Universitat Pompeu Fabra Barcelona

THE DEADLY EFFECTS OF LOSING HEALTH INSURANCE

Arnau Juanmartí Mestres
Universitat Pompeu Fabra and CRES

Guillem López-Casasnovas
Universitat Pompeu Fabra and CRES

Judit Vall Castelló
Universitat Pompeu Fabra and CRES

Barcelona

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The deadly effects of losing health insurance*

Arnau Juanmarti Mestres† Guillem López Casasnovas‡ Judit Vall Castelló§

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Abstract

In this paper, we estimate the effect of health insurance coverage on the health status of undocumented immigrants. We exploit the natural experiment that arises from a reform implemented in Spain in September 2012 that restricted access to public health care for this population. In a differences-in-differences framework, comparing undocumented immigrants with the native population not targeted by the reform, we estimate the effect of the restriction in access to public health care on the mortality rate of undocumented immigrants. The results show that, during its first three years of implementation, the restriction increased the mortality rate of undocumented immigrants by 15%, suggesting that health insurance coverage has a large effect on the health status of vulnerable populations with few alternatives of accessing health care.

JEL classification: H51; I13; J15.
Keywords: Health insurance; Undocumented immigrants; Differences-in-differences.

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†Universitat Pompeu Fabra and CRES-UPF. E-mail: arnau.juanmarti@upf.edu
‡Universitat Pompeu Fabra and CRES-UPF. E-mail: guillem.lopez@upf.edu
§Universitat de Barcelona, Institut d'Economia de Barcelona, CRES-UPF and IZA. E-mail: judit.vall@ub.edu

I. Introduction

International migration flows have increased substantially in the last decades. In 1990, there were 152 million migrants[1] in the world. This number has risen to 244 million in 2015, adding 92 million new migrants to the count (an increase of 61%). Because a major driver of migration is the lookout for better living conditions, a high proportion (64%) of this new 92 million migrants have settled in developed countries. From the 244 million migrants worldwide in 2015, 141 million lived in developed countries, accounting for 11.2% of the total population of those countries, while 103 where established in developing countries, accounting for 1.7% of their population (United Nations 2016).

Although precise estimates are difficult to obtain, several studies suggest that a considerable proportion of migrants are undocumented, that is, they live in the destination country without legal authorization to do so, as established by the regulations of the country[2]. It is estimated that from the 214 migrants in the world in 2010, between 21 and 32 million (between 10 and 15%) were undocumented (International Organization for Migration 2010), although other studies place the number in 50 million, corresponding to almost one quarter of the migrant population (United Nations Development Programme 2009). The country with the highest number of undocumented immigrants is the US, where in 2014 this population was estimated in 11.1 million, accounting for 26% of the immigrant population and 3.5% of the total population (Pew Research Center 2014). In the European Union (EU27), the estimates indicate that in 2008 there were between 1.9 and 3.8 million undocumented immigrants, corresponding to 7-13% of the immigrant population and 0.39-0.77% of the total population (CLANDESTINO 2009). Other studies estimate that among the immigrant population, 64% is undocumented in Southern and Eastern Mediterranean countries (Fargues 2009), 30% in Thailand (Huguet et al. 2012), 45% in South Africa and as much as 98% in Kazakhstan (Sabates-Wheeler 2009). For all developing countries, estimates indicate that about one-third of all migrants are undocumented (United Nations Development Programme 2009).

This increase in migration flows and the challenges it poses to destination countries has placed immigration issues to the forefront of the political debate in many developed

[1]Migrants refer to persons living in a country other than the one in which they are born, or, in the absence of such information, to persons with foreign citizenship.

[2]In the literature, undocumented immigrants are also referred to as unauthorized immigrants, irregular immigrants or illegal immigrants.

countries. There are concerns among the population that the arrival of new migrants displaces native workers and reduces their wages, or that new migrants impose a fiscal burden to the public accounts. In response to this concerns and probably with the intention to deter the arrival of new migrants, many countries restrict the access of undocumented immigrants to public programs, restrictions that have reached important components of the welfare state such as the health care system. In the US, undocumented immigrants are not eligible for Medicaid and Medicare, the two main public health insurance programs in the country, and they are restricted from participating in the state exchange insurance market places implemented by The Patient Protection and Affordability Care Act (Edward 2014).

Access to the health care system for undocumented immigrants is also restricted in the European Union. In a comparative study of national policies implemented in the 27 European Union Member States, Cuadra (2011) finds that only in 5 countries undocumented immigrants are granted access to the public health care system in the same conditions as natives and regular immigrants (including primary, secondary and emergency care). In 12 countries, undocumented immigrants are only entitled to receive emergency care, while in the remaining 10 countries even access to emergency care is restricted.[3] While in this paper we are mainly interested in the consequences of eligibility to public health insurance (or health insurance coverage, more generally), it is worth noting that undocumented immigrants often face other barriers in their access to health care as a consequence of their immigrant status or their irregular situation. In a review of literature, Hacker et al. (2015) document many studies identifying several barriers to access, including (apart from lack of insurance coverage) paperwork or other bureaucratic obstacles to access health care even if access is entitled legally, discriminatory practices within the health care system, fear of deportation, communication problems or experience of shame or stigma.

In theory, one would expect that health insurance coverage results in improvements of health. From an individual point of view, health insurance would increase the utilization of health care, which in turn would positively affect health. However, not all health

[3]In the study, access to health care is mainly defined as legal entitlement to receive care as stipulated in the regulations of the respective public health care systems. However, affordability is also taken into account. That is, access is considered restricted if it is conditional on paying such a large part of the cost that health care is inaccessible in practice.

care interventions necessarily lead to health improvements (Fisher 2003), and health insurance can induce risky health behaviors (Dave and Kaestner 2009; Dave et al. 2015), factors that underscore the importance of undertaking empirical evaluations in order to know if health insurance actually results in improvements in the health of the individuals covered. There is, indeed, an extensive literature evaluating the effects of health insurance coverage on health, mainly centered in exploiting expansions in coverage of the main health insurance programs in the US (Medicaid and Medicare). Although many of those studies find positive effects on the health of the populations affected, other studies do not, which makes it difficult to draw definitive conclusions about the effect of health insurance on health.

A main argument given in the literature for the existence of conflicting results is that the effect of health insurance coverage expansions depends on the characteristics of the population groups affected by those expansions (see Levy and Meltzer 2008, Courtemanche et al. 2017 and Sommers et al. 2017 for reviews and discussions of the literature). This observation is especially relevant in our case, because the undocumented immigrant population (and the immigrant population more generally) is known to be different than the native one in important dimensions. Immigrants are usually younger, they are healthier upon arrival to the destination country (Antecol and Bedard 2015) and they consume less health care (Sarría-Santamera et al. 2016). Furthermore, the undocumented status may affect their use of health care services and other public programs because of fear of disclosing their irregular situation. These differences prevent extending to the immigrant population (irregular or not) the conclusions of previous studies analyzing the effect of health insurance on the health of other (natives) populations, studies that are mainly focused on specific native population subgroups (infants, pregnant women, the elderly, or the poor).

To the best of our knowledge, this is the first paper that estimates the effect of health insurance on the health of the undocumented immigrant population (or the immigrant population). To that end, we exploit the introduction of a reform implemented in Spain in September 2012 that restricted access to the public health system to the undocumented immigrant population. We estimate the effect of the restriction on the mortality rate of undocumented immigrants by comparing the mortality pattern of undocumented immigrants and the native population not targeted by the reform in a differences-in-differences framework. Our results show that the restriction in public health insurance coverage has resulted in a significant and large increase in the mortality rate of the undocumented immigrant population targeted by the reform. We estimate that during its first three years of implementation, the introduction of the restriction has increased the monthly mortality

rate of undocumented immigrants by 15% with respect to the pre-reform level, which corresponds to an additional 70 deaths per year as a result of the reform. Reasonably, the effect increases with time after implementation, with an increase of 22.6% in the third year. We also show that the effects of the restriction are higher for amenable mortality, defined in previous research as deaths from causes that should not occur in the presence of timely and effective interventions.

Finally, the results are robust to several robustness checks designed to deal with the potential presence of selective migration induced by the reform. Furthermore, the use of an alternative identification strategy exploiting variation in the pre-reform proportion of undocumented immigrants yields similar results, granting credit to the robustness of our identification strategy. The strong mortality effects of the restriction in public health insurance coverage are consistent with a recent paper evaluating the same reform that reports important reductions in planned care by undocumented immigrants after the reform as well as decreases in satisfaction with emergency care services by the same group (Jiménez-Rubio and Vall Castelló 2018).

The rest of the paper is organized as follows. Section II outlines the characteristics of the reform that restricted access to health care for undocumented immigrants. Section III describes the data and the identification strategy used to estimate the effect of the restriction, and Section IV presents the results of the estimation. In Section V we estimate the effect of the reform using an alternative identification strategy. Section VI concludes.

II. The 2012 Spanish Health Reform

The Spanish National Health System offers free access to a comprehensive package of services and benefits covering primary care, specialized care and emergency care. It is funded almost entirely with taxes. Since 2002, the system is highly decentralized to the 17 Spanish regions (Autonomous Communities[4]), which are in charge of the management and provision of health care in their territories, and in designing and implementing legislation binding in the respective regions. Among other functions, the national government is in charge of designing and implementing national legislation applying to all regions and of undertaking the general coordination of the system. Until 2012, the cover-

[4]Autonomous Communities are the 17 administrative units corresponding to the first level of regional decentralization in Spain.

age of the system was universal. All the Spanish population was entitled by law to receive free access to the system irrespective of personal wealth, labor status or administrative situation. In particular, undocumented immigrants were entitled to the same bundle of services as Spanish natives with the only requirement of being registered as residents in a municipality. This administrative procedure is relatively simple, requiring only for the individual to document his/her place of residence in the municipal register, and it resulted directly in the person receiving a health card, the document that grants direct access to the health system[5].

In 2012, with the stated intention of saving resources and dissuading "health tourism", the Spanish government implemented a reform of the health system with the approval of the Royal Decree 16/2012, which came into effect in September 1, 2012. The reform restricted free access to the health care services for the population of undocumented immigrants, changing the universal nature of the system. In particular, the reform established that, from that point onwards, immigrants had to be in a possession of an official residence permit to reside in Spain in order to be granted access to the system. To obtain a residence permit, the immigrant has to demonstrate that he/she is working regularly on his own or for an employer, or otherwise demonstrate that he has sufficient resources to cover the living expenses during his stay in the country. Undocumented immigrants were restricted access to all the services offered by the National Health System, with three exceptions: (1) Emergency care in the case of serious illness or accident, whichever the cause, until discharge; (2) Health care during pregnancy, birth and postpartum; and (3) Health care for individuals under 18 years old in the same conditions as Spanish natives.

A precise figure of the number of individuals that have been restricted access to the health system as a result of the reform is difficult to obtain. In a study funded by the European Commission (González-Enríquez 2009), the author estimates the number of undocumented immigrants living in Spain each year during the period 2001-2008. From 260645 undocumented immigrants living in Spain in 2001, the number increases substantially until a pick of 1231751 persons in 2005. From this point, it decreases gradually until an estimated 353927 persons in 2008, a reduction due to a general regularization implemented by the government in 2005, the accession of Romania and Bulgaria to the

[5]The registration in the municipal register (Padrón, in Spanish) is mainly used as the official census of individuals in Spain, from which official population statistics are derived. Apart from guaranteeing access to health care, the registration also entitles undocumented immigrants to public education.

EU in 2007, stricter visa requirements for Latin-American immigrants and more intensive repatriation policies. Unfortunately, we have found no estimates of the number of undocumented immigrants in Spain after 2008. However, and although the Spanish government has been reticent in providing this type of information, it stated in a parliamentary response issued on November 15th 2013 (one year and two months after the implementation of the reform) that 748835 health cards had been withdrawn because "(the person) was not residing in Spain when it was verified". In the "Spanish Program of National Reforms 2013", a document that the Spanish government sends yearly to the Council of the European Union and to the European Commission explaining the reforms implemented by the government, it is explicitly stated that with the implementation of the Royal Decree 16/2012 and with the intention of "avoiding fraud regarding the obtainance of the Spanish health card", 873000 health cards of foreigners not residing in Spain had been withdrawn. This last number represents a 13.87% of the immigrant population in Spain in 2012 and a 1.86% of the total population. Some regional authorities tried to introduce a counter-balancing regional law granting access to the health care system for undocumented immigrants. However, as we are interested in the effects of the restriction on a strong health outcome, such as mortality, and as individuals can move throughout the Spanish territory, we focus on the impact of the reform on the entire territory.

III. Data and Identification Strategy

A. Data

We use the *Death Statistics by Cause of Death*, a dataset provided by the Spanish National Institute of Statistics, which registers all deaths occurred in Spain. We use data from the years 2009-2015, a period spanning several years before and after the reform, implemented in September 2012. For each individual death, the dataset contains information on the date of death, the cause of death, the nationality and country of birth of the individual, his/her gender, age and date of birth, and the Spanish region where the death occurred. We compute the mortality rate in each region and time period (at the year-month level), for both the native population (our control group in the differences-in-differences framework) and the undocumented immigrant population (the treatment group). To compute the mortality rates, the corresponding population numbers for each cell are extracted from official population statistics provided by the Spanish National Institute of Statistics.

As is the case with most official datasets, the mortality registers (and the population statistics) do not provide information on the immigrant administrative status. Therefore,

we use nationality to identify the condition of undocumented of the individual, as is usually done in the literature (see, for example, Amuedo-Dorantes and Lopez 2015). In particular, our treatment group consists in individuals whose nationality is of one of the countries in Africa, Center or South America and Asia, which are the nationalities with a higher proportion of undocumented among the immigrant population in Spain (see Gonzàlez-Enríquez 2009). The control group is conformed by individuals with Spanish nationality. Because the undocumented immigrant population is much younger than the native one (with a very low proportion of elder individuals), we restrict both groups to individuals under 65 years old to make the mortality patterns of both groups more comparable.

B. Identification Strategy

Our objective is to estimate the effect of the restriction in access to public health insurance on the mortality rate of the undocumented immigrant population affected by the restriction. To that end, we compare the evolution of the mortality rates between natives and undocumented immigrants before and after the reform in a differences-in-differences regression framework. We estimate differences-in-differences regressions of the form:

$$Y_{tru} = \beta_0 + \beta_1 UndocImm_{tru} + \beta_2 After_{tru} + \beta_3 UndocImm_{tru} * After_{tru} + \beta_4 X_{tru} + \delta_t + \alpha_t + \lambda_r + \upsilon_{tru} \quad (1)$$

Where subscript t refers to a specific time period (year-month), subscript r to a specific region and subscript u to undocumented immigrants (as opposed to natives). Y_{tru} is the mortality rate for each time period, region and undocumented immigrant status. $UndocImm_{tru}$ is a dummy variable equal to 1 for undocumented immigrants and equal to 0 for natives, $After_{tru}$ is a dummy variable equal to 1 for observations after the implementation of the reform in September 2012 and equal to 0 for observations before the reform. We include time fixed effects at the year level (δ_t) to control for national time effects. We also include monthly dummies (α_t; twelve dummies, one for each month) to control for the monthly seasonality in the mortality rates. λ_r are region fixed effects that control for fixed differences across regions. We also include a vector of controls that vary across time, region and undocumented immigrant status (X_{tru}), which includes the unemployment rate, the proportion of individuals in the services sector, the proportion of high skilled individuals, the proportion of individuals with superior education and the

proportion of married individuals. In most specifications, we also include region specific linear trends. υ_{tru} is the error term. To deal with serial correlation within regions present in differences-in-differences estimates in samples with few regions, standard errors are calculated using the cluster wild bootstrapping methods proposed in Cameron et al. (2008).

Our coefficient of interest is β_3, which measures the differential effect in the mortality rate between undocumented immigrants and natives that results from the implementation of the reform. Under the assumption that the mortality rate of undocumented immigrants and natives would have followed the same parallel trend after the implementation of the reform if the reform had not been implemented, and under the assumption that there are no other changes differentially affecting undocumented immigrants and natives occurring at the same time as the reform, β_3 measures the causal effect of the restriction in access on the mortality rate of the undocumented immigrant population.

IV. Results

A. Base Results

To provide preliminary descriptive evidence on the effects of the reform, Figure 1 shows the evolution of the mortality rates of natives and undocumented immigrants during the analysis period 2009-2015, spanning several years before and several years after the implementation of the reform in September 2012 (indicated with a vertical line). The figure shows yearly mortality rates expressed as deaths per 100000 individuals. Different axis are provided for the two populations to facilitate visualization, as the mortality rate is higher for natives. To alleviate concerns that the mortality patterns we observe are driven by cultural differences of some particular immigrant group, the figure is provided for different undocumented immigrant groups in terms of nationality (Africans, Center-South Americans and Asians), which are the immigrant groups with higher proportions of undocumented immigrants.

Figure 1.A shows the mortality patterns for natives and the group of undocumented immigrants that includes all three groups of nationalities. The Figure provides convincing preliminary evidence that the reform has had a positive effect on the mortality rate of undocumented immigrants. Before the implementation of the reform, the mortality of natives and undocumented immigrants follow a parallel decreasing trend. The implementation of the reform has no effect on either the level or the trend of the mortality of natives, which keeps decreasing. To the contrary, the mortality of undocumented immigrants reverses the downward trend and starts increasing just after the implementation

of the reform. Furthermore, the timing of increase is consistent with what we would expect, with the effects on mortality resulting from interruptions of treatment increasing with time. Reassuringly, although with minor differences, this pattern is the same when we differentiate by nationality groups, which provides evidence that the behavior of the mortality rate is not driven by cultural characteristics of some particular group.

Table 1 provides the results of the estimation of the differences-in-differences models (equation 1). Regressions are provided for the group of undocumented immigrants that includes the three groups of nationalities and for each of the nationality groups. The dependent variable is the monthly mortality rate per 100000 persons. The table reports the differences-in-differences coefficient, which measures the effect of the restriction on the monthly mortality rate. We also report the monthly mortality rate of undocumented immigrants for the pre-reform year 2011, and the percentage change the effect represents with respect to the pre-reform level. To check the robustness of our identification strategy, we show different estimates progressively adding additional sets of covariates. Columns 1 through 4 show the regressions including fixed effects at the year, month and region level. Columns 5 through 8 add the controls of the vector X_{tru} (see above), and columns 9 through 12 add region specific linear trends.

Reassuringly, the inclusion of the controls in the vector X_{tru} and the region specific linear trends has, in general, little impact on both the significance and magnitude of the coefficients, providing evidence that there are not unobserved factors biasing the coefficients, and therefore strengthening the causal interpretation of the estimates. In the rest of the paper, therefore, unless otherwise indicated, all regressions presented will include fixed effects, the controls in the vector X_{tru} and region specific linear trends.

Overall, the results indicate a strong and significant positive effect of the introduction of the restriction on the mortality rate of undocumented immigrants. For the regression including all three groups of undocumented immigrants (column 9), the differences in differences coefficient indicates that, in the three years from its implementation in September 2012, the reform has increased the monthly mortality rate of undocumented immigrants by 0.66 deaths per 100000 persons, with the coefficient significant at the 1% level. This effect corresponds to an increase of 15% in the pre-reform monthly mortality rate. The effect of the reform is highly significant and also large in magnitude for the three groups of nationalities, a fact that provides evidence that the effect is not driven by cultural characteristics of some immigrant population subgroup. The coefficient is significant at the 1% level for Africans and Center-South Americans, and significant at the 5% level for Asians. The reform increases the monthly mortality rate of Africans by 16.69% with respect to the pre-reform level, by 23.42% for Center-South Americans and

by 30.40% for Asians.

A simple back of the envelope calculation will facilitate the interpretation of the magnitude of the effect. As the restriction in access to the health system has affected about 873000 individuals (see Section II), the estimated effect of 0.6645 deaths per 100000 individuals each month corresponds to an effect of about 6 deaths each month, or about 70 deaths each year. That is, the estimates suggest that, since its implementation in September 2012, the reform has resulted in about 70 additional deaths per year.

In order to explore the heterogeneity of the effect, we present the results differentiated by three different age groups (ages 0-19, ages 20-39 and ages 40-64). Also importantly, the restriction of access to the system does not apply to individuals under 18 years old, so we would expect a lower or no effect for this age group. These results are presented in Table 2. Reassuringly, there is no effect of the reform in the 0-19 age group, as we would expect. Also coherently, the effect is higher for older individuals, for whom one would expect interruptions of treatment to have a higher impact on their health. For the 20-39 age group, the restriction in access to health care has increased their monthly mortality rate by 16.49% with respect to the pre-reform rate, significant at the 5% level. The effect for the 40-64 age group is of 19.89%, significant at the 1% level.

B. Parallel Trend Assumption and Timing of Effects

To ensure that the results are not driven by other factors differentially affecting natives and undocumented immigrants and to investigate the time pattern of the effects, we augment the differences-in-differences regression with leads and lags before and after the implementation of the reform. In particular, we estimate regressions of the form:

$$Y_{tru} = \beta_0 + \beta_1 UndocImm_{tru} + \sum_{i=-2}^{3} \alpha_i Year(i)_t + \sum_{i=-2}^{3} \theta_i UndocImm_{tru} * Year(i)_t + \beta_4 X_{tru} + \delta_t + \alpha_t + \lambda_r + \upsilon_{tru} \quad (2)$$

Where $Year(i)$ is the ith year before/after the implementation of the reform. The other covariates are the same as in equation 1, including here the whole set of covariates (fixed effects, the controls in the vector X_{tru} and region specific time trends). Although we include month dummies, leads and lags are specified with years to ensure the results are not driven by monthly seasonality in the mortality rates. We have set the base year (omitted in the regression) in the year 3 before the implementation of the reform. The coefficients on the interaction terms between $UndocImm_{tru}$ and each of the years (the

θ_i), therefore, measure that year's increase in the difference in mortality rates between undocumented immigrants and natives with respect to 3 years before the implementation of the reform. The years go from 3 years before implementation to 3 years after. The regressions are reported in Table 3, which shows only the coefficients on the interaction terms. To facilitate visualization, Figure 2 shows a plot of the coefficients with 95% confidence intervals. The figure also reports, for each year, the percentage change in the mortality rate with respect to the base year (3 years before the implementation of the reform).

For the group of undocumented immigrants that includes the three groups of nationalities, the pattern of coefficients (Figure 2.A) is clear. The coefficients for the two years before the implementation of the reform are not statistically different from 0, which indicates that the mortality of natives and undocumented immigrants follow a parallel trend before the introduction of the reform. The coefficient turns and remains highly significant at the year of introduction and the magnitude of the coefficient also increases substantially and remains at this higher level since the introduction year. Overall, this results provide evidence that there are no other unobserved factors differentially affecting the mortality of natives and undocumented immigrants and that the effects we find are the result of the implementation of the reform. The timing in the magnitude of the coefficients is also consistent. Arguably, one would expect that an interruption in treatment takes some time to result in death in the majority of diseases, which is what the results indicate. In the first and second years after its introduction, the restriction in access to health care increases the mortality rate of undocumented immigrants by 16.82 and 15.08%, respectively. The effect is higher in the third year, with an increase of 22.6%. The time pattern of coefficients for each of the three groups of nationalities, although with minor differences, is the same as for the three groups together.

C. Selective Migration

Although the previous results provide evidence in favor of our identification strategy, there is one factor that could be biasing our results. It may be the case that the restriction in access to health care is inducing some undocumented immigrants to migrate to neighboring countries or to their countries of origin in the lookout for better access to health care. If this is the case, and this migration is related with their health condition, this phenomena could be biasing our estimates. In this section we perform several robustness checks to study this possibility. First, we estimate the same type of differences-in-differences models using the log of population as the dependent variable. That is, we study if the reform has induced a differential change in the population of undocumented

immigrants with respect to the population of natives. Table 4 shows the results of this estimation. Odd columns present the regressions with log(population) as the dependent variable for each of the groups of nationalities. Even columns present the differences-in-differences estimates for the change in mortality rates (the same base results of Section IV.A).

In columns 1 and 5, we see that for all groups together as well as for Center-South Americans, there is indeed a differential change in population as a result of the reform, with the population of undocumented immigrants decreasing more (or increasing less) than the population of natives. For Africans and Asians (columns 3 and 7, respectively), however, there is no significant differential change in population. Importantly, in these two cases, the effect of the reform on the mortality rate is strong. That is, it seems that for these two groups of nationalities there is no differential change in the population of undocumented immigrants and natives, and at the same time there is an effect of the reform in the mortality rate, suggesting that the effect on mortality is not driven by selective migration.

Finally, we make and hypothetical exercise and study what would have been the effect of the reform if it had not induced undocumented immigrants to migrate. In particular, we calculate the population of undocumented immigrants after the reform applying the same (mean) percentage change of the six months before the reform, and estimate the differences-in-differences models using this predicted population. Figure 3 shows a graph of the actual population of both native and undocumented immigrants, together with the predicted population of undocumented immigrants after the reform. Assuming that the changes in the trend of the population of undocumented immigrants after the reform are only the result of migration induced by the reform, estimating the differences-in-differences models with this predicted population would give as an estimate of the effect of the reform in the absence of (selective) migration. Table 5 shows the result of this estimation.

In general, the coefficients are less statistically significant and of a lower magnitude. Note, however, that we are making here an strong assumption. We are assuming that all the changes in the population of undocumented immigrants after the reform are the result of migration induced by it. But, of course, there may be other factors not related with selective migration that induce changes in the population of undocumented immigrants after the reform. Even with this strong assumption, the estimates in Table 5 also show an effect of the reform on the mortality rates. Although the effect is not significant for the group including all nationalities, it is still significant for each of the groups of nationalities, although the size of the effect is smaller than with the actual population.

Overall, the results in this section suggest that although selective migration may be causing some bias in our results, large part of the effect on mortality cannot be explained by it, providing further credit for the causal interpretation of the effects presented in the previous sections.

D. Cause of Death: Amenable Mortality

Amenable mortality[6] is generally defined as "deaths from causes that should not occur in the presence of timely and effective interventions" (Holland et al. 2009). It has been used in previous studies mainly as a measure of the performance of the health system (see, for example, Nolte and McKee 2008, 2011). In those studies, which compare amenable mortality over time or between countries, the idea is that the performance or quality of a health system can be measured by the amount of deaths that can be avoided if timely and effective medical care is available.

In our study, if the effects that we find are indeed attributable to a lack of health care access (a lack of health insurance), we should find that the effects are stronger for conditions in which timely and effective medical care has a larger impact on mortality, that is, we should find that the effects are stronger for amenable mortality. This is precisely what we study in this section[7]. Using the International Classification of Diseases (ICD), we use the classification of diseases elaborated in Sommers et al. (2014) to distinguish causes of death between those (more) amenable to health care and those (less) amenable to health care, and estimate the differences-in-differences models separately for these two types of causes of death[8]. In each case, mortality rates are computed as the number of deaths due to the specific conditions (more amenable or less amenable conditions) divided by the total population. Table 6 shows the result of the estimation, where Panel A shows the regressions for more amenable mortality and Panel B for less amenable mortality.

Overall, the results show that the reform has a higher impact for more amenable mortality. For the group including all nationalities of undocumented immigrants, the restriction in access to health care increases the mortality rate of undocumented immigrants

[6] Also termed avoidable mortality, treatable mortality or preventable mortality in the literature.

[7] Sommers (2017) finds that the reduction of mortality that resulted from Medicaid expansions in the 2000s was indeed larger for amenable causes.

[8] The detailed list of conditions classified as (more) amenable to health care can be found in Table 1 of the Supplement of Sommers et al. (2014). All conditions not appearing in this list are classified as (less) amenable to health care.

by 17.26%, significant at the 5% level, while the effect for less amenable mortality is of 12.62%, also significant at the 5% level. This higher effect for more amenable mortality is present for each of the groups of nationalities. The results, therefore, provide clear evidence that the reform has resulted in a higher increase for mortality resulting from causes of death more amenable to health care, as we would expect[9].

V. Alternative Specification: Pre-reform Proportion of Treated

In this section, we use an alternative source of variation to identify the effect of the reform on the mortality of undocumented immigrants. In particular, we exploit variation over the different regions in the proportion of undocumented immigrants before the reform (in the proportion of treated individuals, or, more precisely, in the proportion of individuals that will become uninsured once the reform is implemented). Arguably, a higher proportion of individuals that become uninsured after the implementation of the reform should be associated with a higher mortality rate. A similar strategy, using pre-reform uninsurance rates, has been used in studies evaluating the effect of health insurance in the US (Finkelstein 2007; Finkelstein and McKnight 2008; Miller 2012; Sommers et al. 2014; Sommers 2017; Courtemanche et al. 2017).

Table 7 shows the proportion of undocumented immigrants out of the total population of immigrants in each region in the year 2012 (the reform is implemented in September 2012). The proportion of undocumented immigrants varies from a minimum of 44% in the region with a lower level to a 73% in the region with a higher level. Exploiting this variation, we estimate regressions of the form:

$$Y_{tr} = \beta_0 + \beta_1 PropUI_r + \beta_2 After_{tr} + \beta_3 PropUI_{tr} * After_{tr} + \beta_4 X_{tr} + \delta_t + \alpha_t + \lambda_r + \upsilon_{tr} \quad (3)$$

Where Y_{tr} is the mortality rate of (total) immigrants in period t and region r, $PropUI_r$ is the proportion of undocumented immigrants in region r in the pre-reform year 2012, $After_{tr}$ is a dummy variable equal to 1 for observations after the reform, X_{tr} is a vector

[9]In Appendix Table A1 we present the differences-in-differences estimates for each specific cause of death in the International Classification of Diseases (ICD 10). Results of diseases for which there are less than 2% of deaths in our sample are not shown.

of covariates (including the same covariates as in the specification explained in Section B), δ_t are year fixed effects, α_t are month dummies, λ_r are region fixed effects and υ_{tr} is an error term. As before, standard errors are clustered within regions using the method of wild bootstrapping proposed in Cameron et al. (2008). Apart from using the continuous variable $PropUI_r$, regressions will be estimated also using a binary indicator taking the value 1 for the 5 regions with the highest pre-reform proportion of undocumented immigrants and the value 0 for the 5 regions with the lowest pre-reform proportion (see Table 7). Our coefficient of interest (β_3) measures the effect of the reform (induced by increases in the proportion of treated individuals) on the mortality rate.

Note that this identification approach offers one important advantage over the one used in the previous sections. Arguably, the pre-reform proportion of undocumented immigrants is not related with factors differentially affecting undocumented immigrants and natives, and therefore in this case the proper identification of the effects does not depend on the omission of this type of factors. Therefore, the results from this estimation serve as a robustness check for the proper identification using the previous strategy.

Results are presented in Table 8. Columns 1 and 2 show the regressions for the continuous and for the binary indicator of pre-reform treatment rates, respectively. Columns 3 and 4 present the same regressions but adding the vector of controls X_{tr}. In each case, we show the percentage change the effect represents with respect to the pre-reform mortality rate. First of all, we see that the inclusion of the vector of controls X_{tr} changes minimally the significance and magnitude of the coefficients of interest, reinforcing the causal interpretation of the effects. For the continuous variable (column 3), a 1 pp increase in the proportion of treated results in a 0.70% increase in the pre-reform mortality rate, significant at the 10% level. For the binary case (column 4), being in a region with a high proportion of pre-reform treated individuals results in an increase of 17.09% increase in the pre-reform mortality rate, significant at the 5% level, an effect that is comparable in significance and magnitude to the effect found with the previous identification strategy (Table 1).

Finally, we make a slight variation to this identification approach of using the pre-reform proportion of treated individuals, and instead of using variation over region in the pre-reform proportion of undocumented immigrants, we use variation over the nationality of the immigrant. We collapse the data by time and nationality and estimate regressions of the form:

$$Y_{tn} = \beta_0 + \beta_1 PropUI_n + \beta_2 After_{tn} + \beta_3 PropUI_{tn} * After_{tn} + \delta_t + \alpha_t + \lambda_n + \upsilon_{tn} \quad (4)$$

Where Y_{tn} is the mortality rate in period t for nationality n, $PropUI_n$ is the proportion of undocumented immigrants for nationality n in the pre-reform year 2011, $After_{tn}$ is a dummy variable equal to 1 for observations after the reform, δ_t are year fixed effects, α_t are month dummies, λ_n are nationality fixed effects and υ_{tn} is an error term. Standard errors are clustered within nationality. Regressions are estimated using the continuous variable $PropUI_{tn}$ and also using two indicator variables. The first one takes the value 1 for nationalities that have more than 60% of undocumented immigrants and the value 0 for nationalities with less than 40% of undocumented immigrants. The second one takes the value 1 for nationalities with more than 50% of undocumented immigrants and the value 0 for nationalities with less than 50%. As in the previous case (equation 3), our coefficient of interest (β_3) measures the effect of the reform (induced by increases in the proportion of treated individuals) on the mortality rate.

To compute the proportion of undocumented immigrants for each nationality, we have followed the same method as in González-Enríquez (2009)[10]. We have calculated the proportion of undocumented immigrants for 67 nationalities, which are presented in Table 9. The percentage of undocumented for immigrant nationalities goes from a 0.8% for Gambia to a 84.7% for Ethiopia. We impute a 0% for individuals with Spanish nationality.

Table 10 shows the results of the estimation. Column 1 shows the regression estimated with the continuous variable and columns 2 and 3 the regressions estimated with the indicator variables. Apart from the coefficient of interest, we also show the percentage change the effect represents with respect to the pre-reform mortality rate. For the continuous case (column 1), a 1 pp increase in the pre-reform proportion of undocumented immigrants is associated with a 0.88% increase in the mortality rate, significant at the 1% level. Note that this effect is very similar in magnitude to the effect found

[10]To calculate the percentage of undocumented immigrants for each nationality, we collect data on the number of individuals (for each nationality) that have a residence permit to stay in Spain in 2011 (that we derive from the Ministry of Employment and Social Security). Also for each nationality, we collect from the census the number of individuals living in Spain in 2011. To compute the percentage of undocumented immigrants in 2011 for each nationality, we then subtract the number of individuals with a residence permit from the total number of individuals living in Spain and we divide the result by the later.

when using variation over region (Table 8). In column 2 we see that having a nationality with a percentage of undocumented immigrants over 60% is associated with a 37.98% higher increase in the pre-reform mortality rate than having a nationality with a proportion of undocumented immigrants below 40%, significant at the 10% level. The effect is practically the same in magnitude for the indicator variable of 50% vs. 50%, in this case significant at the 5% level.

Overall, the results in this section show that we also find significant mortality effects of the reform when exploiting variation in the pre-reform proportion of undocumented immigrants (a variable that we can interpret as a form of treatment intensity), which gives further credence to the causal interpretation of our estimates.

VI. Conclusions

The unprecedented increase in international migration flows over the last decades has placed immigration issues at the forefront of media coverage and political debates of destination countries, with the debate often focused on the potential negative consequences of immigration for the labor market prospects of the native population or its negative effect on the public accounts. In this context, many governments in developed countries are implementing restrictions in access to public health care for undocumented immigrants, with little knowledge on the consequences that these type of restrictions in health insurance coverage can have on the health status of a vulnerable population such as the immigrant one.

In this paper, we estimate the effect of health insurance coverage on the health status of undocumented immigrants by exploiting a reform implemented in Spain in September 2012 which restricted access to public health care for the population of undocumented immigrants. Using a differences-in-differences framework, we compare undocumented immigrants with the native population not targeted by the reform to estimate the effect of the restriction in access to health care on the mortality rate of undocumented immigrants. Our results show that the restriction resulted in a large and significant increase in the mortality rate of the population affected. In particular, we estimate that the reform increased the mortality rate of undocumented immigrants by 15% during its first three years of implementation, an effect that corresponds to 70 additional deaths per year as a result of the reform. We also show that the effects of the restriction in access to health care are higher for deaths considered amenable to health care, that is, deaths defined by previous research as those that would not occur in the presence of timely and effective medical care.

Reasonably, our analysis shows that the effects of the reform on mortality increase with respect to time after implementation, suggesting that long term effects are important. In this sense, it is important to note that we are only able to study the effects of the reform for a span of three years after implementation, and that a more complete picture of the effects would require a longer time span.

Overall, these results suggest that health insurance coverage can have large impacts on the health status of vulnerable populations with few alternatives to access health care, and provide evidence that restrictions in public health insurance coverage specifically targeted to the immigrant population have strong negative consequences for their health.

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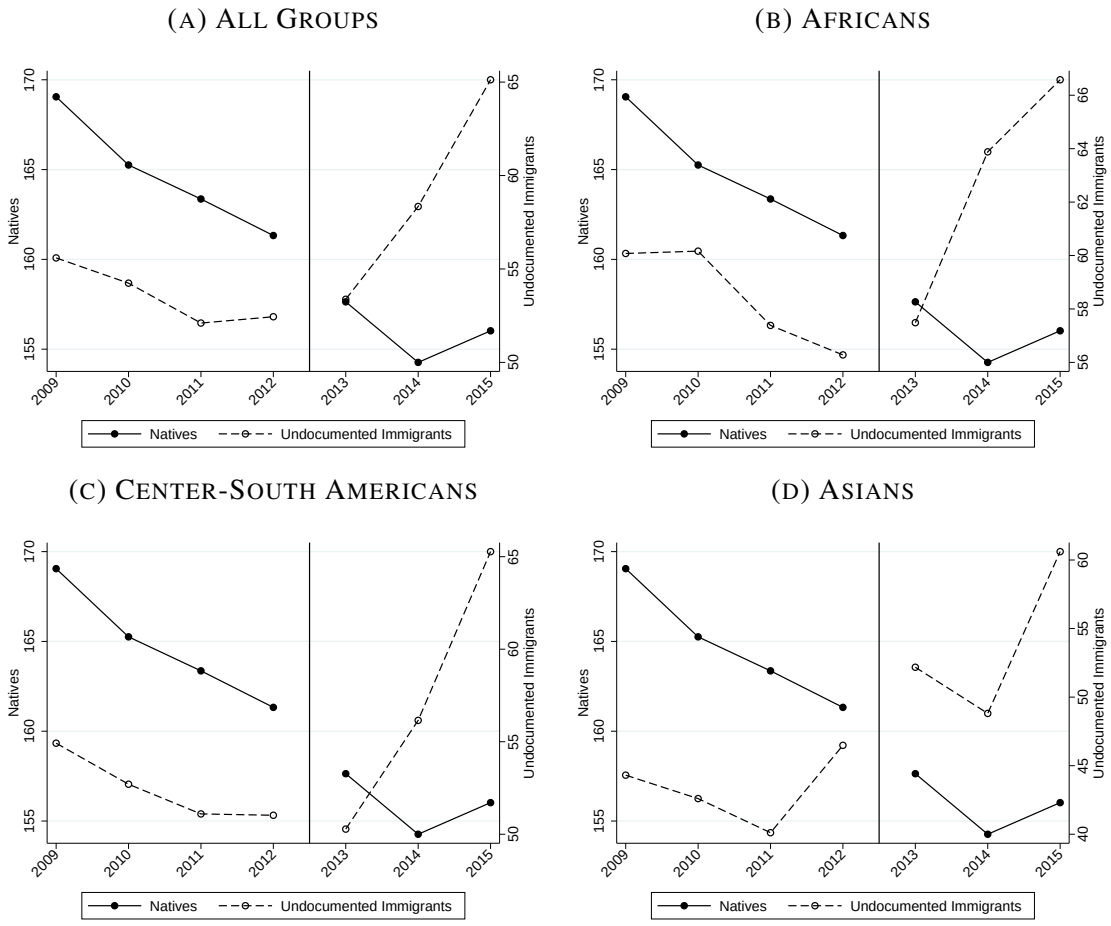
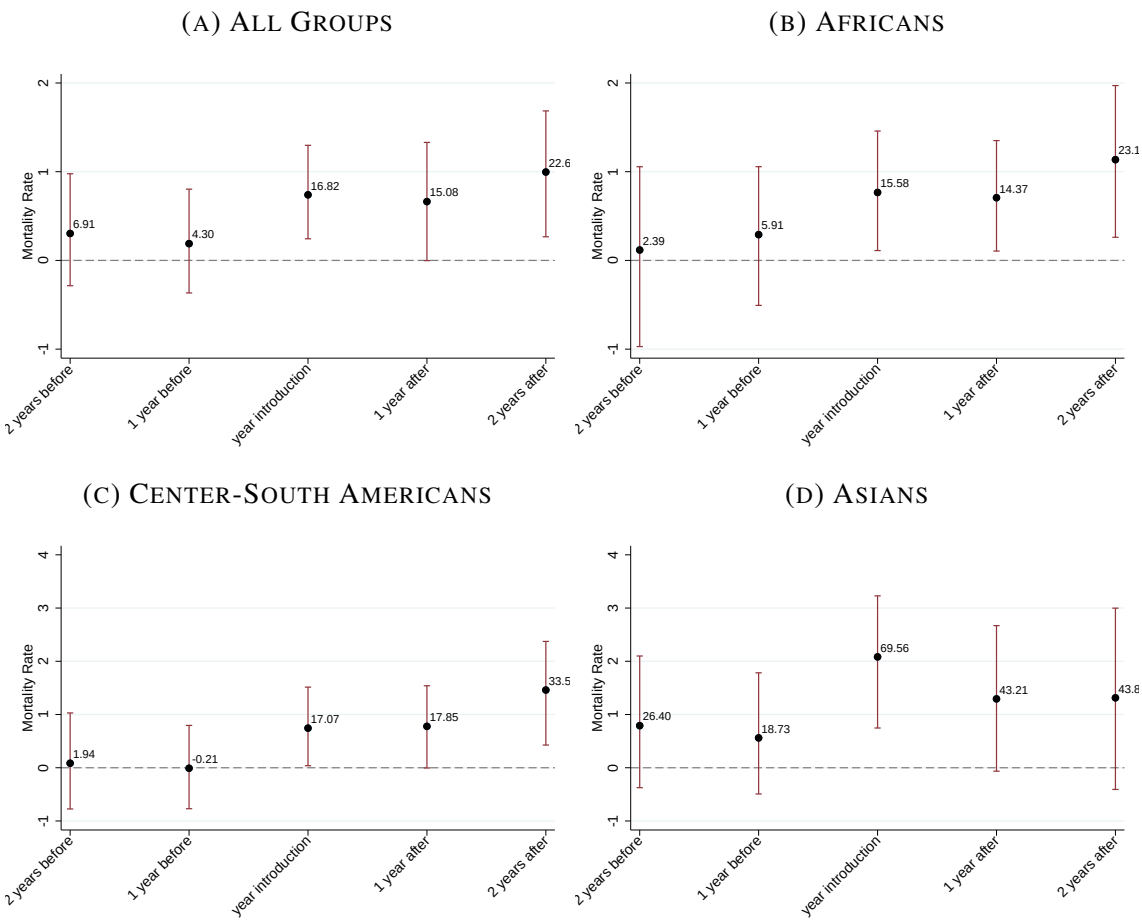
Figures and Tables

FIGURE 1—EVOLUTION OF MORTALITY RATE FOR UNDOCUMENTED IMMIGRANTS AND NATIVES



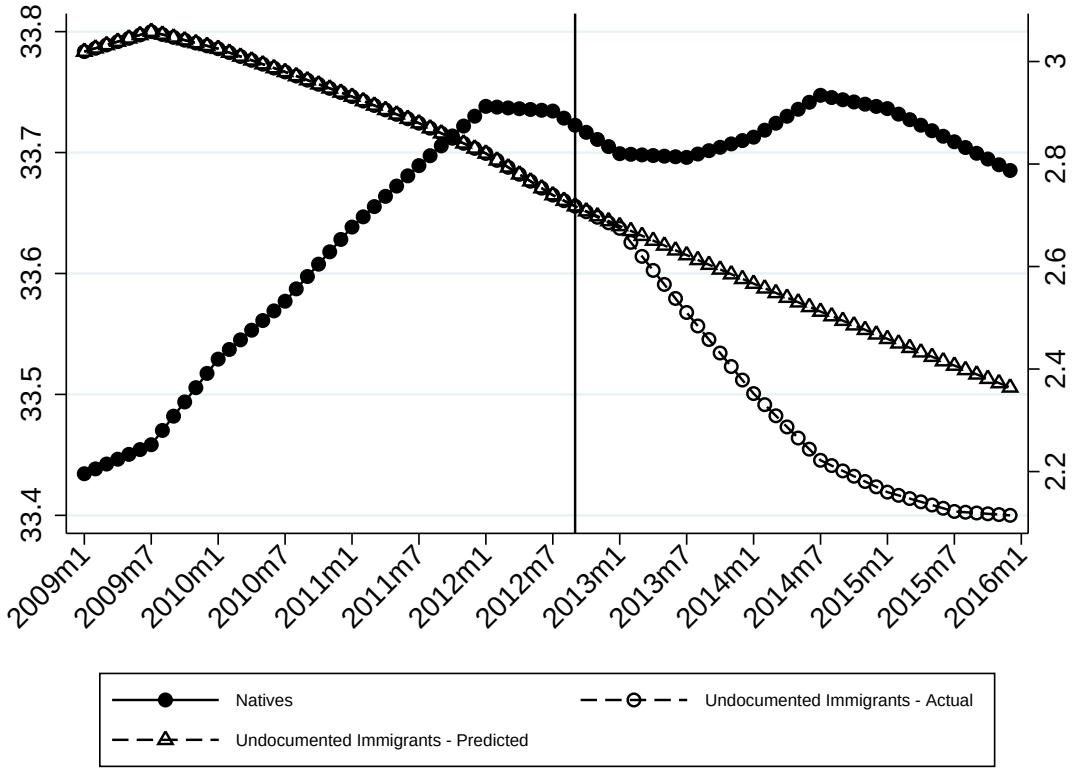
Notes: The figures show the yearly mortality rates (expressed as deaths per 100000 individuals) of both undocumented immigrants and natives for the period 2009-2015. The vertical line indicates the introduction of the reform, implemented in September 2012.

FIGURE 2—EFFECT OF RESTRICTION IN PUBLIC HEALTH INSURANCE ON MORTALITY OF UNDOCUMENTED IMMIGRANTS. LEADS AND LAGS FOR THE DIFFERENCES-IN-DIFFERENCES ESTIMATES



Notes: The figures show the coefficients with 95% confidence intervals for the interaction terms of each year with undocumented immigrant status of the regressions in Table 2. For each year, the figures also show the percentage increase in that year's mortality rate with respect to the base year (3 years before implementation of the reform).

FIGURE 3—POPULATION OF NATIVES AND UNDOCUMENTED IMMIGRANTS (IN MILLIONS)



Notes: The predicted population is computed applying, from the last month before the introduction of the reform, the mean percentage change in the six months before the introduction of the reform.

TABLE 1—EFFECT OF RESTRICTION IN PUBLIC HEALTH INSURANCE ON MORTALITY OF UNDOCUMENTED IMMIGRANTS. DIFFERENCES-IN-DIFFERENCES ESTIMATES

	(1) All groups	(2) Africans	(3) CSA	(4) Asians	(5) All groups	(6) Africans	(7) CSA	(8) Asians	(9) All groups	(10) Africans	(11) CSA	(12) Asians
Undoc. Imm.	-9.6585***	-9.3974***	-9.7117***	-10.5890***	-7.7980***	-7.9767***	-7.7281***	-10.8361***	-7.8383***	-7.8316***	-7.6560***	-10.8057***
	(3.4381)	(3.3452)	(3.4571)	(3.7693)	(2.7758)	(2.8394)	(2.7510)	(3.8571)	(2.7902)	(2.7878)	(2.7253)	(3.8463)
After	-0.6281**	-0.9214***	-0.4217	-0.4046	-0.4894	-0.8023***	-0.3534	-0.7616	-0.4788	-0.7808***	-0.3488	-0.7479
	(0.3132)	(0.3575)	(0.4905)	(0.8916)	(0.3274)	(0.2856)	(0.4025)	(0.9145)	(0.3243)	(0.2780)	(0.4188)	(0.9076)
DD Coeficient	0.8669***	0.6542***	0.9721***	1.5079***	0.6854***	0.8241**	1.0188***	1.0079**	0.6645***	0.7894***	1.0164***	1.0436**
	(0.3086)	(0.2329)	(0.0000)	(0.0000)	(0.2440)	(0.3386)	(0.0000)	(0.4141)	(0.2365)	(0.3063)	(0.0000)	(0.4483)
Pre Reform Mean Mortality Rate	4.4281	4.7294	4.3402	3.4327	4.4281	4.7294	4.3402	3.4327	4.4281	4.7294	4.3402	3.4327
Percentage Change	19.58%	13.83%	22.40%	43.93%	15.48%	17.43%	23.47%	29.36%	15.01%	16.69%	23.42%	30.40%
Constant	15.6271***	15.6571***	15.5994***	15.2020***	15.4047***	15.6694***	17.9618***	17.3556***	15.2681***	15.0404***	18.2586***	17.6457***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Observations	2,856	2,856	2,856	2,856	2,856	2,841	2,856	2,715	2,856	2,841	2,856	2,715
R-squared	0.7928	0.5895	0.6955	0.3787	0.8001	0.5949	0.7039	0.4178	0.8019	0.5980	0.7050	0.4210
FE year, month, region	X	X	X	X	X	X	X	X	X	X	X	X
Controls					X	X	X	X	X	X	X	X
Region specific trends									X	X	X	X

Notes: Standard errors (in parenthesis) are clustered at the region level using the wild bootstrapping methods proposed in Cameron et al. (2008). The dependent variable is the monthly mortality rate (expressed as deaths per 100000 individuals). The pre-reform mean mortality rate refers to the mean mortality rate in the year 2011, and the percentage change refers to the percentage change of the effect (the DD Coefficient) with respect to the pre-reform mortality rate. The controls included in some of the regressions are described in Section 3.B.

TABLE 2—EFFECT OF RESTRICTION IN PUBLIC HEALTH INSURANCE ON MORTALITY OF UNDOCUMENTED IMMIGRANTS. DIFFERENCES-IN-DIFFERENCES ESTIMATES BY AGE GROUPS

	(1) Ages 0-19	(2) Ages 20-39	(3) Ages 40-64
Undoc. Imm.	0.6624**	-0.7560	-16.6770***
	(0.3140)	(0.5832)	(5.9364)
After	-0.5198	-0.0919	-1.2777
	(0.3342)	(0.5212)	(0.8982)
DD Coeficient	0.3578	0.4944**	1.7783***
	(0.2485)	(0.2124)	(0.6330)
Pre Reform Mean Mortality Rate	2.87674	2.99848	8.939815
Percentage Change	12.44%	16.49%	19.89%
Constant	5.0076***	5.9523***	25.9047***
	(0.0000)	(0.0000)	(0.0000)
Observations	2,394	2,856	2,853
R-squared	0.0736	0.0636	0.6846

Notes: Standard errors (in parenthesis) are clustered at the region level using the wild bootstrapping methods proposed in Cameron et al. (2008). The dependent variable is the monthly mortality rate (expressed as deaths per 100000 individuals). The pre-reform mean mortality rate refers to the mean mortality rate in the year 2011, and the percentage change refers to the percentage change of the effect (the DD Coefficient) with respect to the pre-reform mortality rate. Regressions include fixed effects at the year, month and region level, the controls described in section 3.B and region specific linear trends.

TABLE 3—EFFECT OF RESTRICTION IN PUBLIC HEALTH INSURANCE ON MORTALITY OF UNDOCUMENTED IMMIGRANTS. LEADS AND LAGS FOR THE DIFFERENCES-IN-DIFFERENCES ESTIMATES

	(1) All groups	(2) Africans	(3) Center-South Americans	(4) Asians
2 years before	0.3036	0.1175	0.0846	0.7903
	(0.3021)	(0.5023)	(0.9628)	(0.7088)
1 year before	0.1891	0.2905	-0.0092	0.5606
	(0.3163)	(0.3931)	(0.1133)	(0.5874)
Year introduction	0.7392**	0.7659*	0.7438	2.0825***
	(0.3037)	(0.4070)	(0.4975)	(0.7412)
1 year after	0.6627*	0.7066**	0.7779*	1.2936
	(0.3846)	(0.3349)	(0.4514)	(0.8091)
2 years after	0.9961***	1.1356**	1.4598**	1.3136
	(0.3864)	(0.4878)	(0.5663)	(0.9570)
Mortality rate 3 years before	4.3949	4.9152	4.3571	2.9937
Constant	14.8539***	14.8886***	18.0478***	17.2097***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Observations	2,448	2,436	2,448	2,325
R-squared	0.8075	0.5886	0.7102	0.4296

Notes: Standard errors (in parenthesis) are clustered at the region level using the wild bootstrapping methods proposed in Cameron et al. (2008). The table shows the coefficients on the interaction terms between each year and undocumented immigrant status of the differences-in-differences regressions augmented with leads and lags. Regressions include year, month and region fixed effects, the controls in the vector X_{tru} described in Section 3.B and region specific linear trends. The table also reports the sample mean mortality rate in the base year (3 years before implementation of the reform).

TABLE 4—EFFECT OF THE REFORM ON POPULATION. DIFFERENCES-IN-DIFFERENCES ESTIMATES

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All groups		Africans		Center-South Americans		Asians	
Dependent variable:	ln(population)	Mortality Rate	ln(population)	Mortality Rate	ln(population)	Mortality Rate	ln(population)	Mortality Rate
Undoc. Imm.	-2.6870***	-7.8383***	-3.9179***	-7.8316***	-3.3338***	-7.6560***	-5.1313***	-10.8057***
	(0.9565)	(2.7902)	(1.3946)	(2.7878)	(1.1867)	(2.7253)	(1.8265)	(3.8463)
After	0.1644***	-0.4788	0.0317	-0.7808***	0.1816***	-0.3488	0.0102	-0.7479
	(0.0000)	(0.3243)	(0.0588)	(0.2780)	(0.0000)	(0.4188)	(0.0357)	(0.9076)
DD Coeficient	-0.3298***	0.6645***	-0.0994	0.7894***	-0.3476***	1.0164***	0.0625	1.0436**
	(0.1174)	(0.2365)	(0.0901)	(0.3063)	(0.1237)	(0.0000)	(0.0591)	(0.4483)
Pre reform mortality rate		4.4281		4.7294		4.3402		3.4327
Percentage change		15.01%		16.69%		23.42%		30.40%
Constant	16.3626***	15.2681***	15.6526***	15.0404***	17.1220***	18.2586***	15.9692***	17.6457***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Observations	2,856	2,856	2,841	2,841	2,856	2,856	2,715	2,715
R-squared	0.9804	0.8019	0.9754	0.5980	0.9862	0.7050	0.9831	0.4210

Notes: Standard errors (in parenthesis) are clustered at the region level using the wild bootstrapping methods proposed in Cameron et al. (2008). For odd columns, the dependent variable is the logarithm of population. For even columns, the dependent variable is the monthly mortality rate (expressed as deaths per 100000 individuals). The pre-reform mean mortality rate refers to the mean mortality rate in the year 2011, and the percentage change refers to the percentage change of the effect (the DD Coefficient) with respect to the pre-reform mortality rate. All regressions include time, month and region fixed effects, the controls in the vector X_{tru} described in Section 3.B and region specific linear trends.

TABLE 5—EFFECT OF RESTRICTION IN PUBLIC HEALTH INSURANCE ON MORTALITY OF UNDOCUMENTED IMMIGRANTS. DIFFERENCES-IN-DIFFERENCES ESTIMATES WITH PREDICTED POPULATION

	(1) All groups	(2) Africans	(3) Center-South Americans	(4) Asians
Undoc. Imm.	-7.9570***	-7.9011***	-7.7846***	-10.8017***
	(2.8324)	(2.8125)	(2.7711)	(3.8449)
After	-0.2945	-0.6799***	-0.0769	-0.5738
	(0.2991)	(0.2638)	(0.3579)	(0.8606)
DD Coeficient	0.3262	0.5914*	0.5109**	0.7880**
	(0.2097)	(0.3262)	(0.2547)	(0.3629)
Pre reform mortality rate	4.4281	4.7294	4.3402	3.4327
Percentage change	7.37%	12.50%	11.77%	22.96%
Constant	15.5407***	15.1663***	18.6580***	17.6518***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Observations	2,856	2,841	2,856	2,715
R-squared	0.8160	0.6137	0.7357	0.4432

Notes: Standard errors (in parenthesis) are clustered at the region level using the wild bootstrapping methods proposed in Cameron et al. (2008). The dependent variable is the monthly mortality rate (expressed as deaths per 100000 individuals). The pre-reform mean mortality rate refers to the mean mortality rate in the year 2011, and the percentage change refers to the percentage change of the effect (the DD Coefficient) with respect to the pre-reform mortality rate. Regressions include year, month and region fixed effects, the controls in the vector X_{tru} described in Section 3.B and region specific linear trends.

TABLE 6—EFFECT OF RESTRICTION IN PUBLIC HEALTH INSURANCE ON MORTALITY OF UNDOCUMENTED IMMIGRANTS. DIFFERENCES-IN-DIFFERENCES ESTIMATES FOR MORE AND LESS AMENABLE MORTALITY

	(1) All groups	(2) Africans	(3) Center-South Americans	(4) Asians
		PANEL A: MORE AMENABLE CAUSES		
Undoc. Imm.	-6.4876***	-7.3614***	-5.8601***	-7.7407***
	(2.3094)	(2.6204)	(2.0860)	(2.7553)
After	-0.4392*	-0.4905**	-0.5194*	-0.6492
	(0.2240)	(0.2187)	(0.2813)	(0.5885)
DD Coeficient	0.3931**	0.6555**	0.7224***	0.6095**
	(0.1525)	(0.2543)	(0.0000)	(0.2618)
	2.2776	2.3433	2.4291	1.5114
	17.26%	27.97%	29.74%	40.33%
Constant	9.4899***	9.1510***	11.9815***	11.4489***
	(0.0000)	(3.2574)	(0.0000)	(0.0000)
Observations	2,856	2,841	2,856	2,715
R-squared	0.8250	0.6732	0.7039	0.4387
		PANEL B: LESS AMENABLE CAUSES		
Undoc. Imm.	-1.3507***	-0.4703	-1.7960***	-3.0649***
	(0.4808)	(0.3226)	(0.6393)	(1.0910)
After	-0.0396	-0.2903	0.1706	-0.0986
	(0.2093)	(0.2715)	(0.5834)	(0.4215)
DD Coeficient	0.2714**	0.1339	0.2941**	0.4342*
	(0.1287)	(0.1812)	(0.1466)	(0.2560)
	2.1505	2.3861	1.9110	1.9213
	12.62%	5.61%	15.39%	22.60%
Constant	5.7782***	5.8895***	6.2770***	6.1969***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Observations	2,856	2,841	2,856	2,715
R-squared	0.3070	0.1107	0.2486	0.1068

Notes: Standard errors (in parenthesis) are clustered at the region level using the wild bootstrapping methods proposed in Cameron et al. (2008). The dependent variable is the monthly mortality rate (expressed as deaths per 100000 individuals). The pre-reform mean mortality rate refers to the mean mortality rate in the year 2011, and the percentage change refers to the percentage change of the effect (the DD Coefficient) with respect to the pre-reform mortality rate. Regressions include year, month and region fixed effects, the controls in the vector X_{tru} described in Section 3.B and region specific linear trends.

TABLE 7—PROPORTION OF UNDOCUMENTED IMMIGRANTS OVER REGIONS IN 2012

Region	Proportion of Undocumented Immigrants in 2012
Valencia	0.444
Canarias	0.457
Castilla - La Mancha	0.468
Aragón	0.477
Castilla y León	0.478
Illes Balears	0.480
Andalucía	0.494
Extremadura	0.519
Cantabria	0.543
Asturias	0.551
La Rioja	0.559
Galicia	0.585
Madrid	0.591
Navarra	0.603
Cataluña	0.688
País Vasco	0.717
Murcia	0.733

TABLE 8—EFFECT OF RESTRICTION IN PUBLIC HEALTH INSURANCE ON MORTALITY OF UNDOCUMENTED IMMIGRANTS. DIFFERENCES-IN-DIFFERENCES ESTIMATES USING PRE-REFORM TREATMENT RATES OVER REGION

	(1) Continuous	(2) Binary	(3) Continuous	(4) Binary
After	-1.1050*	-0.2084	-0.9686*	-0.2546
	(0.6307)	(0.2757)	(0.5620)	(0.2306)
Proportion UI	0.0159***		0.0270**	
	(0.0057)		(0.0111)	
Proportion UI*After	0.0194*		0.0172*	
	(0.0116)		(0.0100)	
HighRegion		0.7740***		-0.0205
		(0.0000)		(0.3264)
HighRegion*After		0.4567**		0.4623**
		(0.1769)		(0.1896)
Percentage change	0.79%	16.88%	0.70%	17.09%
Constant	2.2846***	2.8674***	1.5668	4.6807*
	(0.0000)	(0.0000)	(1.4802)	(2.3846)
Observations	1,428	840	1,428	840
R-squared	0.1084	0.2376	0.1114	0.2421
FE year, month, region	X	X	X	X
Controls			X	X

Notes: Standard errors (in parenthesis) are clustered at the region level using the wild bootstrapping methods proposed in Cameron et al. (2008). The dependent variable is the monthly mortality rate (expressed as deaths per 100000 individuals). The controls included in some of the regressions are described in Section 3.B.

TABLE 9—PROPORTION OF UNDOCUMENTED IMMIGRANTS OVER NATIONALITY IN 2011

Nationality	Proportion of Undocumented Immigrants in 2011
Ethiopia	0.847
Dominica	0.799
Vietnam	0.783
Liberia	0.775
Saudi Arabia	0.772
Venezuela	0.766
Guatemala	0.756
Panama	0.735
Argentina	0.721
Costa Rica	0.704
South Africa	0.695
Congo, Democratic Republic of the	0.685
Angola	0.666
Uruguay	0.657
Lebanon	0.643
Iran	0.643
Equatorial Guinea	0.624
Kazakhstan	0.624
El Salvador	0.621
Cuba	0.604
Chile	0.596
Iraq	0.589
Syria	0.588
Nepal	0.582
Nicaragua	0.570
Jordan	0.568
Brazil	0.568
Israel	0.561
Paraguay	0.541
Honduras	0.534
Cape Verde	0.467
Turkey	0.461
Indonesia	0.460
Dominican Republic	0.459
Bosnia and Herzegovina	0.458
Peru	0.437

TABLE 9 CONTINUED—PROPORTION OF UNDOCUMENTED IMMIGRANTS OVER NATIONALITY IN 2011

Nationality	Proportion of Undocumented Immigrants in 2011
Colombia	0.436
Sierra Leone	0.434
Korea, South	0.412
Ivory Coast	0.397
Ecuador	0.394
Macedonia	0.370
Guinea-Bissau	0.352
Tunisia	0.331
Kenya	0.328
Serbia	0.327
Guinea	0.315
Egypt	0.307
Bolivia	0.296
Philippines	0.294
Benin	0.286
Togo	0.286
Cameroon	0.275
Thailand	0.268
Burkina Faso	0.229
Senegal	0.218
India	0.204
Japan	0.190
Bangladesh	0.175
Mali	0.158
Nigeria	0.152
Ghana	0.118
Pakistan	0.110
Mauritania	0.105
Moldova	0.089
Algeria	0.086
Gambia, The	0.008

TABLE 10—EFFECT OF RESTRICTION IN PUBLIC HEALTH INSURANCE ON MORTALITY OF UNDOCUMENTED IMMIGRANTS. DIFFERENCES-IN-DIFFERENCES ESTIMATES USING PRE-REFORM TREATMENT RATES OVER NATIONALITY

	(1) Continuous	(2) 60% vs. 40%	(3) 50% vs. 50%
After	-0.20524***	-0.17367***	-0.18217***
	(0.04197)	(0.01649)	(0.02276)
Proportion UI	-0.00619***		
	(0.00086)		
Proportion UI*After	0.01483***		
	(0.00270)		
Top 60% vs. bottom 40%		-0.29883*	
		(0.16936)	
Top 60% vs. bottom 40%*After		0.67661*	
		(0.34457)	
Top 50% vs. bottom 50%			-0.27235*
			(0.13695)
Top 50% vs. bottom 50%*After			0.62140**
			(0.27887)
Percentage change	0.88%	37.98%	38.42%
Constant	2.35598***	2.39272***	2.35372***
	(0.08548)	(0.05767)	(0.09383)
Observations	5,712	4,116	5,712
R-squared	0.92113	0.90535	0.92048

Notes: Standard errors (in parenthesis) are clustered at the nationality level. The dependent variable is the monthly mortality rate (expressed as deaths per 100000 individuals). Regressions are weighted by the population of each nationality and include fixed effects at the month, year and nationality level.

Appendix

TABLE A1—EFFECT OF RESTRICTION IN PUBLIC HEALTH INSURANCE ON MORTALITY OF UNDOCUMENTED IMMIGRANTS. DIFFERENCES-IN-DIFFERENCES ESTIMATES BY CAUSE OF DEATH

	(1) Infectious and parasitic diseases	(2) Neoplasms	(3) Nervous system	(4) Circulatory system	(5) Respiratory system	(6) Digestive system	(7) Other symptons and signs	(8) External causes
Undoc. Imm.	-0.0807	-4.4989***	-0.2347***	-1.3096***	-0.4694***	-0.6323***	-0.0713	-0.0337
	(0.0949)	(1.6015)	(0.0835)	(0.4662)	(0.1671)	(0.2251)	(0.0812)	(0.3154)
After	-0.0169	-0.4831***	0.0081	0.1462	-0.0273	0.0062	-0.0668	0.1169
	(0.0785)	(0.1720)	(0.0430)	(0.1353)	(0.0377)	(0.0337)	(0.1026)	(0.1388)
DD Coeficient	0.0229	0.2787**	0.0040	0.0655	0.0351	0.0074	0.0593	0.0202
	(0.0320)	(0.1356)	(0.0290)	(0.0708)	(0.0371)	(0.0406)	(0.0785)	(0.0940)
Pre reform mortality rate	0.2757	1.2405	0.0696	0.5967	0.2066	0.1944	0.2928	1.0464
Percentage change	8.31%	22.47%	5.74%	10.98%	16.99%	3.81%	20.25%	1.93%
Constant	0.6346	5.5991***	0.6504***	2.2640***	1.3198***	0.9629***	0.0888	2.2785***
	(0.4025)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.3901)	(0.0000)
Observations	2,856	2,856	2,856	2,856	2,856	2,856	2,856	2,856
R-squared	0.0379	0.7965	0.2024	0.4910	0.2971	0.4485	0.1978	0.0882

Notes: Standard errors (in parenthesis) are clustered at the region level using the wild bootstrapping methods proposed in Cameron et al. (2008). The dependent variable is the cause-specific monthly mortality rate (expressed as deaths per 100000 individuals). The pre-reform mean mortality rate refers to the mean mortality rate in the year 2011, and the percentage change refers to the percentage change of the effect (the DD Coefficient) with respect to the pre-reform mortality rate. Regressions include fixed effects at the year, month and region level, the controls described in section 3.B and region specific linear trends.

Universitat
Pompeu Fabra
Barcelona