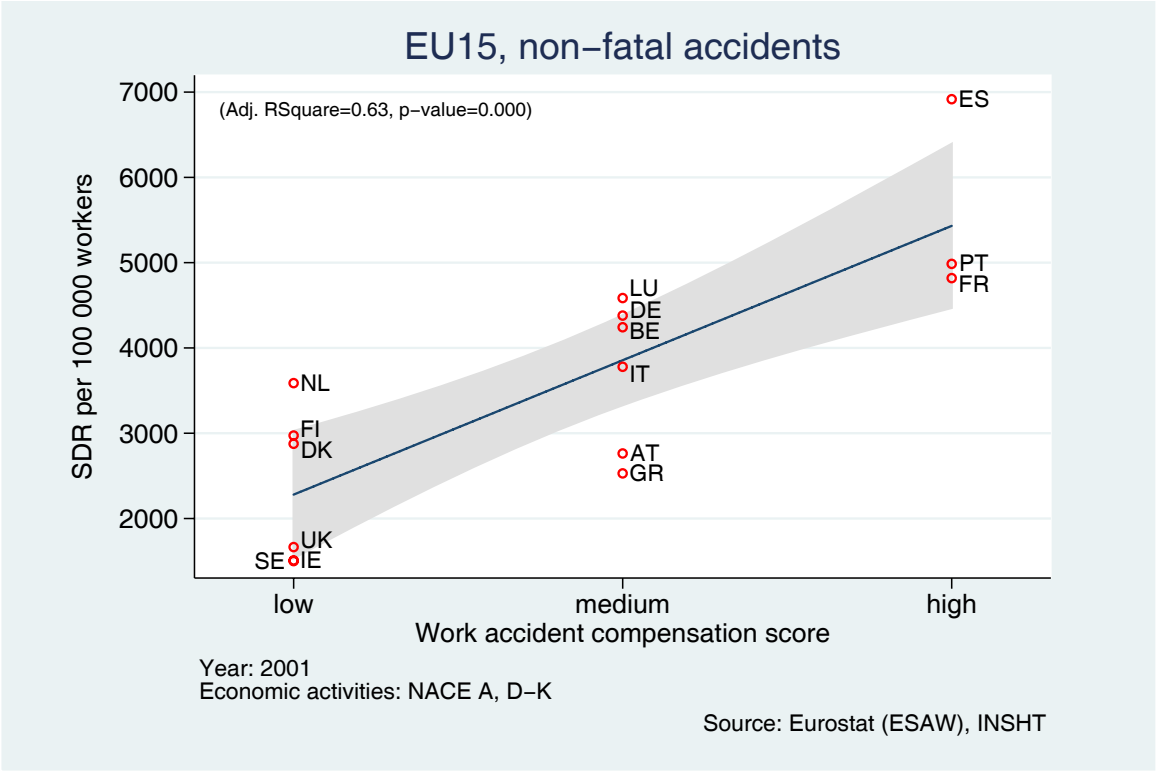
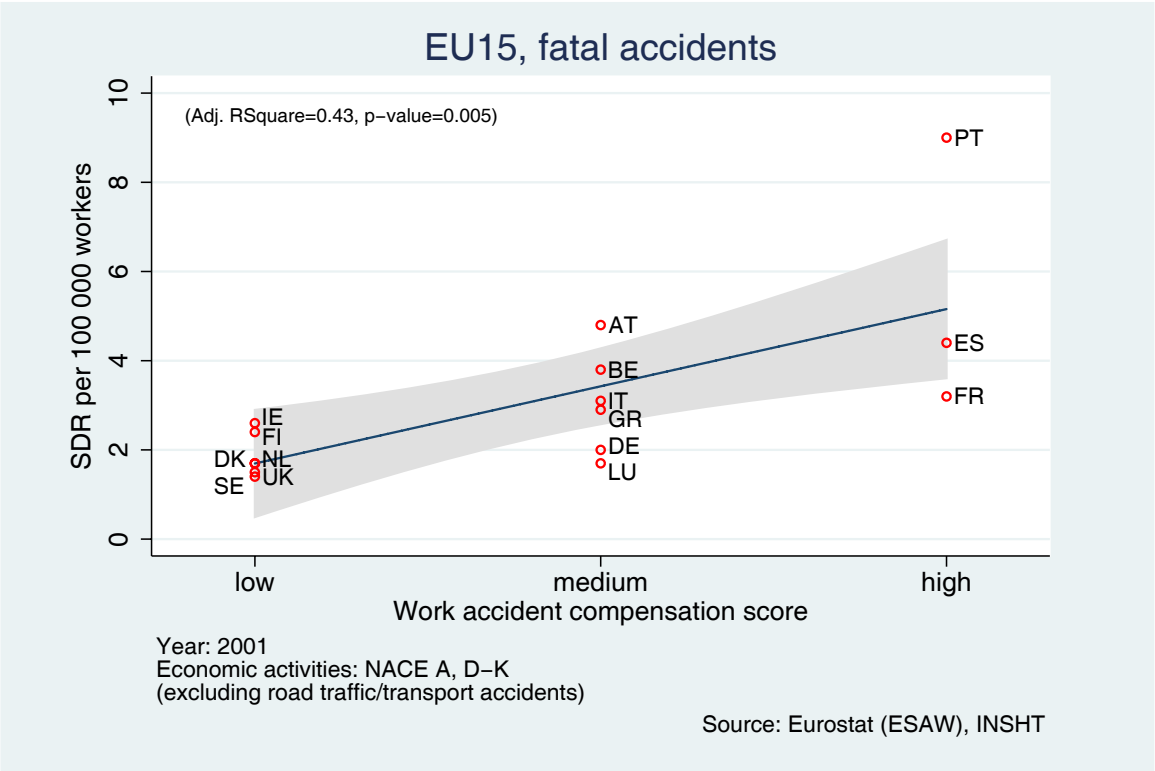


Figure 14: Fatal accidents and work accident compensation score



For the countries with a ‘low’ work accident compensation score we can expect underreporting of work accidents and it is not by chance that these countries also have a non-insurance based reporting system. For countries with ‘high’ work accident compensation we can assume that there is a considerably over-reporting of work accidents. What makes this relationship really hard to understand is that it is similar for non-fatal and fatal accidents. For fatal accidents at work under- or over-reporting is not expected and the problematic road traffic or transport accidents were excluded from the incidence rates.

The distorting effects of different compensation systems on under- or over-reporting can be illustrated with two examples from ESAW data. The numbers of non-fatal accidents at agriculture (NACE A) for Spain and Germany show peculiarities that can only reasonably explained by the existence or non-existence of special incentives.

For the time span 1995 to 2002 Spain has nearly every year highest standardized incidence rates cumulated over the 9 common economic sectors (NACE A, D-K) and is leading often in the single sectors from NACE D to K. The opposite is true within agriculture, e.g. in 2001 only two countries, Denmark and Sweden have lower non-fatal incidence rates than Spain. This phenomenon can be explained as follows: In Spain self-employed farmers (53% of employed in agriculture, see Table 4 above) do not receive sickness benefits for the first fifteen days of absence, whatever the reason, work or non-occupational injury or disease, be. Concerning compensation for minor injuries there is also no difference between work and non-occupational origin for Spanish farmers and there is also no incentive to report such minor injuries.

The next example relates to German farmers. Germany has the highest non-fatal incidence rates in agriculture among the Member States. In the year 2001 Germany reported 13 168 accidents per 100 000 whereas the country with second highest accidents rates, Luxembourg reported only 7 909, i.e. a rate that is ca. 40% lower. Denmark had the lowest incidence rate with only 1437 accidents per 100 000. Thus the incidence rate in Germany is ca. 9 times higher than in Denmark which can hardly be explained with different hazards of German and Danish farm work. One explanation is that German farmers that are self-employed not only have a compulsory insurance but in addition, in the case of an accident at work they also get special benefits that include the provision of assistance to guarantee vital farming operations. This provides a clear incentive for over-reporting.

Insurance theory uses the term ‘moral hazard’ to describe the phenomenon that the insurance contract by itself causes a change in the behaviour of the insured into the direction of less honest and more opportunistic behaviour. Bolduc et al. (2002) study panel data on 9,800 workers in the Quebec construction industry over each month of the period 1977-86, combining administrative data from the Quebec Construction Board with data from the Quebec Workers' Compensation Board. They can confirm their ‘moral hazard’ hypotheses that workers compensation insurance not only effects the occurrence of workplace injuries but also induces a shift to a higher proportion of difficult-to-diagnose accidents.

4.4 EU and the United States: a short comparison of ESAW and CFOI

We have identified severe comparability problems even within the EU15 Member States and it can be expected that comparisons become even much less reliable when EU countries shall be compared with non-EU countries. Benavides et al. (2003) compare for fatal accidents at work the European approach of an occupational injury surveillance system, i.e. ESAW, to one of its counterpart in the United States, i.e. the U.S. Census of Fatal Occupational Injuries (CFOI).

The U.S. CFOI works complementary with another surveillance system, i.e. the National Traumatic Occupational Fatalities (NTOF) surveillance system. The NTOF Surveillance System was developed in the 1980s by the National Institute for Occupational Safety and Health (NIOSH) to fill gaps in the knowledge of work-related injury deaths in the United States. Data was first being collected for calendar year 1980. NTOF evaluates death certificates to identify victims of work injuries. For a case to be included in NTOF, the death certificate must meet three criteria: (1) the decedent must be aged 16 or older; (2) the external cause of death is classified as E800–E999 (ICD–9 [WHO 1977]); and (3) the Injury at Work item on the death certificate is marked positive by the certifier.

The CFOI surveillance system started in 1992. It is considered to be more complete and reliable, since it includes all fatal occupational injuries confirmed by at least two separate sources that document the work relationship of the fatality, such as state agency administrative reports, death certificates and/or workers compensation reports (Rosa et al. 2000).

The CFOI and ESAW reporting systems have a very similar case definition for workplace fatality (Table 6). Both include deaths occurring off company premises during working hours and during work where the vehicle is considered the work environment (i.e., road traffic injuries of a truck driver), although for some European countries, such as the United Kingdom and Ireland, these are excluded. Deaths occurring while commuting to or from work are also excluded by both systems. Both ESAW and CFOI systematically exclude workplace deaths due to non-external causes, such as heart attacks or strokes, unless these were clearly preceded by a traumatic event.

There are two striking differences between the two systems:

1. In the U.S. under the CFOI system work-related deaths are collected across all industrial sectors in the United States, including the public and self-employed sectors. This is very different from the ESAW system where self-employed workers are only partially covered and coverage by economic activity is also limited to the 9 ‘common’ branches (see above).

2. Both systems use completely different search strategies to identify victims of work injury: The CFOI surveillance system is based on a comprehensive, **active search** of different sources, such as death certificates, workers’ compensation, or state agency administrative reports. On the other hand, ESAW is based mainly on **passive notification** linked to specific insurance schemes in 10 E.U. countries, and on labour inspection records for the 5 remaining member countries (Denmark, the Netherlands, United Kingdom, and Ireland).

This comparison raises an immediate question as an active strategy naturally seems superior over a passive strategy. Could it be an advantage to follow an active search strategy also in European countries? Of course this cannot be fully answered within the scope of this report. But there seems not to be much hope for an improvement. The most important point is the quality of the data sources that are available. When the national institutions’ data sources are incomplete or incompatible with regard to the reporting requirements then an active search will fail the same way as a passive strategy does. If a self-employed salesman has a fatal road traffic accident on a business trip that does not appear on his death certificate as work related and his death is of no concern to any insurance this victim will hardly find any way into an official statistic on work accidents.

Table 6

Definitions and Surveillance Systems Characteristic of Fatal Occupational Injuries in the United States (U.S.) and the European Union (E.U.), *adapted* from: Benavides et al. (2003)

	U.S.	E.U.
Agency	Bureau of Labour Statistics (BLS), Census of Fatal Occupational Injuries (CFOI)	EUROSTAT European Statistics on Accidents at Work (ESAW)
Established	1992	1994
Case definition	A death in which the decedent was working at the time of the event	A discrete occurrence in the course of work which leads to the death of the victim
Additional inclusion criteria	Occurring off the employer's premises but was there to work Engaged in work activity where the vehicle is considered the work environment (e.g., taxi, truck) Fatal heart attacks and strokes only if a traumatic work injury was a contributory cause of death	Occurring during work but off company premises Road traffic fatalities (i.e., truck drivers) except for Ireland and the United Kingdom
Exclusion criteria	Commuting deaths (to or from work) Deaths having only a medical origin (i.e., heart attacks at work or strokes)	Commuting deaths (to or from work) Deaths having only a medical origin (i.e., heart attacks at work or strokes) Work accidents which affect specific groups of employees in some countries
Data sources	Active search for at least two reliable sources documenting the work relationship of the fatality: state agency administrative reports, death certificates, or workers' compensation and claim reports	Passive reporting under insurance schemes in 10 member countries and on labour inspectorate report in the remaining five countries
Reference population	An estimation of all civilian employees age 16 years and older from the Current Population Survey plus resident military figures from	Employed persons age 15 years and over estimated through the European Labour Force Survey

One data source for the active search strategy of CFOI is the workers' compensation system. For the EU-15 countries it was already outlined above, that workers' compensation systems may induce severe under- and over-reporting problems which make it difficult to set up a harmonized database for international comparisons of work related injuries. In the early twentieth century, the U.S. workers' compensation system replaced common-law liability as a method for workers to recover payment from the employer for the consequences of work related injuries. Injured workers gave up the right to sue their employers for the promise of a speedy and efficient administrative system that would pay medical and income benefits automatically for injuries that occurred out of and in the course of employment.

That the U.S. workers' compensation system for accidents at work is far from being a homogenous system that produces comparable results in all federal states of U.S. can be learned from Strunin/Boden (2004). The authors perform a study which explores the perceptions of workers about their experience in the workers' compensation in two U.S. states – Florida and Wisconsin. In Florida and Wisconsin, as in most U.S. jurisdictions, private insurers provide workers' compensation insurance. There is no government-provided insurance. In Florida, all non-construction employers with at least four employees an all construction employers with at least one employee must secure workers' compensation coverage unless they are large enough to self-insure. In Wisconsin, virtually all non-farm employers and all farms employing at least six workers for 20 or more days a year must have

workers' compensation coverage. Although the general legal background is the same, the workers' compensation in Florida and Wisconsin – and in other U.S. states - have different organisation and rules, e.g. workers in Wisconsin can choose their own treating physician; but in Florida the employer or insurer has the right to choose the treating physician. If injured workers in Florida seek treatment from providers that the employer or insurer has not authorized, the workers are responsible for paying for those providers' services. That the workers' compensation system is much less responsive in Florida than in Wisconsin can be illustrated by two main characteristics in the year 2002: In Florida a dispute over some aspect of the claim lead to workers' hiring an attorney in 24% of the claims, this happened in Wisconsin only in 6% of the claims. In Florida only 44% of the claims were paid within 14 days of injury versus 81% in Wisconsin. One effect of this reduced responsiveness, which was explored in much more detail by the authors interviewing victims from both states, is that the non-responsive insurers raise the costs to injured workers of workers' compensations benefits and thus may reduce the propensity of eligible workers to apply for benefits. This means nothing else that the non-responsive systems induce underreporting whereas a fast responding system may induce moral hazard based over-reporting.

It can be assumed that an active search strategy that uses different data sources can more successful deal with such problems, but the elementary problems stay the same in Europe an in the U.S.

4.5 Actual trends of accidents in the EU15 and Norway (ESAW)

Despite the doubts with regard to international comparability of accident data, a summary graphical overview of actual trends is provided on the following pages. The overview is limited to three graphs, more details are provided in Annex IV The first and second graph relate to the incidence rate of overall non-fatal accidents and the overall incidence rates of fatal accidents in the EU-15 and Norway. The third graph presents the incidence rate of fatal accidents by age groups. The time series that are presented cover the time span from 1994 to 2002.

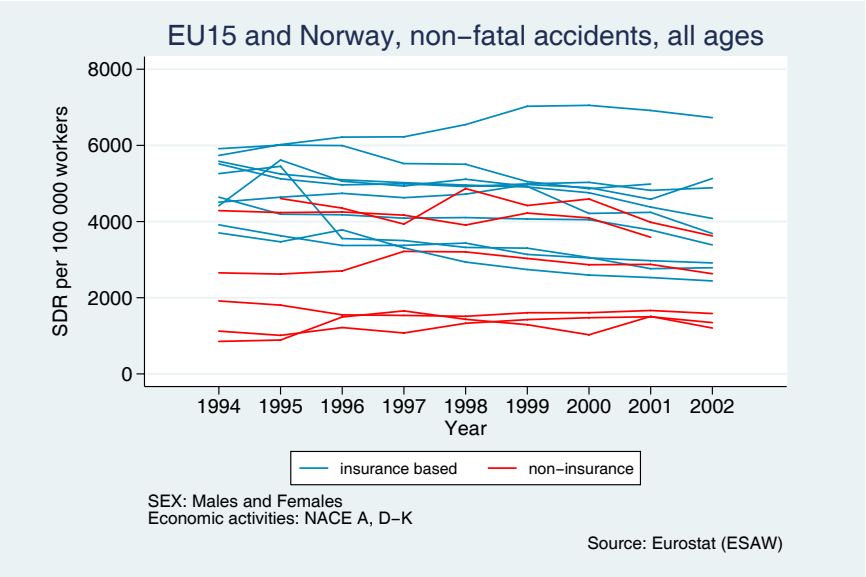
As we have learned, that the reporting system may induce distortions with regard to over- and underreporting different colours indicate to what kind the country belongs.

Non-fatal accidents in the EU-15 and Norway (ESAW)

The overview graph (Figure 15) shows how the time series from the insurance based and non-insurance based countries cluster versus top and bottom of the graph. An overall downward trend for the non-extreme insurance based countries can be identified, no uniform trend is detectable for the countries from the non-insurance based countries but they have already lower levels than the countries from insurance based systems.

Most remarkable is the development of the non-fatal incidence rates for Spain which is the country with maximum values of the incidence rate for almost every year. These maxima even increase until 1999 from then on it continues with small declines to 2002. The minima incidence rates are generated by Ireland and Sweden.

Figure 15

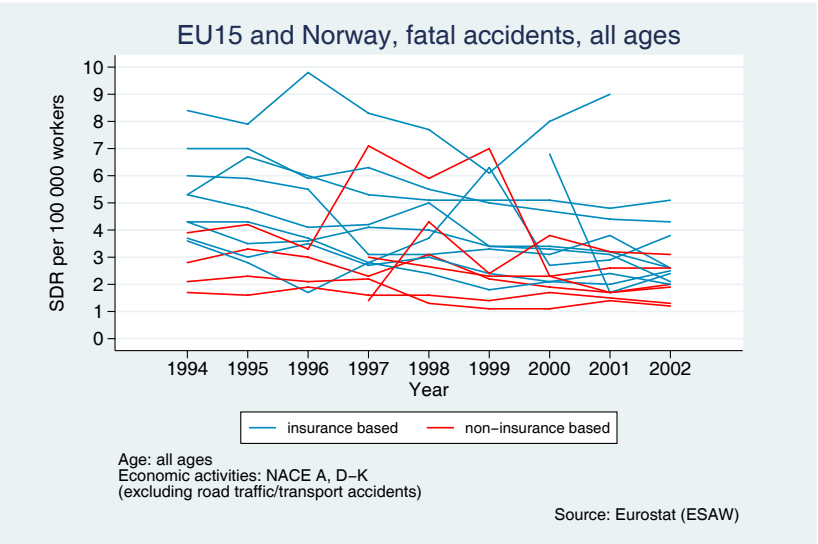


Fatal accidents in the EU15 and Norway (ESAW)

The overview graph (Figure 16) demonstrates the much more erratic and volatile nature of the fatal incidence rates in comparison to the non-fatal incidence rates which make the fatal incidence rates much more complicated to interpret.

The maxima of the fatal incidences are generated by Portugal, with the exception of 1999, where Ireland that has an extreme volatile development clearly exceeds Portugal that is in this year also slightly exceeded by Greece. The minima incidence rates of fatal accidents can be found in the United Kingdom and Sweden.

Figure 16

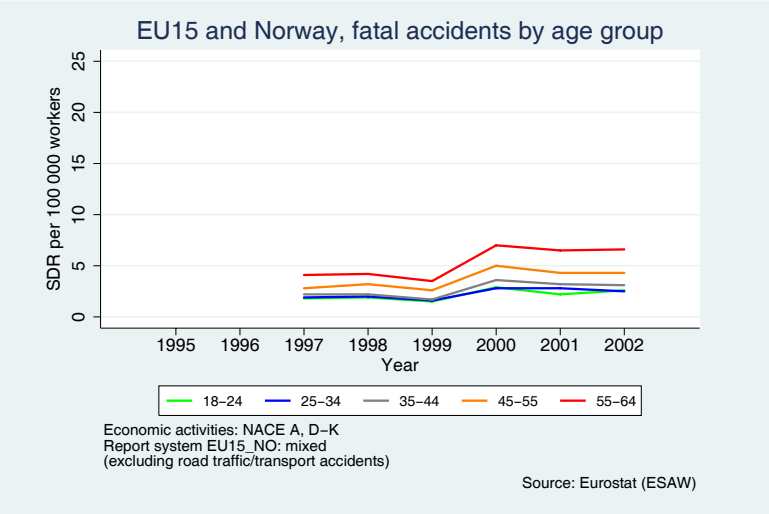


Fatal accidents in the EU15 and Norway by age group (ESAW)

A summary of fatal incidence rates by age groups is presented in Figure 17. The aggregated data for the EU-15 and Norway show that after 1999 the fatal incidence rates start to increase and that the gradient of higher incidence rates in the older workers in comparison to the younger workers becomes significantly steeper. It was to be pointed out, that the fatal incidence rates that are presented here exclude fatalities related to road traffic accidents or means of transport to achieve better comparability between the countries and that data that include the cases omitted here do not show this phenomenon.

When one tries to locate this effect in single countries one observes enormous variation between the countries. In the United Kingdom the incidence rates of all age groups are very smooth over time at a very low level. Remarkable increases can be found for example in Austria, France and Italy. Limited or even fragmented data are available for Luxembourg, Netherlands and Portugal. The incidence rate of the age group 55-64 years shows an extreme erratic behaviour in Norway. There is no immediate explanation to this phenomenon but with the background of an ageing labour force this phenomenon is worth to be explored in more detail. This is especially true, when a longer working life will be in the longer run the unique solution to provide a sustainable relief for the pension system of the member states. A longer working life will not be accepted by and cannot be recommended to workers when this dramatically increases the risk of a fatal work injury.

Figure 17



4.6 Actual trends of fatal occupational injuries (ILO data)

Harmonized data for incidence rates of work injuries are not available from the International Labour Organization. Even measurement units may vary from country to country and the incidence rates are not standardized, e.g. for different structure of industries. One advantage is that sometimes longer time series are available, e.g. time series run from the early seventies to the year 2000. One immediate drawback of non-standardized time series is, that e.g. the industrial structure of many countries also has changed dramatically. At least the overall impression that can be derived from these time series is, that the general trend is downward for most countries with few exception e.g. some eastern transition economies and Norway.

4.7 Conclusions

The most important problem with regard to data on work injuries is the limited international comparability. Even when the EU member states can be considered to be far ahead there remains much to be done. At the present status it cannot be recommended to use ESAW or other international data on accidents at work for statistical modelling which could help to identify underlying causal relationships.

An extremely important problem that was derived from descriptive analysis was, that older workers especially workers in the age group 55-64 have a much higher risk of fatal accident than the younger workers and that this risk difference has increased dramatically in some countries starting in the latest nineties.

4.8 Literature

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5 Temporal effects of economic growth on health

While it is correct to say that our finding of the basic inverse relationship between economic growth and mortality is not an entirely new discovery, the temporal aspects of this relationship and its magnitude are not what would be expected given the current status of the research literature. It is well known form the work of Thomas McKeown and his colleagues that economic development has probably been the principal factor involved in mortality decline during the century covering approximately 1860-1950 – especially dealing with the disappearance of the infectious disease as major causes of death. Considerable doubt has been raised, however, as to whether the relationship between economic growth and long-term mortality decline has continued among the wealthiest industrialized countries since the Second World War. This doubt has remained despite the overarching epidemiological finding that in virtually all industrialized countries that socioeconomic status, especially income, is inversely related to mortality rates at the individual level of analysis.

Indeed, several important epidemiological literatures have tended to give priority to other epidemiological risks that could influence mortality trends over the past half century. Especially important have been the effects on chronic disease including consumption of alcohol, tobacco, carbohydrates, total calories and (land) animal fats and the expansion of sedentary occupations. Moreover, the leading research institutes that have focused on the basic inverse relationship between socioeconomic status and mortality have tended to argue that the aggregation of this relationship to the national level implies that socioeconomic inequalities, and especially income inequalities as measured by the Gini Index, is the central modern factor in age-adjusted mortality rates and levels.

Thus there has been a very substantial scientific neglect of the hypothesis that economic growth and level of income/wealth per capita has been the central factor propelling mortality rate declines. The basis for this hypothesis is that technological change, resulting in improved productivity, increased occupational safety and improvement in health care have required financing through investments in the materialisation of engineering innovations. In addition, sustained economic growth has implications for the minimisation of economic instability and recession, for poverty reduction and for increased access by individuals and firms to the new technologies. Finally, economic growth is very much the source of societal investment in human capital as well as insurance systems and stabilised income for non-workers and the elderly.

This fundamental relationship between economic growth and mortality decline, despite having been neglected, is so important that as we can now show, it is almost infeasible to demonstrate any coherent relationship between an established epidemiological risk factor and health – especially in the field of occupational health – without at least adjusting for the overriding effects of economic growth on technological and health care developments.

In the present section, we simply present the most basic over-time relationships between economic growth and mortality in the majority of countries in our project sample. As can be seen graphically in virtually all cases, the relation is clear in both logarithmic form (i.e., independent and dependent variables) and without transformation. In the great majority of cases the non-logarithmic representation shows the more precise relationship both visually

and in terms of explanation of variance. The importance of this is that while it is often conventional, especially in time-series analyses, to represent such relationships in logarithmic form (especially to extract elasticities), it is evident that the more precise representation is either in semi-log form or without logarithmic transformation.

In this report we discuss the temporal relationships, for 23 countries, between the upward trends in GDP per capita in relation to the long term declines in age-adjusted mortality rates. These countries include Western and Eastern European societies, the United States, Canada, Japan, Australia and New Zealand. In all cases except two it is easy to observe the powerful inverse relationship between growth of national wealth per capita and mortality decline. In two Eastern European countries, however, -- Hungary and Poland — we are unable to observe this relationship. The reason is that national wealth per capita did not increase over 1960-2000; indeed, the economic growth trends remain virtually flat. Under those circumstances, and in accordance with our hypothesis, since GDP did not show trend increases (nor declines) the related mortality trends did not show the usual declines (nor increases). To demonstrate several important examples we display below figures 18-32.

As can be seen in the Western European examples of France, West Germany and the United Kingdom the relationship is highly inverse and predictable (figures 18-26), while a similar relationship prevails for Hungary and Poland (figures 27-32) – but in the latter cases there is nearly zero movement either in GDP per capita or the age-adjusted mortality rate.

Figure 18

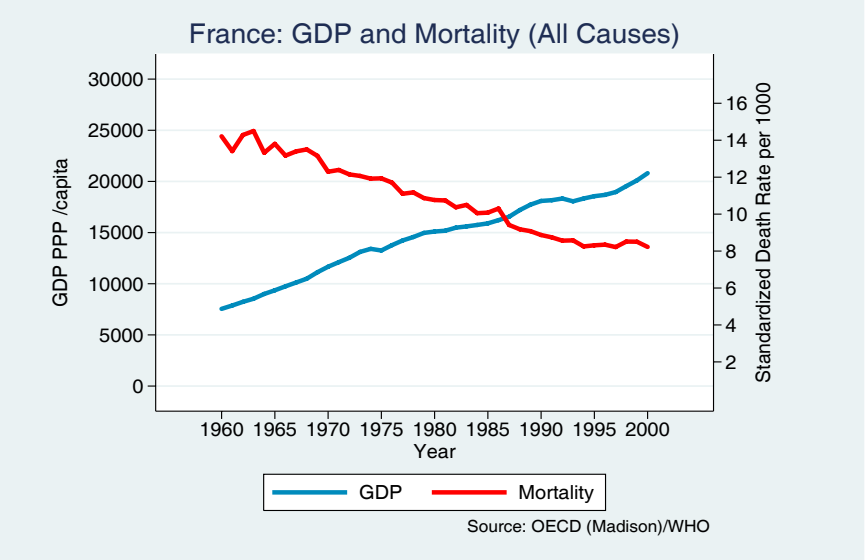


Figure 19

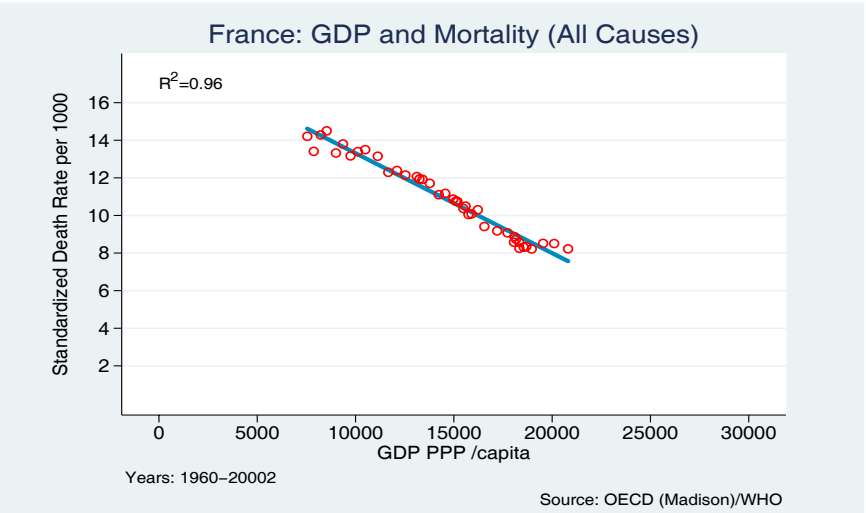


Figure 20

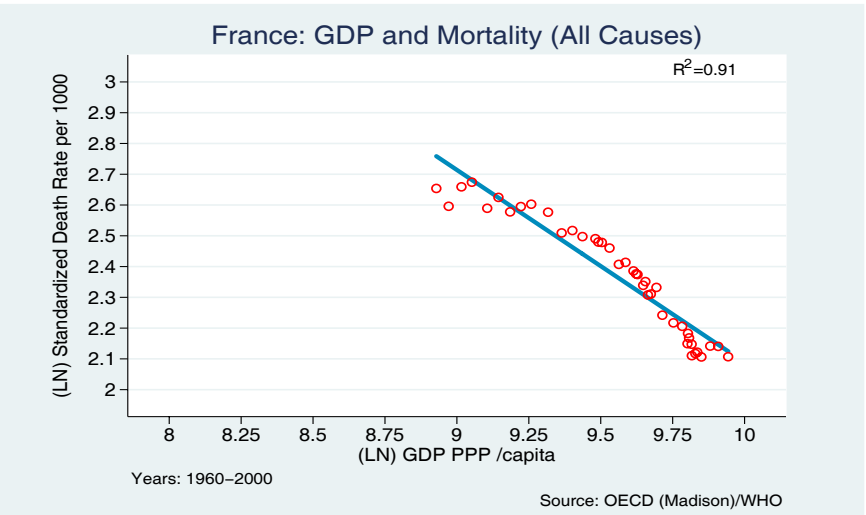


Figure 21

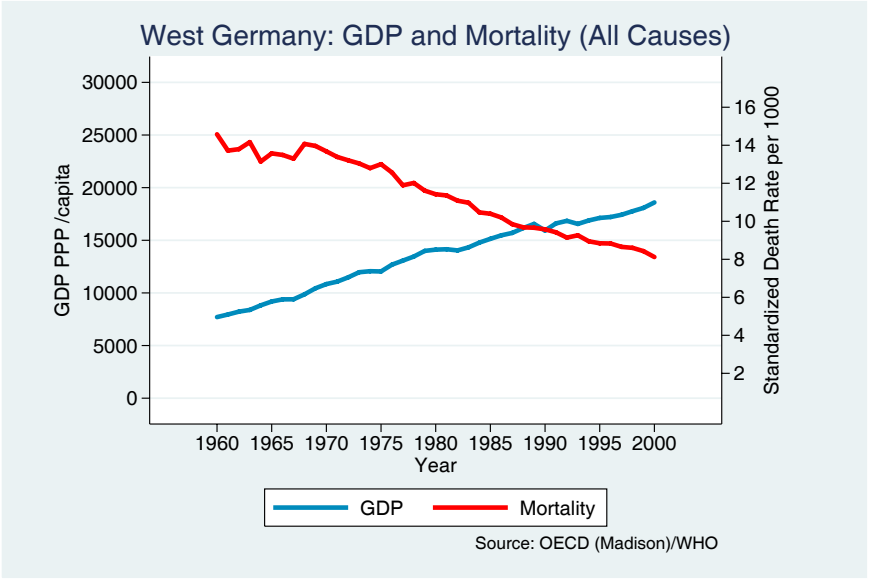


Figure 22

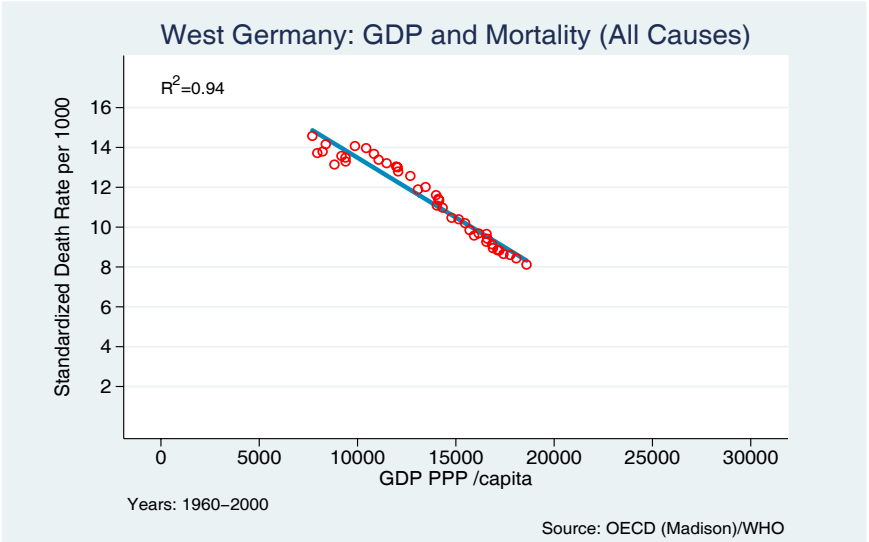


Figure 23

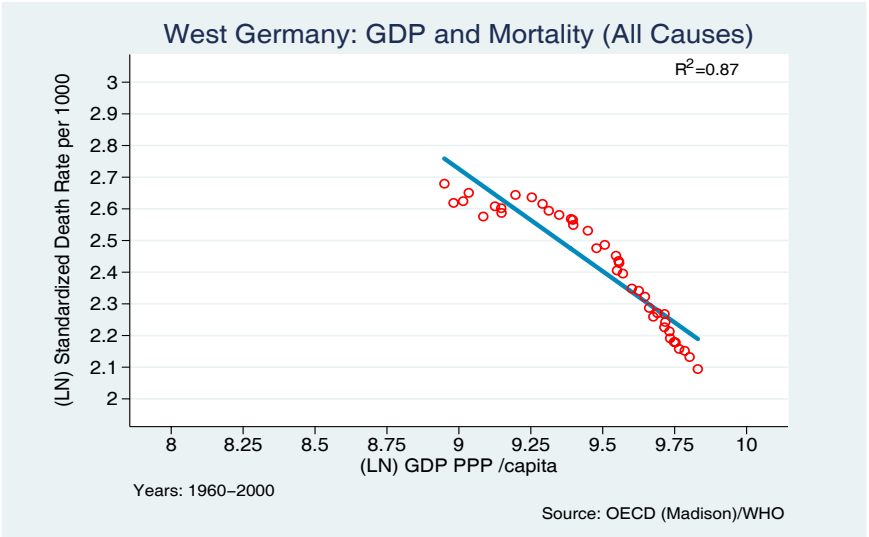


Figure 24

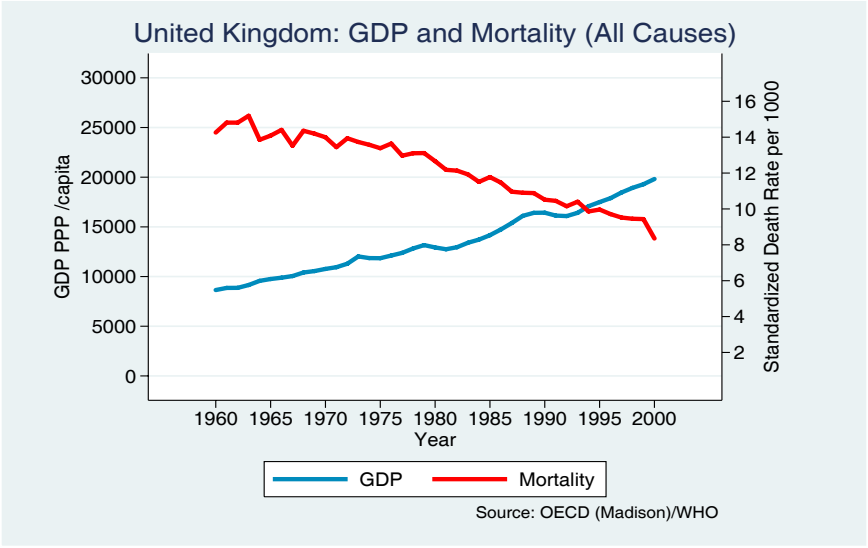


Figure 25

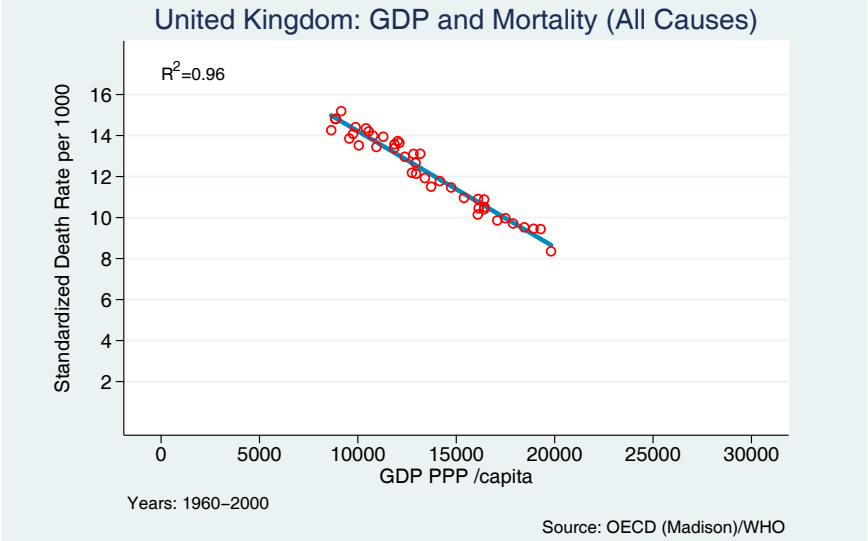


Figure 26

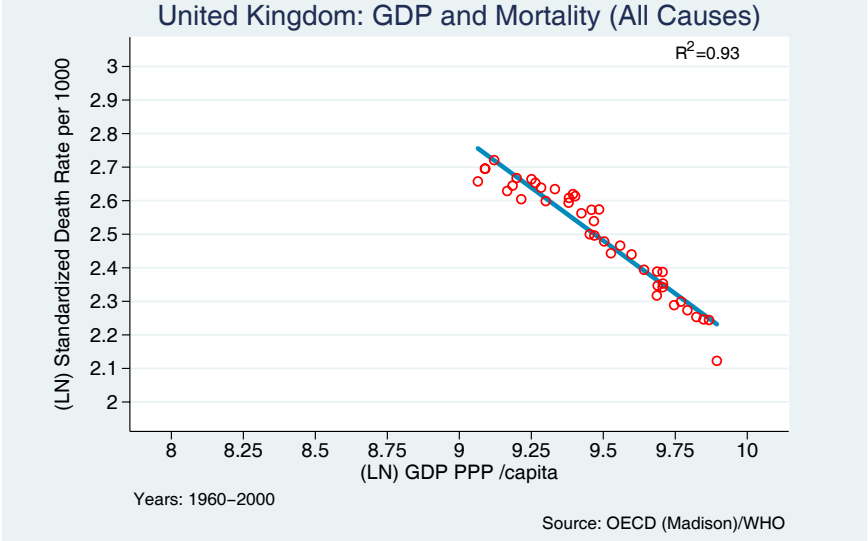


Figure 27

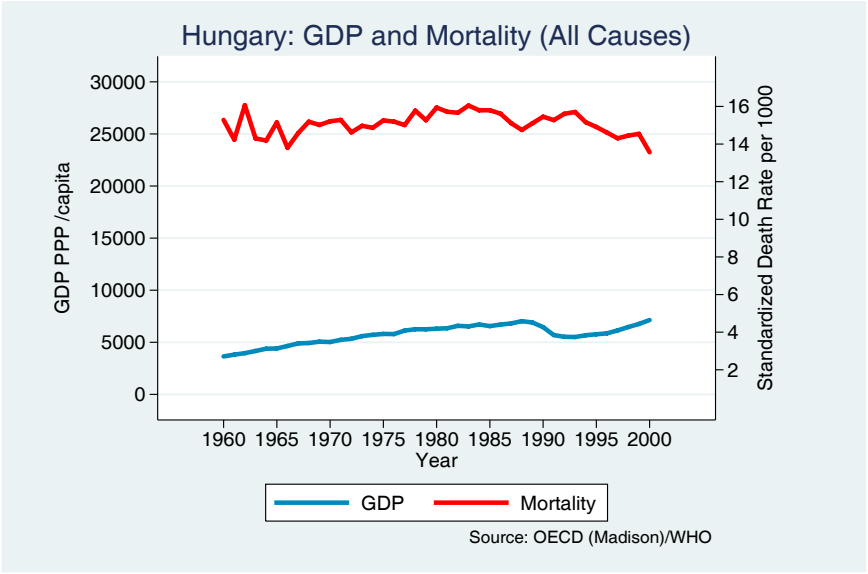


Figure 28

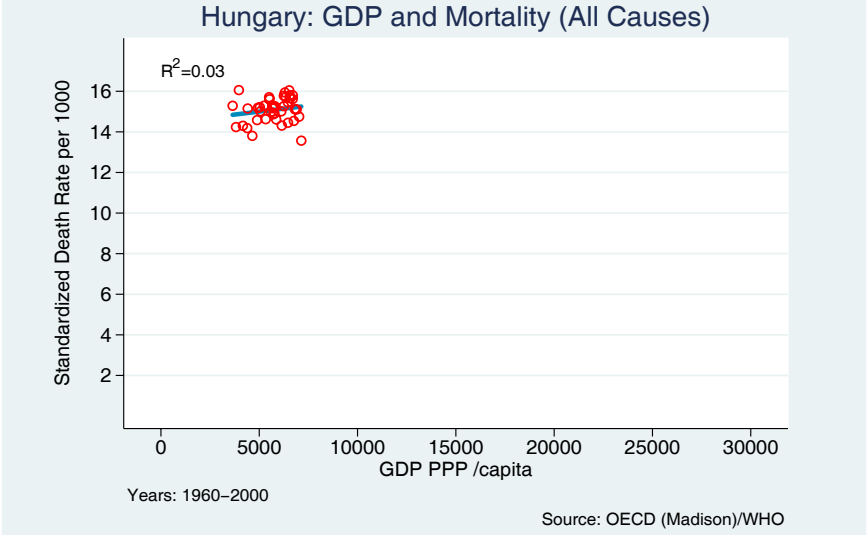


Figure 29

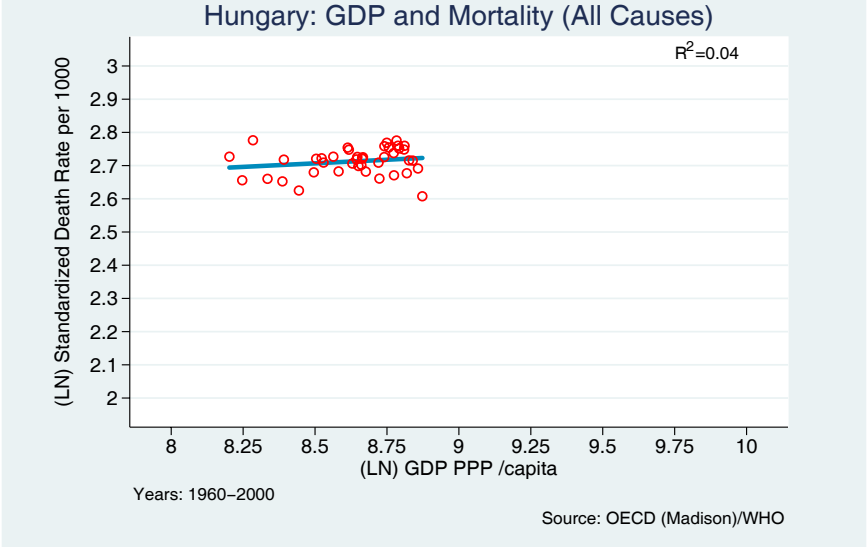


Figure 30

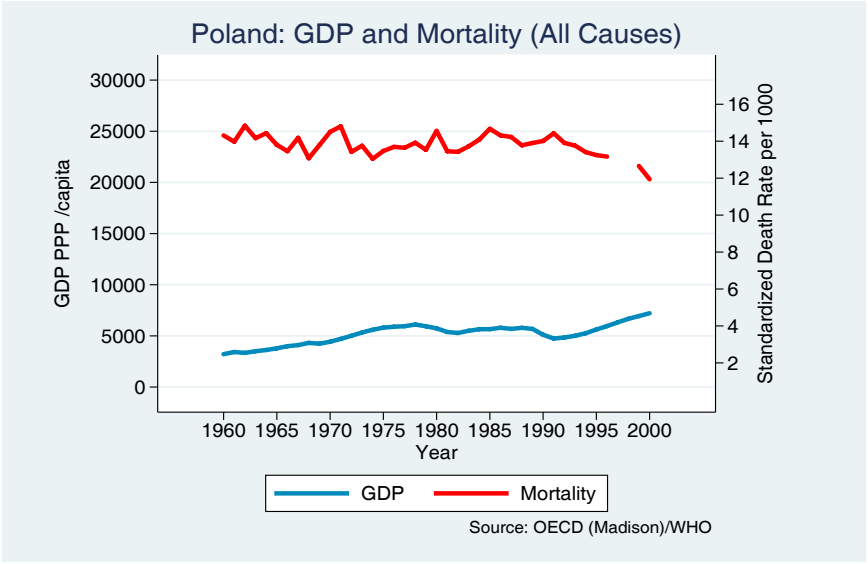


Figure 31

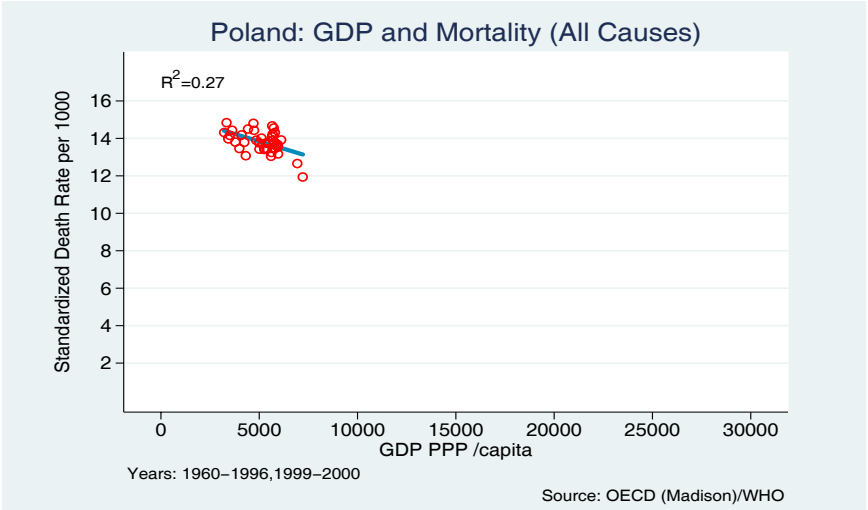
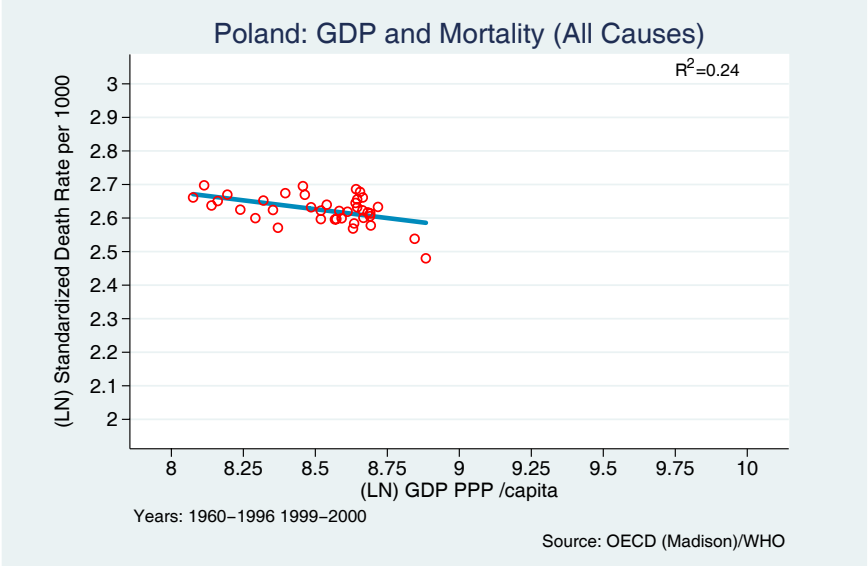


Figure 32



6 Cross-sectional analysis

6.1 Multi-variable approach

The approach of the multi-variable regression analysis is to explain variation in mortality rates across countries in our different samples of regions, e.g, Western Europe, Eastern Europe, North America, Japan. We consider that explanation of variation in mortality represents a multi-causal approach to identify the profile of factors by which we can understand why countries in our samples differ from one another of their mortality rates.

For example, in the accompanying bar charts it can be observed that for total mortality rate differences among countries, factors such as GDP per capita, self-employment and the shadow economy are statistically significant and important. For total mortality, we observe that in most age-groups GDP per capita is the most important explanatory factor. As we add additional factors to the initial explanatory power of GDP per capita, more variance in mortality rates is explained. Thus, in the age-group 55-64, approximately 62 percent of the variance among countries is explained by GDP per capita. This increases to around 78 percent when we add self-employment. It further increases to over 80 percent when we introduce the shadow economy into the model.

The pattern of dominance of GDP per capita in these predictive models depends on age. Between the ages of 25 and 64, GDP is clearly the dominant factor, whereas the shadow economy is the dominant factor in the 15-24 age-group. It can be seen that the same general pattern of the relative predominance of these variables pertains to males and females.

The pattern of explanation of variance observed in the bar charts for different age-groups in the population can also be seen when the cause of death is cardiovascular disease. Indeed, for cardiovascular mortality, GDP per capita represents an even greater proportion of the total variance explained, since the overall explanation of variance usually does not reach 80 percent. Nevertheless, similar principles apply in cardiovascular disease to those of total mortality, largely because cardiovascular disease represents well over half of all mortality in industrialised countries.

A somewhat different picture is seen when one examines the impact of the three major economic variables on mortality due to accidents. Here, the proportion of variance explained due to GDP per capita is typically somewhat higher than 35 percent. The combination of GDP and self-employment brings the explained variance to approximately 57 percent. And, with the addition of the shadow economy, the adjusted explanation of variance now frequently reaches to well over 75 percent. This is most typically seen in the case of males. But the same pattern of explanation of variance also applies to females, bearing in mind that the overall explanation of accidental deaths for women is generally not much greater than 60 percent.

The bar charts shown below indicate the relative power of the three macroeconomic predictors to explain differences in mortality rates among countries, according to age and gender.

Total mortality

Figure 33: Adjusted R²: total mortality, both sexes (cross-sectional, year 2000)

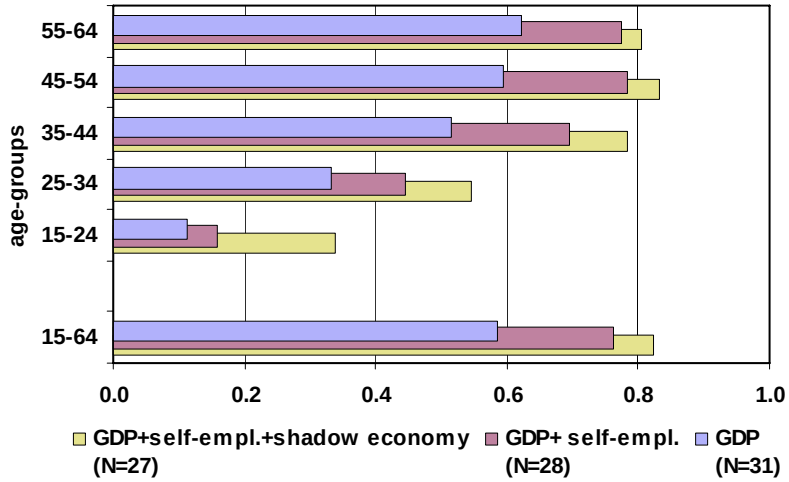


Figure 34: Adjusted R²: total mortality, males (cross-sectional, year 2000)

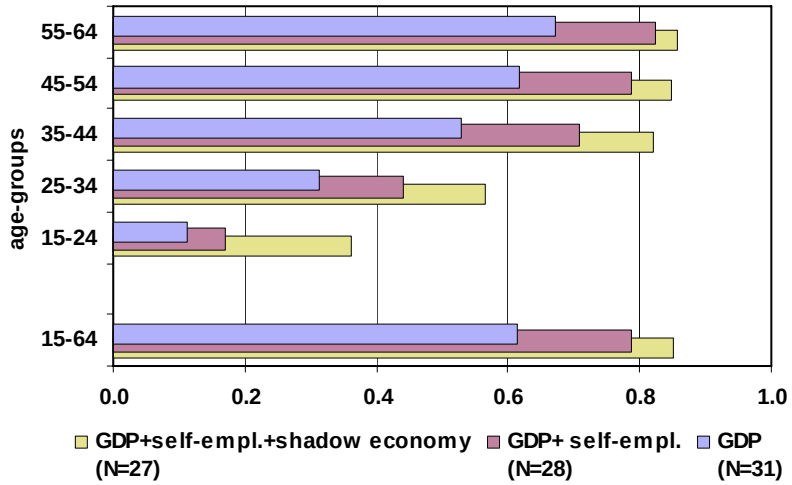
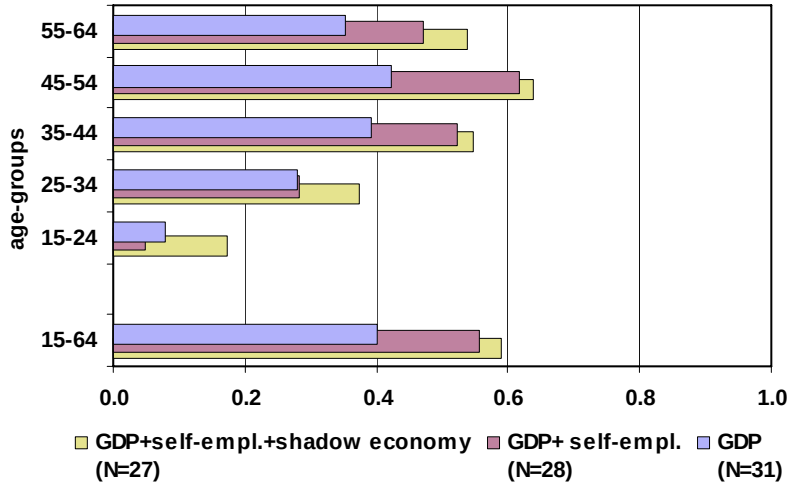


Figure 35: Adjusted R²: total mortality, females (cross-sectional, year 2000)



Cardiovascular disease mortality

Figure 36: Adjusted R²: cardiovascular mortality, both sexes (cross-sectional, year 2000)

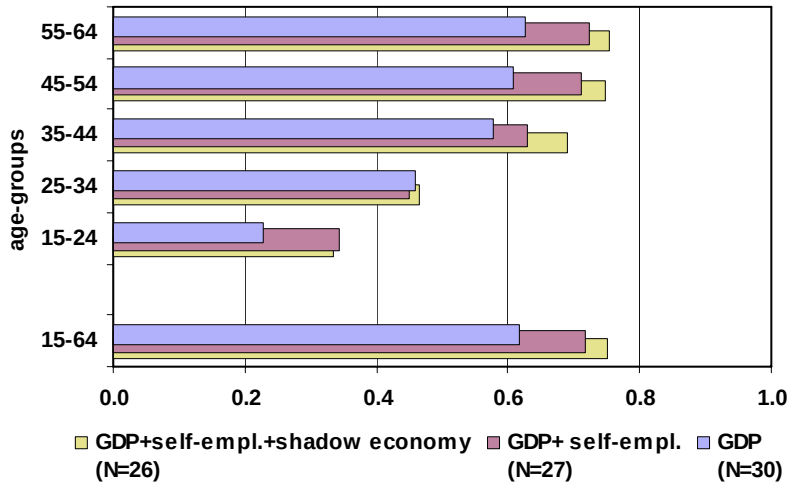


Figure 37: Adjusted R²: cardiovascular mortality, males (cross-sectional, year 2000)

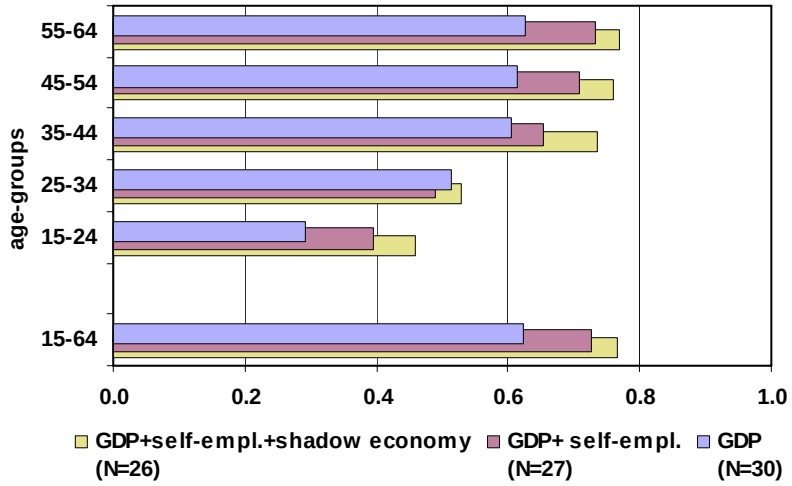
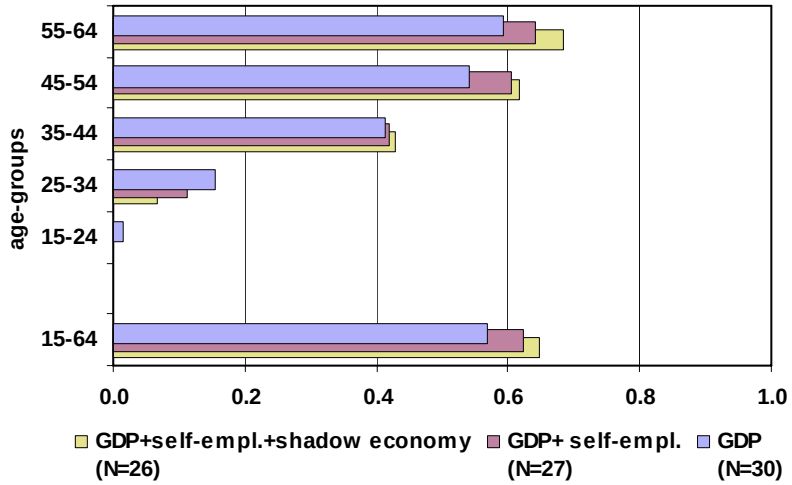


Figure 38: Adjusted R²: cardiovascular mortality, females (cross-sectional, year 2000)



Accident mortality

Figure 39: Adjusted R²: accident mortality, both sexes (cross-sectional, year 2000)

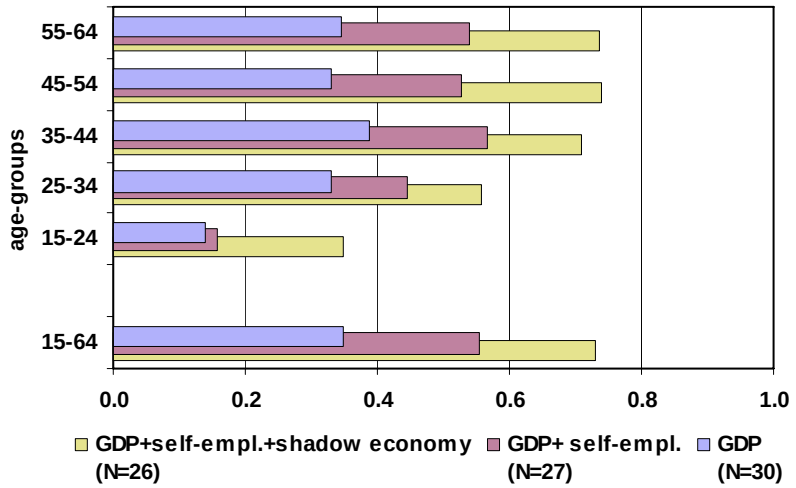


Figure 40: Adjusted R²: accident mortality, males (cross-sectional, year 2000)

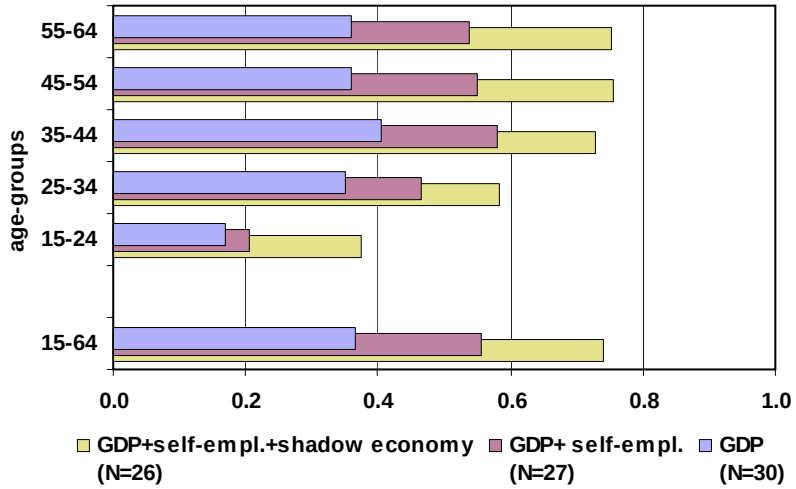
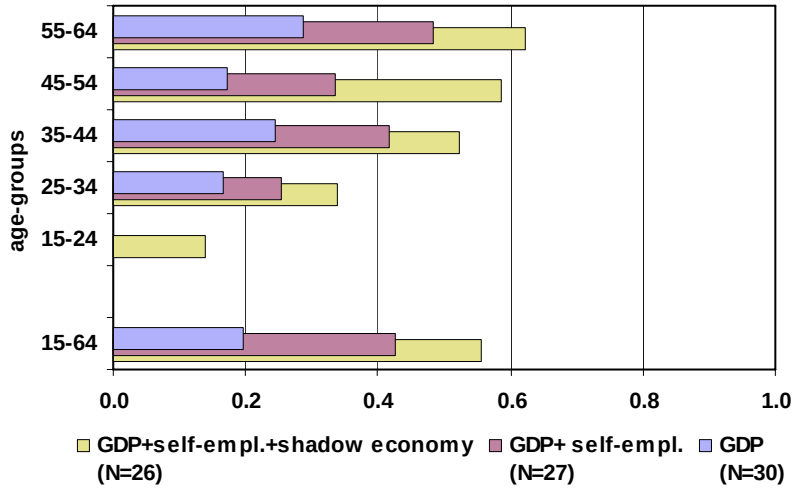


Figure 41: Adjusted R²: accident mortality, females (cross-sectional, year 2000)



6.2 Sample sizes and generalisability of results

From the beginning of this project, the most important methodological problem we have encountered pertains to sample size. In the most ideal case, we would have included in our sample the 25 current European Union countries minus Cyprus, Luxembourg and Malta (due to incomplete data) plus Iceland, Norway and Switzerland (to obtain a broader European picture) and the additional OECD countries of the United States, Canada, Mexico, Japan, Korea, Australia, New Zealand. The concept behind this choice of countries is that (1) it would allow comparability between the Western European countries and the newer Eastern EU countries and (2) it would allow comparisons between the EU countries as a whole and countries of the OECD, several of which are known internationally for their high legislative standards of health and safety at the workplace (United States, Canada, Japan, Australia, New Zealand). This leaves us with a basic sample of 31 countries and, provided that the number of predictors of health outcomes is relatively small, the basic sample should in principle be adequate.

Adding to the feasibility of using 31 countries as the original sample, there would of course be the possibility to use pooled cross-sectional time-series regression, which would greatly increase the degrees of freedom (by as much as the number of years over which data were consecutively available). There were severe restrictions, however, on using the pooled cross-sectional technique. The first is that, with the more popular 'fixed-effects model', we would require variables that show substantial variation over time. This would be true for such variables as GDP per capita. However, for our second most important predictor, namely the proportion of self-employment in the labour force, variation over time is too small (and the broad trends too stable) to include this variable in a fixed-effects model. This leaves open using the 'random-effects approach' to pooled cross-sectional time-series analysis which, in principle, should have worked reasonably well. The major difficulty, in this case, however, is that even the random-effects approach requires that the same variable be available over multiple years. This proved extremely difficult in our own case because the third most important predictor of health outcomes was the magnitude of the shadow economy as a proportion of GDP which is only available, under the best circumstances, at five-year intervals over the last decade or so. An even more serious problem occurs with the Gini index which, for many countries is unavailable more than once in the decade of the 1990's. In general, this means that the pooled cross-sectional time-series approach, even with random effects estimation, would be available for a rather small number of statistical tests. And we are fundamentally left with the sample sizes that are made available by the number of countries which have adequate data in our original or larger samples.

While the main issues of policy put forward by the European Commission for this research specified the initial 31 countries, as researchers, in our scientific obligation to the European commission, it seamed of great importance to provide the most highly generalisable results of our statistical toots. This meant that, at least for experimental purposes, it would be very worthwhile to see whether our analysis of 31 countries could be generalized to much larger (and to some extent smaller) groups of countries at different levels of economic development and with somewhat different political and cultural orientations.

We therefore included additional samples of countries, beginning with the smallest sample of 17 Western European countries. Moving upwards in numbers, we subjected our models to the analysis of 25 Western and Eastern European countries. We then went on to enlarge the sample to 31 countries, including the 25 Western and Eastern European countries and the remainder of the OECD countries (not part of the EU). These included the United States, Canada, Japan, Korea, Mexico, Australia, New Zealand. To these 31 countries, we then added Romania and Croatia, EU candidate countries which usually possess adequate data for our models. We also utilized a 35 country sample, including the additional candidate country of Bulgaria, which eliminates self-employment as a principal predictor, since Bulgaria does not publish these data. In a still larger sample, we were able to add an additional 3 countries within broader Europe, representing the Commonwealth of Independent States (i.e., several countries of the former USSR), the Russian Federation, Ukraine and Moldova.

Finally, in our largest sample, we were able to add an additional nine countries. These included eight in Central and South America (Argentina, Barbados, Brazil, Chile, Costa Rica, Panama, Uruguay, Venezuela), and Israel.

6.3 Total (all cause) mortality, ages 15-64

In our basic economic model, in the sample of 31 countries, including Eastern and Western Europe and OECD countries, the primary four economic variables are all required. GDP per capita is inverse; self-employed workers as a percentage of total employment is inverse; the size of the shadow economy as a percentage of GDP is positive and the Gini index is positive. All variables are statistically significant and the overall explanation of variance is .80. This is our most important “simple” model for the explanation of mortality variation among 31 countries using only the primary economic variables in our model.

When this model is supplemented by total carbohydrate consumption per capita and alcohol consumption per capita, both variables are positively and significantly related to mortality and the adjusted explanation of variance rises to 90 percent. It is clear that the basic four-variable economic model is coherent, has theoretical integrity and provides an “adequate” explanation of mortality. However, the use of two of the most important epidemiological risk factors in several causes of mortality (especially cardiovascular disease, liver cirrhosis) raises the explained variance among age-adjusted mortality rates for the working population by another 10 percentage points. This six variable model, then, though relatively simple in structure, contains all of the key economic predictors of mortality as well as two of the major risks found in the epidemiological literature.

The full model with 6 variables indicates the clear dominance of the economic variables in explaining 15-64 age-adjusted mortality. The most important variable, as usual in these mortality models, is the real GDP per capita with an adjusted coefficient (beta) of -.66. Very close behind the GDP per capita in importance is the proportion of self-employed workers to total employment, having a beta of -.65. Third in importance is the size of the shadow economy in proportion to GDP, with a beta of .34 – roughly half that of GDP per capita or self-employment. Finally, the Gini index of income inequality is also statistically significant

and provides a beta of .19, again about 50 percent lower in strength than the shadow economy.

For the “life-style” variables that are positive and significantly related to overall mortality in the 15-64 age-group, the most important is carbohydrate consumption in grams per capita per day. It shows a beta of .34 (i.e., almost exactly the magnitude of the impact of the shadow economy). This finding is highly consistent with the epidemiological assumption that total consumption of calories, especially in the absence of moderate exercise regimens, enlarges body-mass index which is a risk to the most important chronic diseases (cardiovascular, diabetes, malignancies). In addition, in recent years, epidemiological data have demonstrated that carbohydrate consumption in particular (as compared to protein and fat consumption) is a special risk for diabetes and therefore for overall cardiovascular disease.

Also quite significant, but with a somewhat lower beta coefficient of .23 is overall alcohol consumption (in calories of ethanol per capita per day). It is well known epidemiologically that alcohol is a special risk factor for cardiovascular disease, as it influences rates of hypertension, and can interact with cigarette consumption to influence the rate of oesophageal cancer. It is of considerable epidemiological importance in accidents of all types (especially involving machine handling and motor vehicles) and depression (e.g., suicide) and violence.

This 6 variable model for total mortality is highly effective for the sample of 31 countries which includes Western and Eastern Europe as well as the remaining OECD countries. When the same model is applied to a sample of 24 countries, only including Western and Eastern Europe, the adjusted explanation of variance is still at .90 and only the Gini index is not statistically significant. When the model is applied to 38 countries, including Western and Eastern Europe, the candidate countries of Romania and Croatia, and the Commonwealth of Independent States (i.e., Russia, Ukraine, Moldova, Armenia and Georgia), all 6 variables are significant predictors of morality differences and the adjusted variance explained is .85. Taking the general mortality model to the limits of international data availability, we have 46 countries, which includes the earlier sample of 38 plus Israel and 7 Latin American countries (Argentina, Brazil, Chile, Costa Rica, Panama, Uruguay, Venezuela). For these 46 countries, the 6 variable model is remarkably robust, with all variables significant and an adjusted explained variance of .79. For each of these 4 samples, the clearly dominant predictors of (low) mortality are the GDP per capita and self-employment.

Age- and sex-specific analysis

For males, for total mortality 15-64 in our main 6 variable model, only the Gini index is not significant, but the adjusted explanation of variance is approximately .90. The picture changes somewhat when we examine the male mortality rates for individual age-groups. In the age-group 15-24 explanation of variance is .72; here the Gini coefficient is significant, while the overall GDP per capita is not.

For the age-groups 25-34 and 35-44, all variables are significant, including GDP and Gini, but the most powerful variable predicting lower mortality rates is self-employment. For 25-34 and 35-44 the explained variances are, respectively, .83 and .90.

In the age-groups 45-54 and 55-64, explained variances remain high at .87 and .86. In both age-groups, however, all variables are significant except for the Gini index. In these two age-groups, GDP per capita is clearly the dominant explanatory factor followed by the beneficial effects of self-employment.

For females, all 6 of the main predictive factors are significant except for the shadow economy, which yields a total explanation of variance of .76 (i.e., somewhat lower than in the case of the male mortality models). Altogether, it must be pointed out that the Gini index is far more powerful in the case of female mortality than male. In the age-group 15-24, neither GDP nor the shadow economy is quite statistically significant, though the Gini index shows a strong positive relationship to mortality as does self-employment with an inverse relationship. Total explanation of variance is .72.

In the age-groups 25-34 and 35 and 44 nearly all variables are statistically significant (except alcohol consumption in the 25-34 age-group). Adjusted explanations of variance are respectively .79 and .71. For the age-groups 45-54 and 55-64 all variables are nearly significant, except for the shadow economy which is not. The Gini index in both cases shows strong positive relations to mortality. However, the dominant and beneficial predictors of (low) mortality are self-employment and GDP per capita. Explained variances are, for 45-54, .74 and for 55-64, .68.

Graphic analysis

A graph of the fit (prediction) of the model to 15-64 mortality rates (see)shows a principal distinction between Eastern European countries (plus Mexico), with extremely high rates of mortality, as compared to Western European and other OECD countries (US, Canada, Japan, Korea, Australia, New Zealand) with comparatively lower mortality rates. Clearly the chief distinction between these two groups of countries is GDP per capita, which has tended to be the dominant factor in the principal diagnoses of mortality in the working age-group. However, it is important to note that apart from one country (Hungary), the fit of the model to the general multivariate relationship is excellent. This means that for the other 30 countries, mortality rates are very close to fitting the multiple regression estimate.

6.4 Cardiovascular mortality, ages 15-64

The basic economic model for CVD involves three variables of our standard group of four, since the Gini index is not significant. The GDP per capita (negative sign), self-employment (negative) and shadow economy (positive) together provide an adjusted explained variance of .71 in the sample of 31 European and OECD countries.

An additional 6 percent of explained variance is provided by two other statistically significant “life-style” variables involving carbohydrate and alcohol consumption per capita. In this model of 5 variables, as in the case of total mortality, the GDP per capita and self-employment

variables are clearly dominant, with beta coefficients of -.64 and -.60 respectively. The extent of the shadow economy provides a coefficient of .33. The two consumption factors show coefficients somewhat below that; carbohydrate consumption is at .29 and alcohol consumption at .21. This seems clearly a cause of death that responds very strongly to the primary economic variables and rather less to those of consumption.

An alternative model provides controls for three other epidemiological risks that are well-known in the literature – namely, animal fat (i.e., saturated fat), cigarette consumption (with a cumulated lag effect over 5 years) and (a dummy) variable for Mediterranean region. There is a traditional debate in the epidemiological literature as to why Mediterranean region countries tend to have somewhat lower cardiovascular mortality; some scientists have argued that a “standard” Mediterranean diet emphasising olive oil, fish and low land animal fats, are the crucial set of factors, while a second group argues that wine consumption (especially red wine) reduces cardiovascular disease. We find that animal fat consumption (beta of .27), cigarette consumption (beta of .24) as well as Mediterranean region (beta of -.30) are all statistically significant – and are consistent with the presence of the three main economic predictors. We therefore conclude that regardless of controls for alcohol or carbohydrate consumption, on the one hand, or of animal fat or cigarette consumption or Mediterranean region, the three principal economic predictors (GDP, self-employed and shadow economy) are the main factors distinguishing CVD mortality rates in European countries and the OECD.

Age- and sex-specific analysis

For male CVD mortality ages 15-64, virtually all variables in the CVD model are significant (carbohydrate consumption has a t-statistic of 1.94), giving an adjusted explanation of variance at .76. In the age-group 15-24, only the GDP per capita is nearly significant with a t-value of -1.84 and an explained variance of .33. In 25-34, all variables are nearly significant except for alcohol consumption which is not significant. Dominating the explanation of variance of .54 are the GDP per capita and self-employment which are associated with lower mortality. In 35-44, all the economic predictors are highly significant, the alcohol and carbohydrate consumption are nearly significant and variance explained is .73. The model results for age-groups 45-54 and 55-64 are nearly identical. Nearly all variables are significant and the explained variances are .74 and .76 respectively.

Models for female cardiovascular disease in the 15-64 age-group are somewhat less powerful, with an especially low predictive value for the shadow economy; it is not significant in any age-group for female CVD mortality. In 15-24 and 25-34, hardly any variable is significant and the explained variances are .17 and .13 respectively. The model begins to assume importance in the age-group 35-44, where GDP per capita and self-employment are significant and explained variance is .42. It is only in the ages 45-54 and 55-64 that the models for female mortality are relatively strong with explained variances at .69 and .76. The two economic variables of GDP per capita and self-employment are the principal predictors for both age-groups, while carbohydrate consumption per capita is also an important factor.

Graphic analysis

The graph of the multivariable relationship between the economic and consumption variables, on the one hand, and cardiovascular mortality 15-64, on the other, once again shows a sharp distinction between the Eastern European countries and the Western European and OECD countries. The Eastern European countries show the highest mortality rates, although both sets of countries show mortality rates that approximate the general regression model. It is also the case that the Western European and OECD countries tend to show considerable "bunching" (clustering), despite the fact that their cluster also approximates the principal regression lineTotal accident mortality, ages 15-64

6.5 Total accident mortality, ages 15-64

Our main model for total accident mortality covers 31 European and OECD countries and, with the four principal economic variables, provides explained variance of .78. All variables (GDP per capita, shadow economy, Gini and self-employment) show stable relations throughout the samples of different countries. In this cause of death, however, the strongest variable predicting higher mortality is the shadow economy with a beta coefficient of .67. The variable involving self-employment provides a high level beta of -.48 and is the second most important (and inverse) predictor of morality.

The same pattern prevails, for predictability of accident mortality differentials, among the sample of 24 Western and Eastern European countries, and here the explained variance is slightly higher, .80. All four variables are virtually statistically significant and the shadow economy continues to be the most important predictor. For the samples of 38 countries (European, OECD and CIS) as well as for the largest sample of 46 countries, explained variance is quite low (.31 and .29 respectively). For both samples, only GDP per capita and self-employment show significant and adverse relations to accident mortality rates.

Age- and sex-specific analysis

Our standard model of four economic predictors is highly effective in the total age-group 15-64 with an adjusted variance of .78. Virtually exactly the same model with the same coefficients and explained variance pertain to males in the overall 15-64 age-group. For males 15-24, the explained variance falls to .49 and only the shadow economy and Gini index are positive and significant. In all other working age-groups – 25-34, 35-44, 45-54, 55-64 – virtually all four economic variables are significant. In the age-groups 35-44 through 55-64 variance explained is approximately .80. The variables dominating the prediction of male total accidents are, first of all, the positive shadow economy and, secondly, the inverse variable of self-employment. The inverse relationship based on GDP per capita prevails throughout the age-groups 25-64 and the Gini index is nearly always statistically significant and positive.

For females, the overall four variable model is a reasonably stable predictor of accident mortality, but the GDP per capita is usually not significant in the individual age-groups. Explained variance for 15-64 as a whole is .69, and that explanation of variance roughly remains the same over the age-groups 25 through 64. As in the case of the males, clearly

the strongest predictor is the presence of the shadow economy. This is followed in strength by self-employment, and lastly by the Gini index which, regardless of age, is always statistically significant and negative.

Graphic analysis

Graphic analysis shows the standard picture which sharply distinguishes Eastern and Western European countries, as well as the OECD, in the multivariable statistical explanation of accident mortality rates. The Eastern European countries (Estonia, Latvia, Lithuania, Poland, Hungary, Czech Republic, Slovakia and Slovenia), with relatively low GDP per capita and higher proportions of the shadow economy, evidence considerably higher mortality rates. Closest to the Western European and OECD countries are the Eastern European countries that are geographically and developmentally closer to the West, including Czech Republic, Slovakia, Poland, Hungary and Slovenia. There is some clustering of the Western and OECD countries, but the importance of the multivariable model in explaining variance among these countries is still evident.

6.6 Non-motor-vehicle accident mortality, ages 15-64

Non-motor vehicle accident mortality rates are predicted by the four economic variable model for 31 European and OECD countries, with explained variance at .75, and only the GDP per capita at slightly less than full statistical significance (t = -1.93). The shadow economy is the dominant variable in this model with self-employment following slightly behind. With a sample size of 24 West and Eastern European countries, all results are nearly identical and the explained variance is .76. However, when the sample increases to 38 countries, including the Commonwealth of Independent States, and than to 46 countries, the explained variances are substantially reduce to approximately .47 for both samples, and only two predictors are significant, namely the GDP per capita and self-employment, with negative signs.

Age- and sex-specific analysis

For males in the age-group 15-24, explained variance is reduced to .51 and the GDP per capita falls in significance, but remains negative. All other variables are significant. In the male age-groups 25 through 64 the explained variance ranges form .62 to .77. Once again, the GDP per capita tends to decline in significance somewhat for 45-54 and 55-64 age-groups, but all other variables are significant and variance explained based on the four predictors is approximately .77.

For female non-motor vehicle accidents mortality, in the age-group 15-24, explained variances radically reduce to .15, but self-employment and the Gini index remain significant. Among the age-groups through 25-64, the three variables self-employment, shadow economy and Gini index are significant, while the GDP looses significance and the explained variance ranges from .47 to .69. In the female 55-64 age-group, however, all four variables are significant and explained variance is again at .69.

Graphic analysis

The graphic analysis for the age-adjusted non-motor vehicle mortality rate for the age-groups 15-64 is a very similar exercise to that of observing the graph of the model for total accidents. Indeed, just as the models are very similar, the graph of the fit of the model to the actual mortality differentials is very much the same. And what has been indicated above as to the differences between Eastern European countries versus those of Western European and the OECD also is true in this case, with the less developed and lower GDP Eastern European countries having very much higher mortality rates

6.7 Motor-vehicle accident mortality, ages 15-64

In age-adjusted motor vehicle mortality for 15-64 age-groups, we use the four economic variable model and first examine the sample of 31 European and OECD countries. By our usual standards in this study, this model is not especially strong, yields an adjusted explained variance of .55 and only the shadow economy is a significant predictor.

A somewhat stronger model is provided for the 24 West and Eastern European countries. Here, both the shadow economy and GDP per capita are significant predictors with explained variance reaching .64. On the other hand, the models for 38 European, OECD and CIS countries, and that for the total of 46 countries are extremely weak with explained variances at .09 and .19 respectively. In these two models, only the GDP per capita is a significant (and negative) predictor.

Age- and sex-specific analysis

For males within the 31 country sample, as in the total motor-vehicle accident mortality, explained variance is .60, but only the shadow economy is a significant and positive predictor. This pattern, of the shadow economy being significant, persists even in the age-group 15-24 for males although the explained variance is only .14. In age-group 25-34, the four-variable model is much stronger, with explained variance at .58 and both the shadow economy and Gni index are significant and positive predictors. In 35-44 and 45-54 ages, the explained variance increases to .66. The GDP per capita as well as shadow economy are significant in 35-44, and the GDP as well as the shadow economy are significant in 45-54. Explained variances reduce in 55-64 to .59 and only the GDP per capita is significant and negative.

For females, in the total age-group 15-64, the explained variance is much reduced to .31, but both the shadow economy and Gini index are positive and significant predictors. Interestingly, although the explained variances are only .09 in 15-24 ages, the shadow economy remains a significant predictor. In 24-34 explained variance rises to .42 and only the GDP per capita is not significant. For ages 35 all the way through 64, however, none of the economic variables is a significant predictor, and it is clear that the models are inadequate for explanatory purposes.

Graphic analysis

Despite relatively weak models in some of the male and female age-specific groups, the overall model for 15-64 for both sexes in 31 countries is relatively strong with explained variance of .68 and all of the four economic variables statistically significant. The graph reveals a well dispersed multiple regression prediction with little clustering. The typical picture of considerably higher motor-vehicle mortality rates in the Eastern European countries is found here, although, interestingly, similarly high rates are found for Greece and Korea to those Eastern European countries. In general, the mortality rates of the involved countries approximate the regression prediction, with a few exceptions: United Kingdom and Japan are considerably lower than their predicted rates, and the United States is higher than its predicted rate. There is, however, no indication that legislation or policy vis-à-vis automobile construction, driving, road engineering, automobile speed, seat belts, etc., that we assume to be more stringent in Scandinavia, Germany and the United States, show unusually low motor-vehicle accident mortality in comparison to the predictions given by the four variable model. Perhaps only Japan and the United Kingdom can be offered as potential examples of unusually effective policy.

6.8 Accidental poisonings, ages 15-64

Accidental poisoning mortality is one of the very few mortality causes whose mortality rates are unrelated to GDP per capita. The typical pattern, however, in this cause of death is for each of the other three primary economic predictors (shadow economy, self-employment, and the Gini index) to play a major international role in explaining differential mortality rates, with explained variance at .63. Most prominent in the 31 country sample is the magnitude of the shadow economy, with a beta coefficient of .81. Second in importance is the inverse relation of self-employment with a beta coefficient of -.61. This is followed in importance by the Gini coefficient whose beta is less than half that of self-employment.

Nearly precisely the same relationships hold for the sample of 24 Western and Eastern European countries with explained variance of .68. Bringing the European, OECD and CIS countries together in a sample of 38, however, removes the Shadow economy from statistical significance, providing an overall explained variance of .50. On the other hand, the shadow economy is significant, but the Gini index is only nearly so. In this sample, self-employment has a strong (negative) .70 beta coefficient, and is significant in all samples of the accidental poisoning mortality outcome.

Age- and sex-specific analysis

For males, with minor exceptions, in the basic four variable model only real GDP per capita is not significant in any age-group. The three other variables are virtually always significant in all age-groups of males mortality. Explained variance ranges from the .50's in the 25 to 44 groups for the .65 range for the age-groups 45-64.

Females show relationships remarkably similar to those of males over the life-course. Once again, only GDP per capita is not statistically significant. For females in the 15-24 age-group only self-employment is significant. From 25 through 64, all economic predictors are

significant except for real per capita income. However, the variances explained are somewhat lower than for the male age-groups. In females 25-34 and 35-44, explained variance ranges form .29 to .42; for age-groups 45 through 64 they range between .53 and .57. As in the case of the males, the shadow economy tends to be the dominant predictor, followed by the beneficial self-employment.

Graphic analysis

For accident poisoning mortality, as is often true, the highest mortality rates are in the Baltic countries, though Finland is also relatively high. Nearly all other countries cluster at considerably lower rates. Given the predictive power of the multi-variable model, it is easy to see which countries tend to lie above or below the confidence limits provided by this model.

6.9 Total malignancies, ages 15-64

The total malignancy prediction equation for 31 countries contains two prime economic predictors, namely GDP per capita, and self-employment, both highly significant, with strong beta coefficients (-.98 and -.67, respectively). Shadow economy and the Gini index are not significant in this model in the presence of total calorie consumption per capita, which is a positive and significant predictor. Alcohol consumption is also a significant predictor of overall malignancies. Cigarette consumption (largely affecting lung cancer mortality) was not found significant for total malignancies in the presence of total calorie consumption and the two main economic predictors.

In the 24 country sample of Western and Eastern European countries, however, only the GDP per capita and self-employment are highly significant; alcohol and total calorie consumption are significant at the 10 percent level of confidence. In the 38 country and 46 country samples, GDP per capita and self-employment, as well as alcohol and total calorie consumption are statistically significant. But in all country samples, GDP per capita is the major influence on mortality rate differentials.

Age- and sex-specific analysis

For males in the 15-24 age-group, GDP per capita is the only influential variable, but yields explained variance of only .18. In all other age-groups for males, GDP per capita provides a strong negative coefficient, and explained variance is in the range of .40 to .50. For the age-group 35-44, in addition to GDP per capita, total calorie consumption is a significant predictor. In the age groups 25-34, 45-54 and 55-64, self-employment is a robust inverse predictor of mortality, while in 35-44, calorie consumption per capita is an important predictor and in 55-64, alcoholic beverages is the important dietary predictor.

In all age-groups from 25-64, GDP per capita is inversely related to malignancy mortality for women and is by far the strongest factor in all female age-groups. In the age-groups 35-64, self-employment is significantly inversely related to malignancy mortality. In addition, in the age-groups 35-54, calorie consumption is a significant positive predictor of mortality. Altogether, it is only in the age-groups 35-54 that the economic models are especially powerful and account for approximately .60 of the variance explained.

Graphic analysis

The typical graphic pattern of high mortality rates prevails among the Eastern European countries. However, near the bottom of the Eastern European high mortality groups are Belgium and France, although they are well within the location of the predicted model. The countries with well-developed health and safety legislation, especially Japan, the Scandinavian countries, Canada, United States and Germany are very close to the main prediction line of the regression equation, and certainly their mortality rates are no lower than would be exactly predicted by the model itself. There is therefore no reason to assume that, beyond issues of GDP, self-employment and overall calorie consumption, legislative or other policy characteristics of these countries provide especially low mortality rates.

6.10 Liver cirrhosis, ages 15-64

Cirrhosis of liver mortality is dominated by GDP per capita and self-employment with strong inverse relations. In the 27 country sample (Europe and the OECD) that contains data from as many countries as are available, explained variance is a moderate .63. In this model, however, other controls are present. First of all, a control is inserted for suicide, largely as a means of controlling for potential statistical misdiagnosis, but also as a means of controlling for potentially severe depression. It is consistently significant in the majority of all liver cirrhosis models. Also under control, of course, is per capita alcohol consumption which is statistically significant at the 10 percent level. Carbohydrates consumption and total fat consumption are under control, since liver cirrhosis is an important metabolic illness. Given data limitations on the diagnosis of cirrhosis of liver, our principal models were limited to 27 countries.

Age- and sex-specific analysis

For males in the age-group 15-24 (where for many countries, liver cirrhosis mortality rates are virtually zero), the only significant predictor is real GDP per capita which, interestingly, explains 50 percent of the mortality variance. In the age-group 25-34 virtually the entire model is significant, with only self-employment significant at less than the 10 percent level, and adjusted explanation of variance is .62. Predictive capacity of the model in the 35-44 age-group is dominated by real GDP per capita, but the control for suicide is of considerable importance as is the consumption of fat; explained variance in this age-group drops to .59. In the 45-54 age-group the dominant predictors are GDP per capita and self-employment, while alcohol consumption per capita, suicide and fat consumption per capita are important additional inputs. In 55-64, the primary variables GDP per capita, self-employment and alcoholic beverages consumption are the principal predictors, though control for suicide is quite important, and total explained variance is at .61.

For females in the 15-24 age-group, GDP per capita and self-employment are the principal predictors followed by alcoholic beverages consumption per capita, giving a reasonable explained variance of .51. In the 25-34 age-group, the massively dominant inverse predictor is real GDP per capita, followed by the high consumption levels of alcoholic beverages. The two significant variables together lead to an explained variance of .50. A richer model is seen in the age-group 35-44 with, surprisingly, only alcoholic beverage consumption not significant.

All other variables are significant, including the controls for suicide, carbohydrate consumption per capita and fat consumption per capita. The model yields an explained variance of .55. The age-group 45-55 provides the strongest model of explained variance, at .60. Nearly all variables are significant, and the model is again dominated by GDP per capita (only carbohydrate consumption per capita is significant at the 10 percent level). At ages 55-64, explained variance is somewhat reduced to .51 and only the two principal economic predictors are significant, namely real GDP per capita and self-employment.

6.11 Homicide, ages 15-64

For the sample of 31 European and OECD countries, an excellent model is provided by the four main economic variables, where all are significant and adjusted explained variance is .80. The anomaly in the case of homicide is that, while GDP per capita is inverse to mortality and statistically significant, it is not at all the dominant predictor. In this cause of death, the extremely dominant predictor is the Gini index. It is followed in importance by self-employment (with the usual negative sign) and the shadow economy.

These relations are similar in the case of the sample of 24 Western and Eastern European countries with explained variance of .82. However, GDP per capita is not at all significant, and the dominant predictor in this model is the shadow economy. However, if we add to the 31 European and OECD countries the CIS countries of Russia, Ukraine, Moldova and Georgia, the impact of the shadow economy disappears, the other three variables are significant predictors and explained variance is .68. Finally, in the largest sample of 46 countries, explained variance is reduced to .45 and only the Gini index and self-employment are significant.

Age- and sex-specific analysis

For male homicide 15-24, only the Gini index and self-employment are significant, the Gini index showing extraordinary dominance; the explained variance is .66. It rises to .73 in the age-group 25-34, where only GDP is not significant and the model is dominated by the Gini index. A remarkable series of pictures are presented by the models for homicide in the age-groups 35-44, 45-54 and 55-64. Explained variance in these cases is at approximately .80 and all of the variables are significant in all models. Once again, the Gini index dominates the explanation of variance.

Female homicide mortality in the 15-24 age-group also yields a substantial model with explained variance at .59 and only GDP per capita not significant. Explanation of variance falls, in the 25-34, to .37 with only Gini and self-employment significant and considerable dominance by the Gini index. In 35-44, explained variance is .46, the GDP per capita is not significant. Almost exactly the same situations pertain to female homicide at 44-54 and 55-64, with GDP per capita the only variable not significant at the .05 percent level (i.e., it is nearly significant). Explained variance for 35-44 is .46, whereas it rises to the .60's in the 45-54 and 55-64 age-groups.

6.12 Suicide, ages 15-64

Suicide in the 15-64 age-group is not very well accounted for by our four-variable economic model. Of those variables, only self-employment shows a consistent (and negative) relation to mortality among 31 countries, with explained variance of .33. Virtually the same relationship pertains when the sample is reduced to 24 Western and Eastern European countries.

When the sample is enlarged to 38 countries including European, OECD and CIS countries, the additional variable of GDP per capita becomes significant, but the explained variance remains below .30. Even including all 46 countries does not allow the explained variance to go upwards of .32, and the same two predictors are prominent, namely self-employment and GDP per capita.

Age- and sex-specific analysis

For 14-24 male suicide rates, only self-employment is significant, and the adjusted explanation of variance is .04. In 25-34 male suicides, no single predictor is significant, but self-employment does approach .06 level of confidence and explained variance improves somewhat to .14. In 35-44, explained variance increases to .46, where self-employment is the sole significant predictor. In 45-54, self-employment continues to be a prominent inverse predictor, but is joined by real GDP per capita, giving an explained variance of .43. And virtually the same pattern is found in 55-64 year olds, where explained variance is .41.

For female suicide rates 15-24, there are no significant economic predictors. In 25-34 self-employment is a nearly significant predictor, and explained variance is .07. In 35-44, again, self-employment is the singular significant predictor, and provides explained variance at .15. In 45-54 and 55-64 female suicide rates, no predictors are significant.

6.13 Summary of cross-sectional findings

We have tested a model containing at least four economic predictors by which we attempted to account statistically for variation in mortality rates in the working-age populations of Western and Eastern Europe and the OECD countries. In this effort, we attempt to explore the most serious implication, namely mortality, in the field of occupational health and safety. The main variables have been real GDP per capita (negative sign), self-employment as a proportion of total employment (negative sign), the shadow economy as a proportion of total GDP (positive sign) and the Gini index of income inequality (positive sign). This type of model was tested in total age-adjusted mortality for the 15-64 population and an additional nine specific causes of death: cardiovascular, malignancies, total accidents, non-motor-vehicle accidents, motor-vehicle accidents, accidental poisoning, cirrhosis of liver, suicide and homicide.

The four primary economic predictors were found significant in total and cardiovascular mortality, total accidents and non-motor-vehicle accidents. In the motor-vehicle accident mortality, the shadow economy and occasionally the GDP were significant predictors. In accidental poisoning, only the GDP per capita is not significant and the shadow economy is

clearly the strongest variable. In malignancy mortality, GDP per capita and self-employment are important and significant predictors (in addition to total calorie consumption per capita). In cirrhosis of liver, the GDP per capita and self-employment are statistically significant predictors. In suicide, GDP per capita and self-employment are inverse predictors, whereas in homicide, again, GDP per capita and self-employment are significant predictors (inverse); however, the Gini index is a quite strong positive predictor and is the dominant variable for this cause of death.

The fact that the overall model of four predictors is crucial in total mortality for the working-age population as well as in cardiovascular mortality and accident mortality – representing the vast majority of all mortality between 15-64 – supports the main conclusion that each of the four variables is a stable predictor for the major causes of death and their subdivisions by age and sex. The other major source of mortality, malignancies, also shows the effect of the two principal economic predictors, GDP per capita and self-employment. The remaining causes of death, which are not high prevalence sources of mortality, but which are of theoretical importance, usually show the influence of two or three of the four main economic predictors. The evidence, then, is that at least two, and often three, of the economic predictors are present in all of the identified causes of death in the population 15-64. These patterns are also evident when one examines in detail the diffusion of these predictors according to age and sex for each of the causes of death under study.

We also observe that our findings which, crucially, pertain to the 31 country sample of Western and Eastern Europe and the OECD, typically can also be found when one reduces the sample to Western and Eastern Europe only, or enlarges the sample to include the CIS countries, or increases the sample to a maximum of 46 countries, including 8 Latin American countries and Israel. The point of this exercise is to investigate whether it is possible to generalise our findings to different samples and, in particular to the largest sample that the international data will allow. Since we have seen that this is true, it can be concluded that the findings pertaining to these four variables approximate a general principle of mortality explanation among highly developed and middle-industrialized countries with market economies, regardless of culture or political structure. One type of policy implication is that it is now evident that macroeconomic indicators, such as those described in the study, are the prime sources of severe problems of occupational health among industrialized countries, and Europe in particular.

6.14 Tables

Table 7: Relation of 4 main economic variables to age-adjusted mortality of major causes of death in the working age (15-64) population for EU and OECD countries, both sexes

Dependent Variables		Independent variables				
		GDP at PPP pro capita	Size of the shadow economy	Gini-index	Self-employed workers as percentage of total employment	
Total mortality	Std. Beta	-0.646	0.374	0.218	-0.521	N=31
	t-statistic	-4.982	2.946	2.372	-5.343	R^2= 0.804
	p-level	**0.000**	**0.007**	**0.025**	**0.000**	
Cardio-vascular	Std. Beta	-0.620	0.363	0.087	-0.517	N=31
	t-statistic	-3.920	2.348	0.780	-4.352	R^2= 0.709
	p-level	**0.001**	**0.027**	**0.442**	**0.000**	
Total accidents mortality	Std. Beta	-0.282	0.675	0.301	-0.475	N=30
	t-statistic	-2.031	4.976	2.977	-4.487	R^2= 0.776
	p-level	**0.053**	**0.000**	**0.006**	**0.000**	
Motor-vehicle accidents	Std. Beta	-0.221	0.512	0.240	0.002	N=31
	t-statistic	-1.120	2.649	1.711	0.014	R^2= 0.546
	p-level	**0.273**	**0.014**	**0.099**	**0.989**	
Non-motor-vehicle accidents	Std. Beta	-0.286	0.657	0.310	-0.602	N=31
	t-statistic	-1.933	4.546	2.959	-5.414	R^2= 0.746
	p-level	**0.064**	**0.000**	**0.006**	**0.000**	
Accidental poisoning mortality	Std. Beta	0.008	0.815	0.313	-0.616	N=31
	t-statistic	0.047	4.695	2.490	-4.623	R^2= 0.634
	p-level	**0.963**	**0.000**	**0.019**	**0.000**	
Malignant neoplasms mortality	Std. Beta	-0.710	-0.021	-0.338	-0.304	N=31
	t-statistic	-3.223	-0.098	-2.165	-1.838	R^2= 0.436
	p-level	**0.003**	**0.873**	**0.781**	**0.007**	
Liver cirrhosis mortality	Std. Beta	-0.720	0.435	0.334	-0.819	N=24
	t-statistic	-3.066	1.589	1.589	-2.732	R^2= 0.423
	p-level	**0.006**	**0.129**	**0.129**	**0.013**	
Homicide	Std. Beta	-0.274	0.376	0.779	-0.463	N=31
	t-statistic	-2.073	2.907	8.317	-4.666	R^2= 0.797
	p-level	**0.048**	**0.007**	**0.000**	**0.000**	
Suicide	Std. Beta	-0.390	0.263	-0.102	-0.509	N=31
	t-statistic	-1.625	1.119	-0.601	-2.821	R^2= 0.332
	p-level	**0.116**	**0.273**	**0.553**	**0.009**	

Table 8: Final models: Relation of selected variables to age-adjusted mortality of major causes of death in the working age population 15-64 for EU and OECD countries, both sexes

Dependent variables	Std. Beta t-statistic *p-level*	Main economic variables				Epidemiological variables					Number of countries Adj. R^2
		GDP at PPP pro capita	Size of the shadow economy	Gini-index	Self-employed workers (% of tot. employm.)	Suicide in population 15 to 64 years	Total calories consumption (/cap/day)	Carbohydrates consumption (gram/cap/day)	Alcohol (calories /cap/day)	Total fat consump. (gram/cap/day)	
Total mortality	**Std. Beta**	**-0.661**	**0.345**	**0.187**	**-0.655**			**0.344**	**0.226**		**N=31**
	t-statistic	**-7.117**	**3.760**	**2.502**	**-8.645**			**4.257**	**3.448**		Adj. R^2=
	p-level	***0.000***	***0.001***	***0.020***	***0.000***			***0.000***	***0.002***		*0.901*
Cardio-vascular	**Std. Beta**	**-0.644**	**0.334**		**-0.600**			**0.292**	**0.211**		**N=31**
	t-statistic	**-4.612**	**2.444**		**-5.399**			**2.547**	**2.241**		Adj. R^2=
	p-level	***0.000***	***0.022***		***0.000***			***0.017***	***0.034***		*0.775*
Tot. accid mortality	**Std. Beta**	**-0.282**	**0.675**	**0.301**	**-0.475**						**N=30**
	t-statistic	-2.031	**4.976**	**2.977**	**-4.487**						Adj. R^2=
	p-level	*0.053*	***0.000***	***0.006***	***0.000***						*0.776*
Motor-veh. acc. mort.	**Std. Beta**	**-0.221**	**0.512**	**0.240**	**0.002**						**N=31**
	t-statistic	-1.120	**2.649**	1.711	0.014						Adj. R^2=
	p-level	*0.273*	***0.014***	*0.099*	*0.989*						*0.547*
Non-motor-veh acc.	**Std. Beta**	**-0.286**	**0.657**	**0.310**	**-0.602**						**N=31**
	t-statistic	-1.933	**4.546**	**2.959**	**-5.414**						Adj. R^2=
	p-level	*0.064*	***0.000***	***0.006***	***0.000***						*0.746*
Acc. poisoning mor.	**Std. Beta**	**0.008**	**0.815**	**0.313**	**-0.616**						**N=31**
	t-statistic	0.047	**4.695**	**2.490**	**-4.623**						Adj. R^2=
	p-level	*0.963*	***0.000***	***0.019***	***0.000***						*0.635*
Mal. neoplasms mort.	**Std. Beta**	**-0.964**			**-0.561**		**0.363**		**0.278**		**N=31**
	t-statistic	**-6.077**			**-3.786**		**2.307**		**2.084**		Adj. R^2=
	p-level	***0.000***			***0.001***		***0.029***		***0.047***		*0.575*
Liver cirrh. mortality	**Std. Beta**	**-0.928**			**-0.392**	**0.372**		**0.248**	**0.245**	**0.339**	**N=27**
	t-statistic	**-5.358**			**-2.336**	**2.740**		1.768	1.931	**2.312**	Adj. R^2=
	p-level	***0.000***			***0.030***	***0.013***		*0.092*	*0.068*	***0.032***	*0.629*
Homicide	**Std. Beta**	**-0.274**	**0.376**	**0.779**	**-0.463**						**N=31**
	t-statistic	**-2.073**	**2.907**	8.317	**-4.666**						Adj. R^2=
	p-level	***0.048***	***0.007***	*0.000*	***0.000***						*0.797*
Suicide	**Std. Beta**	**-0.390**	**0.263**	**-0.102**	**-0.509**						**N=31**
	t-statistic	**-1.625**	**1.119**	-0.601	**-2.821**						Adj. R^2=
	p-level	***0.116***	***0.273***	*0.553*	***0.009***						*0.332*

7 Time-series analysis

We have seen that economic growth plays the primary role in the long-term decline of mortality rates in industrialised countries. We also observe, from cross-sectional analysis that the instability of employment, and especially the unemployment rate play a substantial damaging role in overall mortality and cardiovascular mortality. It is a long-standing hypothesis in the field of occupational health that stability of employment is important both for the adjustment of workers to the diffusion of new technologies and to the entire area of work stress involving the integration of employees into coordinated work roles. Important bodies of theory with respect to organisational systems and analysis emphasises the importance of employee coordination and integration to the voidance of accidents and the maximisation of job satisfaction.

Quite apart from these issues of person-environment fit, the unemployment of workers in substantial numbers and over considerable durations, makes it more difficult for former employees to adjust to new work situations, especially where it is important for them to maintain old skills and acquire new ones specific to the firms in which they will be employed. Finally, the ability of the middle-aged worker to reintegrate into the workforce after having been unemployed additionally imposes serious problems of work stress because of typical reductions in wages and salaries, job seniority and non-wage and retirement benefits.

With this background, we examined a series of time-series regression analyses which combine the effects of economic growth and both cyclic and structural unemployment rates, for the G-7 countries of Canada, France, Germany (West), Italy, Japan, United Kingdom and Uinted States.

In the following time-series analyses, we have used the Error-Correction-Method (ECM) to describe both factors which influence the level of age-adjusted mortality through time as well as first difference (annual changes) in those mortality rates.

We first approach the issue of age-adjusted total mortality from the standpoint of interaction between variables. This means that we expect that the impact of economic growth on mortality will vary to some degree in accordance with the presence of unemployment. We expect this because the general population experiences macroeconomic conditions in light of the simultaneous occurrence of both changes in wealth per capita and labour market conditions. Despite the overwhelming beneficial importance of economic growth to mortality reduction, there is also evidence that, in the short term, rapid economic growth, especially following recessions, is associated with temporarily increased mortality. Proposed explanations for this short-term effect are: (1) the adjustment to technological innovations that are the subject of heightened investment during periods of economic growth (i.e., the Schumpeter Effect of “creative destruction”), (2) the temporary requirements of elevated speed and volume of work corresponding to increases in aggregate demand and (3) sharp increases in worker productivity resulting from the fact that unemployment (as a lagging economic indicator) continues to remain high after economic recessions, because employers are reluctant to significantly increased hiring until the economic recovery is sustained. Such temporary work pressures during economic upturns reduce the beneficial effect of economic growth in the short term and make it more likely that the return to work by the formerly

unemployed (i.e., the decline in the unemployment rate) may be minimally beneficial until economic expansion is well under way.

In the following analyses of total age-adjusted mortality, we have applied two alternative interaction term models. The first involves real GDP per capita over a distributed lag of at least 10 years. In addition, we include the multiplication of GDP per capita and the unemployment rate in this model. In all of the 7 countries under experiment, this short model is significant in both level and first difference forms.

In the second model, we include the unemployment rate, with a cumulative lag of at least 10 years, as well as a variable representing the multiplication of GDP per capita and the unemployment rate. Here again, principal variables in the 7 countries are significant in both level and first differences.

Assessing the comparative strength of the two alternative models, while explanations of variance are comparatively similar, the model emphasising GDP growth as its primary variable appears to be the more consistently predictive of mortality.

Total Mortality Models

Multivariate relations between macroeconomic factors and total age-adjusted mortality rates for 7 EU countries

Canada GDP Model, total mortality, 1965-1997

	Constant	Trend*	GDP*UR*	lags	GDP*	lags	Residual from level model lag 1	*R* bar square	Durbin-Watson
	Coeff (t)	*Coeff* (t)	*Coeff* (t)		*Coeff* (t)				
Model 1, level 1965-1997	*57.9453* **(18.3924)**	*0.1403* **(1.2496)**	*-0.4810* **-(4.6774)**	0-12	*-4.5758* **-(10.0673)**	0-11		*0.9942*	*1.6929*
Model 1, first difference 1966-1997	*0.0327* **(0.6997)**		*-0.4554* **-(2.9253)**	0-12	*-5.5410* **-(3.1375)**	0-11	*-1.1206* **-(6.0663)**	*0.6520*	*1.9116*

* variables in logarithmic form

Canada UR Model, total mortality, 1965-1999

	Constant	GDP*UR *	lags	UR*	lags	Age-adj. mortality	lag	Residual from level model lag 1	*R* bar square	Durbin-Watson
	Coeff (t)	*Coeff* (t)		*Coeff* (t)		*Coeff* (t)				
Level 1965-1997	*32.0260* **(7.4604)**	*-2.8444* **-(7.4896)**	0-12	*2.8728* **(7.1279)**	0-13	*0.4396* **(5.7940)**	2		*0.9927*	*1.9917*
first difference 1966-1997	*-0.0394* **-(1.2650)**	*-1.9607* **-(3.2536)**	0-12	*1.7136* **(2.0560)**	0-13	*0.2642* **(1.9571)**	2	*-0.8883* **-(4.5077)**	*0.5745*	*2.0114*

* variables in logarithmic form

France GDP-Model, 1965-1998

	Constant	GDP*UR *	lags	GDP*	lags		Residual from level model lag 1	*R* bar square	Durbin-Watson
	Coeff **(t)**	*Coeff* **(t)**		*Coeff* **(t)**					
Level 1965-1998	*60.2660* **(25.5707)**	*-0.5856* **-(10.8306)**	0-12	*-4.6519* **-(15.5559)**	0-11			*0.9940*	*1.9275*
first difference 1966-1998	*0.0056* **(0.1862)**	*-0.5315* **-(3.9088)**	0-12	*-5.3922* **-(6.7919)**	0-11		*-1.0951* **-(5.6109)**	*0.7601*	*1.7150*

* variables in logarithmic form

France UR-Model, 1965-1998

	Constant	GDP*UR *	lags	UR*	lags	Age-adj. mortality	lag	Residual from level model lag 1	*R* bar square	Durbin-Watson
	Coeff **(t)**	*Coeff* **(t)**		*Coeff* **(t)**		*Coeff* **(t)**				
Level 1965-1998	*35.7420* **(7.7558)**	*-3.2189* **-(7.6875)**	0-12	*3.4580* **(7.1540)**	0-13	*0.3099* **(3.0970)**	1		*0.9902*	*2.3732*
first difference 1966-1998	*-0.0241* **-(0.5990)**	*-2.6046* **-(5.3189)**	0-12	*2.6119* **(4.0098)**	0-13	*0.2661* **(1.8537)**	1	*-1.1986* **-(5.2306)**	*0.6454*	*2.0169*

* variables in logarithmic form

Germany (West) GDP-Model, 1967-1999

	Constant	**GDP*UR ***	**lags**	**GDP***	**lags**	**Residual from level model lag 1**	***R* bar square**	**Durbin-Watson**
	Coeff **(t)**	*Coeff* **(t)**		*Coeff* **(t)**				
Level 1967-1999	*35.2084* **(113.7672)**	*-0.5086* **-(14.8797)**	0-12	*-1.9408* **-(29,3469)**	0-11		*0.9980*	*2.0882*
first difference 1968-1999	*0.0066* **(0.1714)**	*-0.5273* **-(13.5410)**	0-12	*-1.9623* **-(4.1706)**	0-11	*-1.0834* **-(5.8125)**	*0.8837*	*1.9131*

* variables in logarithmic form

Germany (West) UR-Model, 1967-1999

	Constant	**GDP*UR ***	**lags**	**UR***	**lags**	**Age-adj. mortality**	**lag**	**Residual from level model lag 1**	***R* bar square**	**Durbin-Watson**
	Coeff **(t)**	*Coeff* **(t)**		*Coeff* **(t)**		*Coeff* **(t)**				
Level 1967-1999	*26.1457* **(14.4457)**	*-1.7979* **-(14.9027)**	0-12	*1.3297*	0-13	*0.2090* **(3.7000)**	1		*0.9979*	*2.1164*
first difference 1968-1999	*0.0369* **(0.7854)**	*-1.9819* **-(5.6705)**	0-12	*1.5374* **(4.1143)**	0-13	*0.3143* **(3.1188)**		*-1.4003* **(6.6195)**	*0.8842*	*2.1392*

* variables in logarithmic form

Italy GDP-Model, 1965-1998

	Constant	GDP*UR *	lags	GDP*	lags		Residual from level model lag 1	*R* bar square	Durbin-Watson
	Coeff (t)	*Coeff* (t)		*Coeff* (t)					
Level 1965-1998	*58.5634* **(14.9341)**	*-1.5807* **-(8.8733)**	0-12	*-3.1869* **-(5.8486)**	0-11			*0.9849*	*1.5953*
first difference 1966-1998	*-0.0050* **-(0.0960)**	*-1.4643* **-(5.3414)**	0-12	*-3.4317* **-(5.9375)**	0-11		*-0.4649* **-(2.5416)**	*0.5934*	*1.7173*

* variables in logarithmic form

Italy UR-Model, 1965-1998

	Constant	GDP*UR *	lags	UR*	lags	Age-adj. mortality	lag	Residual from level model lag 1	*R* bar square	Durbin-Watson
	Coeff (t)	*Coeff* (t)		*Coeff* (t)		*Coeff* (t)				
level 1965-1998	*59.9161* **(4.8078)**	*-5.4325* **-(4.1944)**	0-12	*5.3091* **(3.0427)**	0-13	*0.0930* **(0.6655)**	1		*0.9804*	*1.7154*
first difference 1966-1998	*-0.0129* **-(0.2066)**	*-6.6930* **-(3.3889)**	0-12	*7.1449* **(2.8488)**	0-13	*0.0005* **-(0.0030)**	1	*-0.8104* **-(3.4110)**	*0.5421*	*1.6705*

* variables in logarithmic form

Japan GDP-Model, 1966-1999

	Constant	**GDP*UR ***	**lags**	**GDP***	**lags**			**Residual from level model lag 1**	***R* bar square**	**Durbin-Watson**
	Coeff **(t)**	*Coeff* **(t)**		*Coeff* **(t)**						
level 1966-1999	*52.6992* **(44.0757)**	*-1.8853* **-(6.9663)**	0-13	*-2.1735* **-(4.6297)**	0-12				*0.9946*	*2.0178*
first difference 1967-1999	*-0.0012* **-(0.0198)**	*-1.8629* **-(2.6712)**	0-13	*-2.0143* **-(2.7832)**	0-12			*-1.1174* **-(5.3298)**	*0.5715*	*1.8784*

* variables in logarithmic form

Japan UR-Model, 1966-1999

	Constant	**GDP*UR ***	**lags**	**UR***	**lags**	**Age-adj. mortality**	**lag**	**Residual from level model lag 1**	***R* bar square**	**Durbin-Watson**
	Coeff **(t)**	*Coeff* **(t)**		*Coeff* **(t)**		*Coeff* **(t)**				
level 1965-1998	*52.0225* **(47.5987)**	*-3.8638* **-(22.7895)**	0-13	*1.6168* **(4.4915)**	0-12				*0.9945*	*1.8491*
first difference 1966-1998	*0.0153* **(0.2268)**	*-3.5092* **-(3.2618)**	0-13	*1.4658* **(2.0480)**	0-12	*0.1490* **(1.1125)**	1	*-1.8479* **-(4.6567)**	*0.5625*	*1.9184*

* variables in logarithmic form

United Kingdom GDP-Model, 1965-1999

	Constant	GDP*UR	lags	GDP	lags	Age-adj. mortality lag 1*	Age-adj. mortality lag 2*	Residual from level model lag 1	*R* bar square	Durbin-Watson
	Coeff (t)	*Coeff* (t)		*Coeff* (t)		*Coeff* (t)				
level 1965-1999	*4.6667* **(11.4208)**	*-0.000004* **-(11.0312)**	0-12	*0.0000* **-(4.8569)**	0-13	*-0.4881* **-(4.5907)**	*-0.25053* **-(2.8371)**		*0.9945*	*2.3176*
first difference 1966-1999	*-0.000041* **-(0.0110)**	*-0.000004* **-(8.3898)**	0-12	*0.0000* **-(4.2199)**	0-13	*-0.4458* **-(5.0480)**	*-0.2242* **-(3.0801)**	*-1.2038* **-(5.8793)**	*0.8497*	*2.0375*

* variables in logarithmic form

United Kingdom UR-Model, 1965-1999

	Constant	GDP*UR	lags	UR	lags	Age-adj. mortality lag 1*	Age-adj. mortality lag 2*	Residual from level model lag 1	*R* bar square	Durbin-Watson
	Coeff (t)	*Coeff* (t)		*Coeff* (t)		*Coeff* (t)				
level 1965-1998	*4.8402* **(7.7984)**	*-0.000005* **-(4.8536)**	0-12	*0.0159* **(1.6133)**	0-13	*-0.5411* **-(3.8959)**	*-0.2898* **-(2.1311)**		*0.9931*	*2.2622*
first difference 1966-1998	*0.0050* **-(1.3680)**	*-0.000005* **-(4.2009)**	0-12	*0.0127* **(1.5544)**	0-13	*-0.5010* **-(4.9012)**	*-0.27023* **-2.87505**	*-1.1619* **-(4.6567)**	*0.8138*	*2.0271*

* variables in logarithmic form

United States GDP-Model, 1965-1998

	Constant	GDP*UR *	lags	GDP*	lags	Age-adj. mortality	lag	Residual from level model lag 1	*R* bar square	Durbin-Watson
	Coeff **(t)**	*Coeff* **(t)**		*Coeff* **(t)**		*Coeff* **(t)**				
level 1965-1998	*41.7759* **(7.6871)**	*-1.2106* **-(6.3920)**	0-4	*-2.1609* **-(6.8541)**	0-13	*0.3881* **(4.9947)**	1		*0.9924*	*1.8973*
first difference 1967-1999	*-0.0246* **-(0.7534)**	*-1.2931* **-(6.7403)**	0-4	*-2.0132* **-(5.5056)**	0-13	*0.2427* **(1.6151)**	1	*-0.8604* **-(3.4973)**	*0.6545*	*1.8594*

* variables in logarithmic form

United States UR-Model, 1965-1998

	Constant	Trend*	GDP*UR *	lags	UR*	lags		Residual from level model lag 1	*R* bar square	Durbin-Watson
	Coeff **(t)**		*Coeff* **(t)**		*Coeff* **(t)**					
level 1965-1998	*71.4815* **(0.8397)**	*-6.8599* **-(25.4717)**	*-2.9369* **-(21.3236)**	0-4	*2.3783* **(11.4540)**	0-13			*0.9965*	*1.9022*
first difference 1966-1998	*-0.0787* **-(0.5420)**		*-2.8774* **-(12.8942)**	0-4	*2.3785* **(9.4675)**	0-13		*-0.9812* **-(5.0539)**	*0.8458*	*1.8861*

8 Conclusions and policy implications

8.1 Interpretations of key findings

This study used cross-sectional, pooled cross-sectional time-series, and time-series regression techniques to test hypotheses that the influence of standard risk factors to health in the working age population could be found at the national level of analysis. If this were found to be true, then policy makers might be able to use the results in the formulation or alteration of occupational health policies in accordance with their measured effects on mortality. Further, the particular interest was to see whether indicators of change in the macro economy and the labour market were intrinsically related to mortality processes which could then differentiate the experience of industrialized countries. If this, in turn, could be substantiated, then mortality rates, for the major causes, could be taken as prime indicators of the effectiveness of national policy in the areas of the macro economy, labour market, social protection, the management of firms and occupational health and safety. Our principal finding is that national mortality rates are highly responsive to changes in the overall economy and the labour markets within (internal) and outside (external) small and large firms.

The most important findings were that real GDP per capita and the proportion of the population that is self-employed influence the great majority of variation in mortality rates across industrialized countries. Both of these factors are highly inversely related to age-adjusted mortality rates. The second group of economic variables influencing variation in mortality rates are the proportion of the GDP that is constituted by the shadow economy (a major risk factor to higher mortality) and economic inequality (similarly influencing higher mortality rates).

Why is real GDP per capita such an important, indeed fundamental, source of low age-adjusted mortality? Perhaps the broadest answer is that since economic growth is dependent on the development of science and technology, it is actually the development of science and technology itself that is the foundation of improved health of workers in national populations. Science and technology provides the basis of solutions to traditional and newer problems of the adaptation of persons to the bio-physical-chemical environment and the human, or built, environment. Adaptation here refers to the development of solutions to problems of survival and maintenance of functioning (i.e., “health”). The fundamental importance of the economy to health is four-fold: it provides the basis for financing (1) the transformation of the scientific, conceptual basis of adaptation into its material manifestation based on engineering, (2) the initial sources of scientific work in research and development, (3) the entrepreneurship required to bring innovations into production processes and markets and (4) consumers’ and firms’ capacity to purchase the embodiments of these innovations, both as goods and services.

Specifically, the capacity of economic growth to finance the implementation of established occupational safety and health norms is of basic significance to the health of employees. These include norms pertaining to ergonomics, toxicology, climate control, chemical risk factors (especially carcinogens) and transportation hazards. Potentially of equal importance

is the financing of medical and surgical technologies to reduce the severity of accidents or diseases originating in the workplace through (1) the development of emergency and ambulatory procedures and (2) in-hospital intensive care procedures to alleviate illness/disability and prolonged life. Further, when comparing countries it is important to bear in mind the differential access of working populations to available high-technology healthcare through the national, insured and private healthcare systems. All of these issues of employee access are again very largely a function of the wealth of societies – in their public and private sectors' capacity to finance the ability to receive care.

We have identified an essential role of GDP per capita as a prime source of the ability of societies to finance and materialize scientific and technological advances in human adaptation. Concomitant with long-term economic growth is 'economic development.' This involves the classic movement (empirically observed, though not logically necessary) of many societies in the modern era from economic emphasis on the primary and secondary to that of the tertiary sector. Most recently in the late 20th and early 21st centuries, the further development has been within the late tertiary sector into the 'knowledge' or information economy. This appears to be characterised by substantially reduced manufacturing employment in complex hierarchical organizations and the full emergence of the scientific, technical and managerial professions in addition to the retail trade and restaurant and hotel amenities of the most diverse and highly developed urban societies.

When we focus on the narrowest indicators of this development of economic sectors, we can point to the statistical power of self-employment (and family employment) as an inverse predictor of mortality. This is consistent with the large occupational epidemiological literature which cites employee autonomy as a central factor in occupational health or, more technically, the importance of worker control over the work process. More broadly, however, it is plausible to extend this interpretation to development of the advanced tertiary sector which is characterized by smaller firms that are less hierarchically structured and more flexible in terms of their capacity to adapt to competitive changes in the marketplace. It is also consistent with the description of the individual proprietorship and small firm which are regarded as the principal sources of innovation, both in themselves and in relation to larger firms.

The entrepreneurial nature of the small firm is considered, in the economics literature, to be the basis of diffusion of innovations, and this entrepreneurial role is assumed to be the basis of technological development when seen as a basic learning process for work organizations and consumers. All told, we have evidence that at least the proportional presence of individual-based and small firms are an indication of (1) employee-manager autonomy, (2) the presence of advanced tertiary sector development dominated by smaller and more flexible firms in an innovative, information society environment and (3) a competitive economy with a relatively high degree of entrepreneurship and innovation.

It appears to be true that GDP per capita and self-employment, in their intrinsic benefits to health, apply to the working life of the most advanced economies. There is also evidence that the proportionate presence of the shadow economy and income inequality, in terms of their damage to health, relate to economies with relatively low GDP per capita and therefore relatively low development of the advanced tertiary sector. All in all, then, it seems clear that

higher levels of employee health are associated, internationally with both higher levels of national income and of sectoral economic development.

These findings point to the wisdom of the European Commission in its assertion that a prime goal for the EU should be economic competitiveness. It seems clear that such competitiveness would be the basis of economic well-being and therefore occupational health as well. In promoting competitiveness with an eye to on economic productivity, there is evidence that investment in the health and safety of workers, via firm operations themselves and the healthcare system, is essential. Also of basic importance is investment in research and development and in the education ("life-long learning") of society, so that the skills of workers are able to continually match developments in the innovative economy. Finally, the support of smaller and innovative firm development should contribute to productivity and thus to employee health.

8.2 Hypothesis validation

From the macroeconomic standpoint and that of overall labour conditions, our primary hypothesis is that countries with comparatively high economic growth would be in a financial position to invest in ergonomically sophisticated machines and physical environment, emissions control within the work setting, climate and hygienic control within industry and adequate employee training to minimize accidents or other unintended exposure to industrial/occupational risks. Also such countries would have the financial means to assure a high minimal grade of healthcare under ensured conditions, thus minimizing severity of accidents and illnesses and reducing the mortality rate related to those illnesses. Finally, sustainable economic growth is the most certain inhibitor of recessions – i.e., the great sources of economic instability which both create the massive stresses of unpredictability in the workplace and the fear of loss of jobs and income.

This central hypothesis of the overarching importance of economic growth primarily indicated by GDP per capita in purchasing power parity (PPP) is the central source of health and mortality improvement in modern industrialized societies. This hypothesis has been sustained in samples of countries derived from the principal international databases provided by the World Health Organization, International Labour Organization, World Bank, OECD and Eurostat. This finding is all the more remarkable because in recent years some doubt has been placed on this hypothesis by proponents of the position that it is income inequality within countries, rather than underlying economic growth that is central to damaged population health and well-being, as well as a very recent development in the literature suggesting that, paradoxically, economic decline and unemployment are sources of underlying benefit to population health.

While economic growth is clearly the outstanding factor influencing the comparative health of industrialized nations, it is not the only major factor. We have discovered that a second factor tends largely to account for those countries for which age-adjusted mortality rates are somewhat lower than would be accounted for by economic growth alone. For example, a classic mystery among industrialized country epidemiologists is why a country like Germany with its relatively high GDP per capita, excellent medical care, and stringently controlled

occupational health policies should have a substantially higher age-adjusted mortality rate than Greece, with the opposite characteristics. Or, again, how shall we account for a country like the United States, despite the highest GDP per capita, having a lower life expectancy than France with a substantially lower GDP per capita. It appears as though we have discovered at least one of the key missing variables that would account for this paradoxical phenomenon. Our first finding along these lines was that the proportion of workers in a given country's labour force who are "contributing family workers" show a very strong inverse relationship to mortality. A follow-up, eventually the key, finding was that the self-employed as a proportion of the labour force also has a strong inverse relation to age-adjusted mortality, while, in contrast, the proportion of a country's labour force that is composed of wage and salary workers is highly positively related to age-adjusted mortality.

Based on current up-to-date work-stress theory and epidemiological studies, as well as classical studies in organizational sociology, bureaucracy, socioeconomic status, and industrial psychology, the mainstream interpretation of these findings would be that employment in highly bureaucratic and hierarchically ordered organizations comprises a principal set of risk factors to occupational and overall population health. If we are correct about this, based on our own empirical findings, then the two pillars of occupational and population health in the industrialized world are (1) a stable level of economic growth and (2) employment in institutions having a minimum of bureaucratic features and social hierarchies.

These "pillars" of the relationship between economic development and life expectancy in industrialized countries tend to account for an extraordinarily large proportion of variance in age-adjusted mortality rates across OECD and European samples of countries. There nevertheless remain a number of factors which continue to account for much of the remaining variability in age-adjusted mortality rates. One such factor, interestingly enough, is the proportion of the population employed in agriculture, which is positively related to mortality rates, in addition the proportion of the population with at least a secondary school level of education is inversely related to mortality, while the unemployment rate of the population with a secondary school education is positively related to mortality. These three factors (agricultural employment, secondary school education and unemployment rates) are significantly related to mortality holding constant the major effects of GDP per capita and the proportion of the population that is self-employed.

A somewhat different view of the importance of national economic performance for mortality can be seen in an alternative but statistically somewhat less powerful predictive model. This model would consist of GDP per capita, and labour market factors bearing on the stability of economic growth patterns. Thus increased employment per capita among the population with primary school education is related to lower mortality, whereas increased unemployment rates in the population with primary school education is positively related to mortality.

All of the above findings pertain to total mortality as well as cardiovascular mortality. We began our analyses with cardiovascular mortality since it is the most heavily cited source of illness related to occupational stress that is found in the work-stress literature. However, it can easily be inferred that many other causes of illness and death could similarly arise out of the emotional stresses of work including infections, accidents and cognitive mismanagement of work due to disturbed social relationships or use of such substances such as alcohol. We

therefore decided to take the most comprehensive view of stress-related relationships to the economy, which might be manifested in the occupational sphere, and concluded that the broadest range of medical pathologies should be kept in mind. This resulted in our examination of total age-adjusted and age-specific mortality for the whole population and each of the two sexes.

There is a second group of findings, based on historical time-series analysis, that we believe provides new insights into the importance of occupational stress. These analyses were performed for the United States, Canada, Japan and the four additional G7 countries France, Germany, Italy and United Kingdom. As in the cross-sectional analyses previously cited, GDP per capita in PPP is nearly always the most important factor in mortality decline since at least the second world war in industrialized countries. This finding is of considerable importance, given current beliefs held by many health specialists that dietary and environmental factors, which represent damaging risks to health, are actually the most important statistical determinants of a population's health. Our data indicate, on the contrary, that the sustainable trends of economic growth are the central factors which predict mortality declines in the second half of the twentieth century.

There is a very important caveat to this general conclusion about the beneficence of economic growth to health. We are now able to measure the effect of very short-term increases in economic growth as tending to exert a somewhat damaging influence on population health. This can also be seen in the occasionally negative relationship between unemployment rates and mortality within the very first year that unemployment rates increase – despite the fact that in general the medium and long-term impact of unemployment rates is to increase the mortality rates. The literature indicates several reasons for these paradoxical relationships. Best known relates to the business cycle theories of Schumpeter in which investment in innovation plays a central role. Since technological innovations are generally introduced into the economy during economic upturns, there are some adjustments necessary by the working population to changes in the technological structure, adaptational learning curves, and changes in administrative hierarchies which are classic sources of stress. But these sources of stress, relating to the "growing pains" of firms and other organizations are necessary to the medium- and long-term development of economic growth which remain the fundamental sources of expansion of life-expectation.

A second and rather obvious element of work pressure that increases in the short term due to expansion of aggregate demand is an increase in the speed, volume, intensity and hours of work. Equally noteworthy is the model of increased work stress that arises out of the concept of unemployment as a lagging business cycle indicator. In that formulation, as the economy exits from recession, with increased economic growth, employers are nevertheless unready to hire new employees (or rehire former employees) because they are not as yet getting signals that the economic upturn will be sustained. Therefore, the unemployment rate remains high during and even after economic recovery is well underway. This means that employers will wish to increase the speed and volume of work among existing employees so as not to lose orders for increased product and services. Similarly as recessions begin, with declining GDP, employers will be somewhat reluctant to dismiss large numbers of workers because they do not yet have clear signals that recession will become deeper, and they would prefer not to have to retrain employees unnecessarily lost during the recession. This

implies that productivity will fall during recessionary periods and increase as the economy moves into recovery.

8.3 Specific methodological and policy implications

1. It is feasible to identify macroeconomic indicators at the national level which can be used to describe several of the main factors which predict mortality rates in the working-age population in European countries and the remainder of the OECD.

2. While, to a large extent, it is feasible to utilise mortality rates, including by major causes of death, as measures of population health (or damage to health) associated with the economic environment, it is not yet feasible to utilise measures of the incidence or prevalence of disease or disability for these purposes.

3. Given the importance of the four main macroeconomic variables in mortality prediction, systematic attempts to evaluate the efficacy of legislative health and safety standards for national populations, must in some manner, control, adjust, or otherwise account for the effects of GDP per capita, employee autonomy, shadow economy activity and wage/status inequality.

4. Since GDP per capita is the main predictor of health (via low mortality rates) in the working population, it is evident that the European Commission is correct in emphasising international economic competitiveness, with an eye toward improved GDP per capita as a principal policy goal. This study indicates that this economic policy goal is also intrinsic to the improvement of health.

5. This study provides additional evidence that employee autonomy, the presence of relatively small firms and entrepreneurship should be encouraged in the early 21st Century economy. It is a key factor in predicting improvements in national health.

6. The shadow economy is not only a problem because it deprives governments of revenue required to support education, health care and social welfare. In itself, the extent of the shadow economy, with its lack of health and safety standards, appears to have a pronounced effect on diminishing the health of working people. National health policy would thus require efforts to minimise the size of this portion of the national economy.

7. The international epidemiological debate over whether income inequality has a damaging effect on population health is, to some degree, resolved by the data of this study. It has been found that particularly among younger males (under 45) and females of all ages, that income inequality, measured by the Gini index, is an important factor in increasing their mortality rates. The importance of the Gini index is not seen when one looks at total mortality ages 15-64, largely because males in the ages of 45-54 and 55-64, with relatively high mortality, do not display this relationship. This “uncovering” of the importance of income inequality of younger men and all age-groups of women points to the potential importance of policy action to minimise wage and job status differentials based solely on the grounds of gender and age.