

# The Rise of Person-centered Care: Effects of Single-Room Nursing Home Quotas on Long-Term Care

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## Abstract

This study examines the implications of the rising person-centered care model on the long-term care market, specifically focusing on the promotion of higher single-room occupancy in nursing homes. We exploit the staggered implementation of a state-level policy that requires nursing homes to meet single-room quotas, forcing many long-term care providers to convert multiresident rooms into single-occupancy rooms. Our difference-in-differences analyses are based on data from the German Care Statistics covering the period between 2007 and 2019. These data offer detailed insights into the universe of individuals needing care, their specific care arrangements, and all nursing home facilities in the country. Our results indicate that the policy significantly decreases the likelihood of individuals in severe need of care securing a bed in a nursing home. The likelihood of individuals receiving professional home health care remains unchanged by the policy. We observe, however, a notable increase in the proportion of people in severe need of care in informal home care. The policy generates substantial direct net fiscal gains for long-term care insurance and local communities. These likely exceed potential indirect fiscal costs that may arise, for instance, due to reduced income tax revenues for federal and national governments resulting from lower labor supply among informal caregivers.

Keywords: single-room policy, nursing home access, home health care, informal care, difference-in-differences, never treated

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## 1. Introduction

With the demographic shift generating both increased demand for nursing care and, because nurses are retiring at unprecedented rates, a potential reduction of supply, intense public debates about waiting times for nursing home beds have emerged in many advanced economies (Heger et al. 2023, WHO 2020). In the United States and Europe, for instance, waiting times of six months or more are relatively common (European Commission 2021, AHCA/NCAL 2024, Miller 2023). Despite these challenges, over decades, health policies in these settings have provided support for resource-intensive person-centered care—an immensely popular strategy in the medical and specifically the nursing profession to enhance service quality by prioritizing individuals’ preferences and aligning care provision with their health and life objectives (Berwick 2009, Kruk et al. 2018, Brummel-Smith et al. 2016, Kogan et al. 2016). As suitable living conditions for residents represent a cornerstone of this concept, the steep global rise in person-centered care has come along with a trend toward significantly fewer multiresident rooms. This trend was fueled in several instances by regulations capping the maximum number of residents per room (Kelly et al. 2019). For instance, mandates for converting resident rooms to double or single occupancy were introduced in Massachusetts (United States) and several federal states of Germany (Brown et al. 2021, Reuters 2022). Nursing homes in Ohio (United States) receive a financial incentive for every additional private room they offer (Stulick 2024). Recent studies have demonstrated that person-centered care leads to various important (health) benefits for residents (Sjörger et al. 2013, Winzelberg et al. 2005, Cusack et al. 2023, Bertuzzi et al. 2023, Zhu et al. 2022). However, the intensive nature of person-centered care raises concerns that the availability of professional services for a vastly growing number of individuals in severe need is compromised.

In this paper, we examine whether an increase in low-occupancy rooms contributes to limited nursing home access and whether these effects extend to the professional home health care market and to informal home care. An increase in low-occupancy rooms likely reduces the overall number of beds in nursing homes, especially when multiresident rooms are converted into more spacious ones because of high remodeling costs and bureaucratic challenges associated with capacity expansion (Herr and Saric-Babin 2016). Moreover, given the allocation of nursing home beds on a first-come, first-served basis

rather than the principle of care dependency, this capacity drop potentially enhances the demand for intensive professional home health care. However, since professional providers are also stretched thin because of the demographic shift (ZQP, 2019), it may be untrained family members who absorb much of the care burden implicitly expelled by nursing homes with a higher share of single rooms. This potential redirection of a large portion of severely dependent individuals into informal home care ties into a public debate in advanced economies on family caregiving and deserves special attention for several reasons. First, lack of specialized training of informal caregivers can pose a significant risk to individuals with severe care needs (Backman et al. 2021, Bakx et al. 2020, Groenou and de Boer 2016). Many caregivers are now responsible for duties once handled by trained medical professionals, such as managing medications, monitoring health, and administering injections (NASEM 2016). Second, caring for relatives often entails a lower salary (Carrino et al. 2023, Simard-Duplain 2022, Carr et al. 2018, Schmitz and Westphal 2017) and a lower probability of working outside the home (Kolodziej et al. 2018). Third, informal caregivers also tend to experience heavy mental and physical strain (De Zwart et al. 2017, Bauer and Sousa-Poza 2015, Schmitz and Stroka 2013).

We first analyze the relationship between a state-level policy that requires German nursing homes to meet single-room quotas and the number of nursing home beds. Further access measures include out-of-pocket payments for nursing home care and the number of nursing homes. In a second step, we examine the policy's effect on the share of individuals in home health care and informal home care. Because people with severe care needs require the kind of assistance that places a significant burden on informal caregivers, we focus on them.

We estimate standard two-way fixed-effects regression models to examine the effects of the single-room policy, and we present several other models as robustness checks. Our core data come from the official German Care Statistics and span 2007 to 2019 (FDZ-Bund und Länder 2020). The data include information on all people assigned to care dependency in Germany as well as information on the universe of home health care services and nursing homes. Our results reveal that the reform mandating minimum single-room shares negatively affects access to nursing home care. They further indicate robust significant shifts of the burden of care from nursing homes to family members. All results are

robust to a comprehensive set of checks including the restriction of the comparison group to never-treated states and variations to clustering the standard errors.

Based on our estimates, we calculate direct net fiscal gains of the single-room policy that stem from reduced long-term care insurance and social assistance payments for nursing home care for individuals with severe care dependency. These are likely larger than the indirect fiscal costs of increased informal care possibly resulting in lower labor supply by family members. The policy generates fiscal distinctions between winners and possible losers. Long-term care insurance and local communities benefit from fiscal gains, while federal states and the national government may face (moderate) fiscal losses due to reduced income tax revenues, as the policy does not yield significant direct fiscal impacts at their level.

This paper contributes to three streams of literature. First, it offers an important economic perspective on the scarcity of nursing home beds potentially resulting from the rise in the concept of person-centered care. We identified more than 500 articles on person-centered care that were published in the top journals in medical and nursing sciences over the past decade. Several dozen articles on this topic were published in multidisciplinary journals of health services research. They include empirical examinations of the relationship between nursing quality and various aspects of person-centered care (e.g., Sullivan et al. 2018, Afendulis et al. 2016). In contrast, we were unable to find a single paper on elderly care and person-centered care in a high-ranked general-interest economics journal or leading public-economics and health-economics journal. Our paper addresses a significant gap in the literature concerning whether person-centered care is associated with a reduction in access to nursing homes and the implications thereof for home health care and informal home care.

Second, the consequences of lower-occupancy rooms for clinic patients and nursing home residents have been studied, with a focus on factors such as patient satisfaction with care, noise and quality of sleep, infection rates, recovery rates, and patient safety issues (Van de Glind et al. 2007, Calkins and Cassella 2007). This includes research suggesting that nursing staff tend to rate single rooms more favorably in terms of enhancing resident privacy, dignity, and confidentiality (Maben et al. 2015). To the best of our knowledge, estimated effects of both lower-occupancy rooms and policies promoting

lower-occupancy rooms on nursing home access as well as alternative care arrangements are currently missing in the literature. Our paper aims to fill this evidence gap by directly addressing the impacts of such policies on nursing home access and alternative care arrangements.

Third, our paper complements the literature on substitution effects across elderly-care arrangements and fiscal implications associated with the various care arrangements. There are studies documenting substitution effects but also complementarities between formal home-care services and informal caregiving (Shen 2024, Stabile et al. 2006, Charles and Sevak 2005, Balia and Brau 2014, Bonsang 2009). Informal caregiving can substantially delay and reduce the risk of nursing home entry (Charles and Sevak 2005, van Houtven and Norton 2004). In Germany, in regions with less informal care options nursing home usage is higher (Herr et al. 2024). We also found one study rigorously analyzing the effects of facility care on informal care. It documents that these effects depend on the level of care dependency (Kim and Lim, 2015). The authors find no significant reduction in care among informal caregivers of severely dependent individuals, i.e., family members address residual demand for care even when their family members are in care facilities. Cremer et al. (2017) argue that the role of subsidized long-term care becomes critical in the presence of uncertain family support. Shen (2024) show that fiscal costs of financing home health care depend on the extent informal home care is reduced and (female) labor supply increased. Korfhage and Fischer-Weckemann (2024) estimate the fiscal costs of informal caregiving and Geyer et al. (2017) analyze the fiscal effects of subsidized formal care.

## **2. Institutional background**

### *The German elderly-care sector*

The German elderly-care system is divided into informal home care, home health care, and nursing home care. Conceptually, they all provide care as a single good but are addressed to different levels of need. Informal home care encompasses the majority of individuals in need of care and is characterized by family support in daily life (Fischer and Müller 2020). As informal care givers are typically semiprofessionals, care recipients in informal health care generally require fewer care procedures and have relatively mild health-related impairments. When health conditions deteriorate, informal health

care is often replaced by home health care. Home health care providers perform specific medical and personal-hygiene procedures and often also household tasks. They employ qualified registered nurses complemented by nurse assistants. Therefore, home health care provides an opportunity for individuals with significant care needs to continue living at home while receiving appropriate care. The third type, nursing home care, takes place in residential facilities designed to provide for the needs of severely dependent individuals.

To be considered in need of care and qualify for financial support through German long-term care insurance, individuals must undergo an assessment by the Medical Review Board. The board is an independent entity of the statutory health insurances. Individuals were historically assigned to one of three care levels or to an additional category for hardship care. Higher care levels are assigned to individuals with more severe care needs. Since implementation of the Care Strengthening Act in 2017, the definitions of care levels have changed and their number has expanded to five aimed at better reflecting individual care needs (see Table A1 in the appendix).

The financial allowances depend on the type of care and cannot be combined. Individuals that receive informal care only receive a lump-sum payment that the individual can spend freely on different services. Care costs in home health care are covered on a fee-for-service basis up to a limit defined by the assessed care level. Prices for home health care services are either determined through negotiations between providers and pension insurance funds or, in some federal states, fixed at the state level. Consequently, the vast majority of home health care providers report accepting significantly fewer admission requests than they receive (ZQP, 2019).

In nursing home care, while care costs are partly covered, service costs are primarily paid by the individuals in need of care. Nursing home care is the most expensive type of care provision. Prices are negotiated between the individual nursing homes, on the one hand, and the long-term care insurance funds as well as the community responsible for social security payments, on the other hand. This ensures that prices are mainly cost-based and limits significant price increases. High demand for scarce nursing home beds tends to lead providers to operate at nearly full capacity, which is also necessary to run

profitably. Due to the regulated negotiation process, nursing home prices are not fully flexible, and nursing homes maintain waiting lists. As a result, care recipients often experience waiting times of several months before securing a bed (Arntzen et al. 2022). There are several factors influencing the waiting time, including referrals from hospitals to nursing homes (Sennlaub et al. 2020). Note that in general, in Germany, social security may cover part of the out-of-pocket costs that exceed the benefits of the long-term care insurance for all three care types if an individual lacks sufficient financial means.

#### *Introduction of person-centered care and single-room quotas*

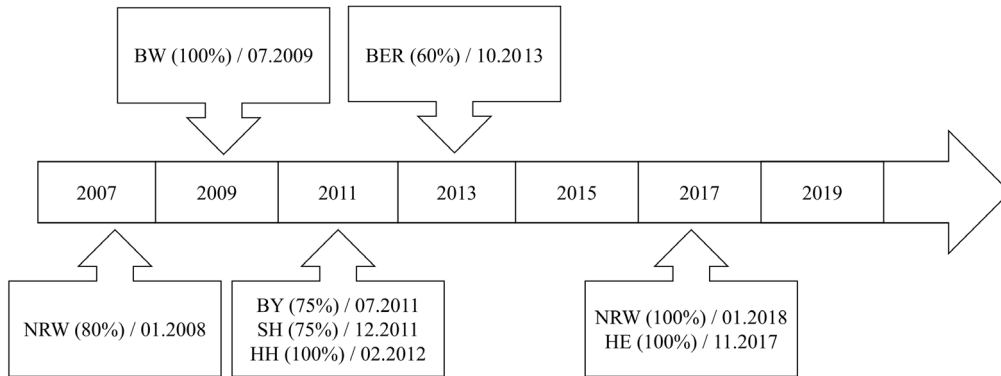
One reason for these access limits might be the transition to the person-centered care model and more single rooms. Specific to person-centered care is its emphasis on providing more privacy in nursing homes. The largest construct within the person-centered care framework is the care environment, wherefore the person-centered care framework is associated with a significant trend toward higher single-room nursing home shares (Kelly et al. 2019). Figure A1 in the appendix illustrates the strong positive correlation between the person-centered care model and the number of single rooms by displaying the parallel evolution over the last decade of the number of publications on nursing care using the terms person-centered care or single rooms, respectively.

The trend toward more single rooms is further reinforced by the introduction of regulatory requirements for single-room shares in approximately half of the German federal states. German state regulators have gradually introduced mandatory single-room quotas, beginning in 2008. North Rhine Westphalia, the first German state implementing this reform, stated its aim was to “enable elderly, disabled, and care-dependent people to live a life that respects their self-determination and dignity.”

Single-room policies in German federal states typically grant nursing homes a transition period of 10 years. Only after this grace period are single-room quota levels enforced by regulators through converting as many multiresident rooms to single rooms as required to fulfill the mandated single-room share. As nursing home revenues are strongly connected to the number of rooms and residents, this implies that during the grace period, nursing homes have an incentive to close the gap between their single-room share and that mandated by the regulator.



**Figure 1: Introduction of single-room quotas in Germany**



*Note:* The figure illustrates the introduction date of single-room quotas in German federal states within the observation period. North Rhine Westphalia (NRW) first introduced the reform in 2008 with an 80 percent quota and then raised it in 2018 to 100 percent. BW=Baden-Württemberg, BY=Bavaria, SH=Schleswig-Holstein, HH=Hamburg, BER=Berlin, HE=Hesse.

Figure 1 illustrates the introduction of quota levels at different points in time. After North Rhine Westphalia introduced a mandatory quota of 80 percent single rooms, six additional federal states followed suit within our observation period (Schleswig-Holstein, Hamburg, Berlin, Hesse, Baden-Württemberg, Bavaria) (Terranus 2022). The last state to introduce a quota was Lower Saxony, after the end of the observation period in 2023. In 20 nursing homes randomly drawn from the universe of data, the price difference between a double and a single room ranges between €100 and €300 per month, which residents are required to pay out of pocket. For reference, the average out-of-pocket costs amount to between €1,800 and €2,800 across the federal states.

### 3. Data and descriptive statistics

We use a comprehensive data set based on two sources. Our main source is the German Care Statistics (FDZ-Bund und Länder 2020), which span from 2007 to 2019. Every two years, on December 1, regional statistical offices gather data from care insurers and care facilities. Based on the administrative records from the latter, the German Care Statistics provide a full overview of care recipients, who are unambiguously classified as receiving either only informal home care, formal home health care, or nursing home care. The data include details regarding location, age, gender, and care dependency for all 5 million individuals in need of care in Germany. For reference, 7 million people in the United States are estimated to be currently eligible for long-term care insurance benefits in accordance with the Health Insurance Portability and Accountability Act (HHS/ASPE 2016).

Our dataset furthermore includes detailed information on nursing homes including their county of residence, nursing personnel, ownership type, and number of available beds (including single rooms). Additionally, the data include information on nursing homes' prices and private out-of-pocket payments (i.e., price net of long-term care insurance benefits). We supplement the German Care Statistics with data from the Federal Office for Building and Regional Planning (INKAR), which include regional information on demographics, economic parameters, and population at the county level (the smallest level in the German Care Statistics) (BBR 2023).

The data-preparation process and analyses were conducted at the Research Data Center of the Statistical Offices of the Länder in Hanover. The German Care Statistics cover all nursing homes in Germany. The number of nursing homes has steadily increased over the years, from approximately 11,000 in 2007 to around 15,300 in 2019. We exclude 15,823 providers exclusively offering short-term care or day care. This leaves an estimation sample of 75,676 observations.

In Table 1, we summarize key information on our outcome variables. We use the number of nursing home beds as our main access measure. The average nursing home has about 78 beds. For reference, a nursing home in the United States serves, on average, 85 residents daily (NCHS 2022). To capture the county-level effect of less access to nursing homes due to increased single-room shares for those who

do not get into nursing homes, we concentrate on the shares of the elderly in care levels 3+ who are receiving professional home health care and informal health care. A person’s care level is designed to approximate the extent of their care needs, which is larger for individuals in care levels 3+ relative to the other care levels. In appendix A, we describe our approach of ensuring consistency in the county-level share of elderly in care levels 3+ throughout the observation period. In our data, nearly half of the sample of severely dependent individuals receives nursing home care. Roughly 20 percent are in home health care, and more than 30 percent are being cared for exclusively by family members in informal health care. In Table A2 in the appendix, we display descriptive statistics for our secondary outcome variables and control variables. The former include the average out-of-pocket payments for nursing home care (which may increase when the price raises due to a reduced supply of shared-room beds) and the county-level number of nursing homes, nursing home entries, and nursing home exits to capture substitution effects. The control variables are described in Section 4.

**Table 1: Descriptive statistics**

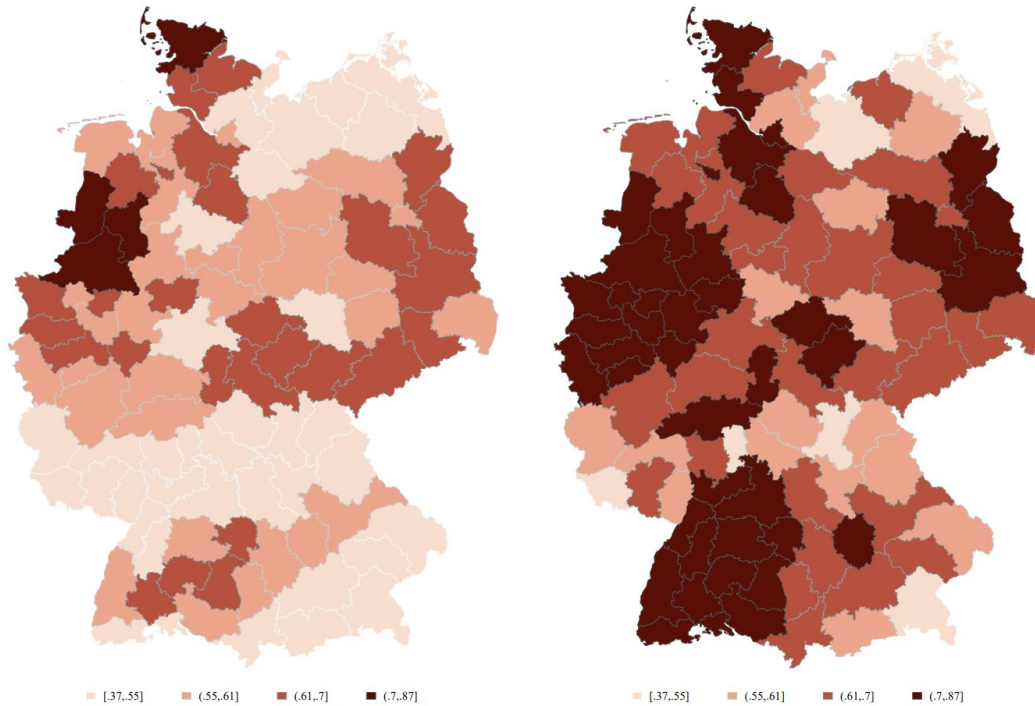
<b>Variable</b>	<b>Mean</b>	<b>SD</b>	<b>p10</b>	<b>p90</b>	<b>N</b>
Beds	77.59	46.43	26	135	75,679
Share of people in severe need of care in...					
Nursing home care <sup>#</sup>	0.47	0.09	0.36	0.59	2,849
Home health care <sup>#</sup>	0.21	0.06	0.14	0.29	2,849
Informal care <sup>#</sup>	0.32	0.09	0.22	0.42	2,849

*Note:* <sup>#</sup> County level.

*Source:* Own calculations based on the German Care Statistics, Statistical Offices of the Länder, [10.21242/22411.2007.00.02.1.1.0 -10.21242/22411.2019.00.02.1.1.0].

We illustrate the trend in single-room shares across German regions in Figure 2 by depicting the shares in 2007 and 2019. In 2007, single-room shares were relatively high (>70 percent) in the northern, northwestern, and mideastern federal states. The map indicates an overall increase in the shares of single rooms, which was more pronounced in states with binding quotas than other states. We observe particularly strong increases in the states with the longest exposure to binding quotas, i.e., North Rhine Westphalia (in the West) and Baden-Württemberg (in the Southwest).

**Figure 2: Regional variation in single-room shares**



*Note:* The figure illustrates regional variation in average single-room shares, divided by quartiles (2007 on the left and 2019 on the right). We calculate the single-room share by dividing the aggregate number of single rooms by the total number of available rooms in each county. For data-security reasons, we depict 100 spatial planning regions, which represent a more aggregated level than the county level.

*Source:* Own calculations based on the Care Statistic, Statistical Offices of the Länder, [10.21242/22411.2007.00.02.1.1.0 - 10.21242/22411.2019.00.02.1.1.0]

#### **4. Estimation strategy**

We estimate a difference-in-differences model in a multiple-linear-regression framework with both unit (e.g., nursing home) and year fixed effects. We control for nursing home ownership type and service level (e.g., whether a facility provides only long-term care). For further detail, refer to appendix B. We cluster standard errors at the state-year level. The treatment indicator equals 1 if the nursing home is located in a federal state with a single-room quota and 0 otherwise. This indicator is interacted with a dummy variable that equals 1 after the implementation of the quota and 0 before. In our preferred model, we incorporate dynamic treatment effects by interacting the treatment dummy variable with binary indicators for each two-year interval after the implementation of the policy, as the data are available biennially. This approach is motivated by the grace period during which nursing homes were required to meet the single-room quota. It addresses the concern that the point estimate from the previous model

is primarily influenced by observations made relatively close to the policy's introduction, as most states implemented the reforms around the midpoint of our observation period.

We implement various robustness checks to probe the reliability and validity of the study's findings. Following prior work (Huang et al. 2023, Chatterjee et al. 2022), we conduct event-study analyses to examine the progression of outcomes in states that introduced single-room quotas compared to control states. The estimates of the effects prior to the introduction of the policy allow us to determine whether outcomes were diverging between treatment and control states in the absence of the policy. The lack of persistent divergence would bolster confidence that the parallel-trends assumption holds. We run a series of other tests to check the robustness of the results with respect to threats to the identification strategy and our approach to clustering the standard errors, which are described in detail in appendix C.

## 5. Results

We display the estimated average effect across periods in panel A of Table 2. The table shows that the single-room policy significantly reduces the number of beds available in nursing homes by roughly one unit (column 1). In Table A3 in the appendix, we demonstrate that the policy was binding and effectively increased the single-room share in nursing homes (column 1).

Regarding the implications for the care market, we observe a significant decline in the share of people in severe need of care in nursing homes by roughly 1.5 percentage points (panel A of Table 2, column 2). Next, we assess whether professional home health care providers augment their elderly-care services in response to the reduced capacity in nursing homes. Our results suggest that this is not the case, as the share of people in severe need of care in home health care remains unaffected by the reform (column 3). In contrast, we observe a surge of roughly 1.5 percentage points in the share of people in severe need of care receiving informal care in their homes. This suggests that the reform shifted the burden of care to family members, who now fully bear it. Consistent with these findings, we observe that the correlation between nursing home care and informal home care is approximately three times as strong as the correlation between nursing home care and home health care (pairwise correlations of -0.77 versus -0.26). This suggests that nursing home care is more closely related to informal home care than

to home health care. Table A3 in the appendix also reveals a positive effect on average out-of-pocket payments (in spite of limited flexibility due to the price negotiation process) but no effect on market composition in terms of entry and exit of nursing homes.

**Table 2: Effects of single-room policy**

	Care markets			
	(1)	Share of people in severe need of care in...		
		(2)	(3)	(4)
Beds	Nursing home care <sup>#</sup>	Home health care <sup>#</sup>	Informal care <sup>#</sup>	
<i>Panel A: Average effects across periods</i>				
Post-policy introduction	-1.063** (0.417)	-0.015** (0.006)	-0.002 (0.004)	0.016*** (0.006)
<i>Panel B: Dynamic effects</i>				
Post-policy introduction periods (each period = 2 years)				
0	-0.410 (0.278)	-0.009** (0.004)	-0.003 (0.005)	0.012** (0.005)
1	-1.222*** (0.304)	-0.017*** (0.006)	0.003 (0.005)	0.014*** (0.005)
2	-2.364*** (0.376)	-0.021*** (0.006)	-0.003 (0.005)	0.025*** (0.006)
3	-2.414*** (0.476)	-0.032*** (0.006)	-0.002 (0.008)	0.034*** (0.008)
4	-4.441*** (0.747)	-0.041*** (0.010)	-0.008 (0.012)	0.049*** (0.008)
5	-6.096*** (0.619)	-0.069*** (0.009)	0.003 (0.009)	0.066*** (0.010)
Controls	X	X	X	X
Unit FE	X	X	X	X
Wave FE	X	X	X	X
N	75,679	2,849	2,849	2,849

*Note:* \* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01; <sup>#</sup> County level; Standard errors clustered at the state-year level in parenthesis. At period 0, the policy had been in effect for 1 to 23 months, depending on when it was introduced in each state. At period 5, the policy was introduced between 10 and 12 years ago.

Source: Own calculations based on the German Care Statistics, Statistical Offices of the Länder, [10.21242/22411.2007.00.02.1.1.0 -10.21242/22411.2019.00.02.1.1.0]

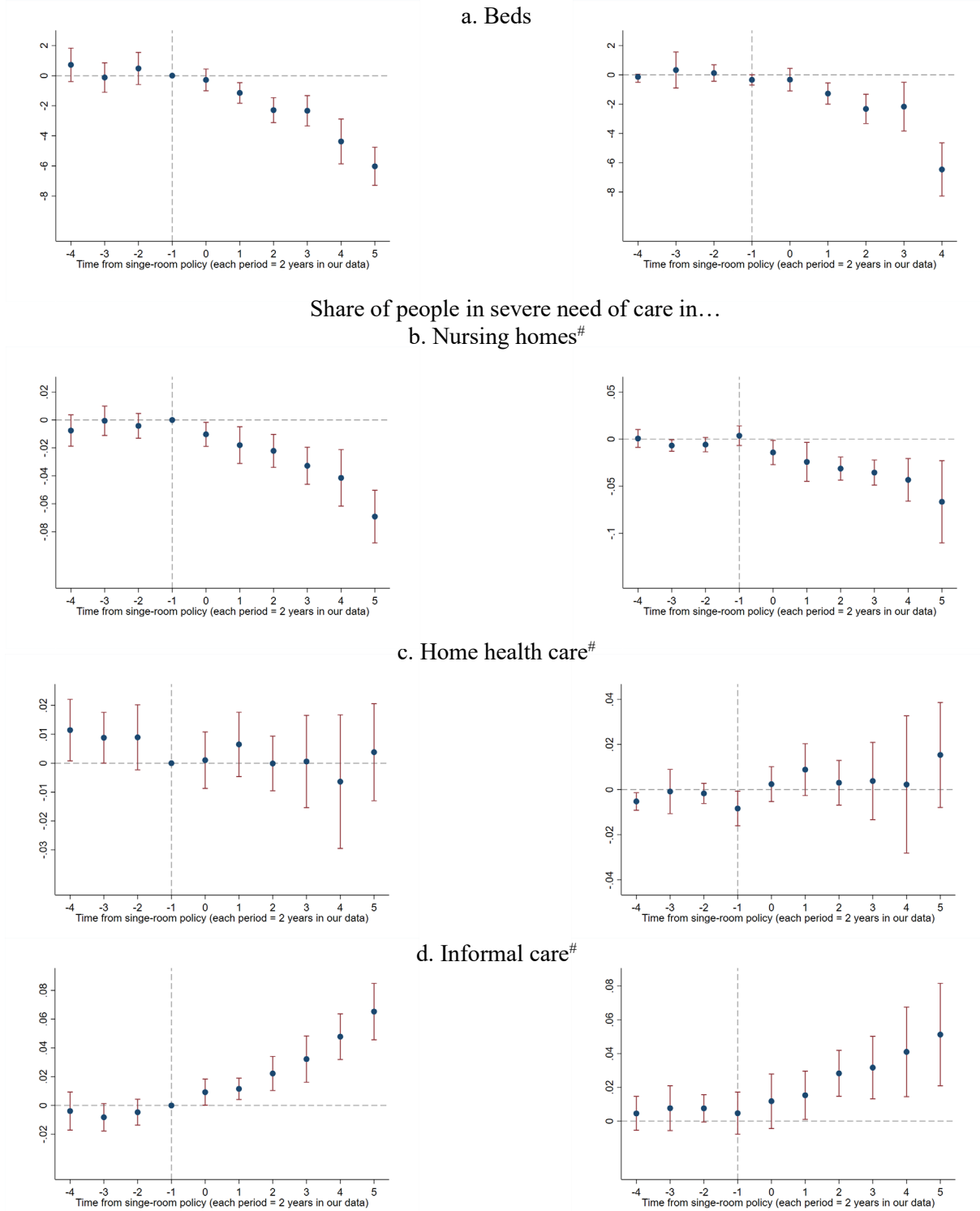
Results for the extended model—that is, the estimates of dynamic treatment effects—are displayed in panel B of Table 2. Column 1 indicates that the shortfall in the number of beds is substantially growing over time in absolute terms, consistent with the logic of the legal transition period granted to nursing homes. At period 3 (6 to 8 years after the reform) and period 5 (10 to 12 years after the reform), the

number of beds is reduced by roughly 2.4 (−3 percent relative to overall average displayed in Table 1) and 6.1 (−8 percent), respectively. This is consistent with the results for dynamic effects on the single-room share and on out-of-pocket payments for nursing home care, which follow a very similar pattern (Table A4 in the appendix, columns 1 and 2). Yet again, we do not observe any impacts on market composition (columns 3–5 of the same table).

Regarding care-arrangement dynamics, we estimate the policy to reduce the share of people in severe need of care in nursing home care after 6 to 8 years and 10 to 12 years by 3 percentage points (−6.5 percent) and 7 percentage points (−15 percent), respectively (panel B of Table 2, column 2). Meanwhile, home health care use remains stable (column 3). Informal home care usage, in contrast, progressively increases as a result of the reform (column 4). The sizes of the estimated effects on informal home care are similar to those for nursing home care in absolute terms.

Concerning the examination of the reliability and validity of the study’s findings, Figure 3, left panel, presents the event-study results for the two-way fixed-effects model. These results show that the effects are concentrated in the periods after, rather than before, the policy implementation. This suggests that the parallel-trends assumption holds. The Callaway and Sant’Anna estimator produces similar event-study results (right panel of the figure). The corresponding event study results for the secondary outcome variables are displayed in Figure A3 in the appendix. They indicate that these findings are not driven by a violation of the parallel-trends assumption.

**Figure 3: Event-study effects of single-room policy**



*Note:* <sup>#</sup> County level. The left panel of the figure displays the results of the two-way fixed-effects model. The right panel displays the results of the Callaway and Sant’Anna estimator. Each dot represents a coefficient estimate. Vertical bars denote the 95% confidence intervals, which account for clustering at the state-year level. The x-axis represents periods (in 2-year intervals) relative to the policy’s implementation. At period 0, the policy had been in effect for 1 to 23 months, depending on when it was introduced in each state. The point estimate for the policy effect on the number of nursing home beds in period 5 (10 to 12 years after the reform) is unavailable in the right panel because of the change in the identifier for homes in North Rhine Westphalia. The dot and vertical bars displayed at period -4 represent average estimates over this and all preceding periods. See Figure A2 in appendix D for coefficient estimates for up to ten years prior.



Tables A5 and A6 in the appendix display the robustness checks for the average effects across periods on the various outcome variables. Tables A7–A12 in the appendix show the same robustness of the dynamic-effect results. The results for the primary outcomes, the single-room share, and the average out-of-pocket payments are overall robust across model specifications. Estimates of the effects of the policy after several years on the total number of nursing homes, as well as their entries and exits in a county, turn statistically significant in some model specifications but are statistically insignificant in the most conservative ones.

## 6. Discussion

We first aim to use the estimates to derive rough yet conservative estimates of the direct net fiscal gains of the single-room policy and discuss the extent to which indirect fiscal costs emerge. Subsequently, we aim to identify and discuss the public authorities that appear to benefit from (or be disadvantaged by) it.

The direct net fiscal gains consist of changes in long-term care insurance payments and social assistance payments for nursing home care, which we calculate in the following. Given the absence of any significant policy effect on the share of severely care-dependent individuals in home health care (panel B of Table 2, column 3), we focus on the results for nursing home care and informal home care. We analyze the direct fiscal implications of transitioning from costly nursing home care to less expensive informal caregiving. We conservatively calculate the direct net fiscal gains to be EUR 121.5 (USD 169 in PPP) per month per individual with severe care dependency.<sup>1</sup> Compare appendix E for details. Based on this, we calculate that the total direct net fiscal gains associated with the policy will amount to about EUR 1.19 billion (USD 1.65 billion in PPP) per year if the policy is scaled up nationally.<sup>2</sup>

Next, we discuss whether there are any indirect effects in terms of forgone taxes and social security contributions when informal caregivers alter their labor supply (Reichert, 2015). Two arguments lead us to believe that, if any, these indirect effects are relatively small. First, informal care episodes typically

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<sup>1</sup> We use purchasing power parities exchange rates of 2024 provided by IMF (2024).

<sup>2</sup> There are roughly 815,000 German individuals with severe care needs (German Federal Statistical Office, 2024). When all nursing homes in the country were to be exposed to enforced single-room mandates, the total fiscal gains would amount to EUR 815,000 individuals x 121.5 x 12 months = 1.19 billion.

begin before the nursing home admission of a care-dependent person and continue after the person enters the nursing home (Kim and Lim 2015).<sup>3</sup> As a result, decisions about labor market participation often occur earlier in the care dependency period, well before the point at which the care-dependent family member might enter a nursing home. Second, Schmitz and Westphal (2017) suggest that informal caregivers in Germany make decisions about their short- and medium-term labor market participation at the beginning of the episode of care provision. These decisions exhibit a high degree of persistence, meaning they are unlikely to change significantly later. For reference, we demonstrate in appendix F that, under an upper-bound scenario for the indirect fiscal effects of the policy due to a decrease in income tax revenues, the direct net fiscal gains are unlikely to be offset.

A full welfare analysis of the single-room policy is beyond the scope of this paper. However, to provide guidance to policymakers, we briefly discuss the broader implications informed by economic reasoning. On the provider side, the policy likely reduces nursing home revenues due to fewer residents, even with moderate price increases that partially finance remodeling investments. While cost savings from reduced staffing needs could partially offset these losses, the extent of such savings remains uncertain.

Care-dependent individuals who secure a bed in a nursing home despite the policy face increased costs due to rising prices. The extent to which they benefit from an improved quality, as suggested by the literature on person-centered care, is unclear. For those caused by the reform to receive informal care, lower out-of-pocket costs and higher utility of staying at home are key advantages. Importantly, they may, however, also experience reduced care quality in informal settings compared to professional nursing homes. Moreover, informal caregivers likely bear significant burdens, in particular health impacts. Hence, these considerations highlight the policy's complex trade-offs between fiscal savings, provider adjustments, and household welfare.

This study has several limitations. First, we need to leave investigation of the effects of the quota policy on the quality of care and resident satisfaction to future researchers because of the unavailability of

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<sup>3</sup> This complementary informal care is no longer covered by the long-term care insurance in Germany that pays for nursing home care instead.

good-quality information at this point. Second, our data do not include the waiting time for professional care and (part-time) employment status among informal caregivers, which represent policy-relevant outcome variables. Third, existing nursing homes may start reconstructing their buildings or removing beds shortly before the end of the legal transition period. To fully capture the policy's effects, a longer follow-up period is advisable.

## **7. Conclusion**

We investigated the impact of state-mandated shares of single rooms in Germany on access to nursing homes and the share of individuals with severe care dependency in professional home health care or informal home care. We found a robust negative impact of the single-room quota on the number of nursing home beds, with effects growing over time and becoming substantial as the transition phase granted by the legislator ends. These results strengthen concerns about potential access limitations in the sector due to the rise of the person-centered care model in nursing care.

We found the share of individuals in severe need of care who are in informal home care to significantly increase because of the quota policy. The share of people in severe need of care who receive home health care, in contrast, is unaffected by the policy. This suggests that outpatient care providers lack absorptive capacity, which may be associated with the general nursing-personnel shortage.

We calculate the shift from nursing home care to informal home care to yield direct net fiscal gains of approximately EUR 1.19 billion (USD 1.65 billion in PPP) annually if scaled up nationally. The increase in informal home care can be problematic for care-dependent individuals with complex needs due to the lack of specialized training among informal caregivers. Furthermore, it could place significant strain on informal caregivers, who may, for instance, experience mental and physical stress. Given these burdens, the fiscal gains could be allocated to benefit people with children—for instance, through reduced long-term care insurance premiums—since children often provide informal care.<sup>4</sup>

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<sup>4</sup> In Germany, for this reason, public long-term care insurance already distinguishes between individuals without children, who had to contribute 4 percent of their income, and those with children, who paid 3.4 percent in 2023.

Policy makers may address nursing home access concerns through need-based waiting lists and a regional allocation system across care settings. Expanding professional inpatient and outpatient long-term care capacity may be necessary when policy makers aim to fully offset reduced nursing home access. Future research should explore ways to improve the absorptive capacity of the home health care market.

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## Appendix

### Appendix A: Redefinition of the concept of care dependency

The concept of care dependency was revised at the end of 2016, expanding from three care levels to five care grades to better reflect individual care needs. To ensure consistency throughout the observation period, we use the 3 care-level categorization, which was in effect before 2017. We converted the care grades from the years 2017 and 2019 into care levels (Table A1). With the introduction of the care grades, individuals who were at the higher end of a care level group were upgraded, but there were no downgrades.

### Appendix B: Technical Details on Estimation Strategy

We estimate difference-in-differences models in a multiple linear regression framework with both unit (e.g., nursing home) and time (e.g., year) fixed effects using the following equation:

$$y_{j,t} = \alpha + \beta PostPI_{s,t} + X'_{j,t}\gamma + k_j + t_t + \epsilon_{j,t} \quad (1)$$

In this equation,  $y_{j,t}$  represents the outcome variable for unit  $j$  in state  $s$  at time  $t$ . The coefficient  $\beta$  measures the effect associated with the implementation of the single-room quota policy. Specifically,  $PostPI_{s,t}$  (post-policy introduction) is a binary indicator that equals one if the single-room quota is in place in state  $s$  during period  $t$ , and zero otherwise. The vector  $X$  represents a set of covariates, specifically binary indicators for nursing home ownership type and service levels (e.g., whether a facility provides only long-term care). The fixed effects  $k_j$  control for unobserved characteristics that are constant over time within each unit. The fixed effects  $t_t$  control for factors that vary over time but are constant across NHs. The error term  $\epsilon_{j,t}$  captures the remaining variation in the outcome variable not explained by the model.

In a model extension, we incorporate dynamic treatment effects, allowing for the treatment effect to vary over time. This is expressed in the following equation:

$$y_{j,t} = \alpha + \sum_{t=0}^T \beta^t PostPI_{s,t}^t + X'_{j,t}\gamma + k_j + t_t + \epsilon_{j,t} \quad (2)$$

Here, the variable  $PostPI_{s,t}^t$  is a binary indicator that takes the value of one in state  $s$  with the single-room policy turning one in period  $t$  and zero otherwise.

### Appendix C: Robustness Checks

In this study, we run a series of tests to check the robustness of the results with respect to threats to the identification strategy.

- a) In a first robustness check, we add to the regression model a variable measuring the rurality of the NH location, the county-level population density, and the county-level population fraction with severe needs of care. The continuous rurality measure constitutes the share of residents living in municipalities with a population density of less than 150 inhabitants per square kilometer.
- b) In a further robustness check, we exclude NHs from North Rhine Westphalia (NRW) from the analysis due to a change in the unit identifier starting in 2015. This circumvents that for each NH from this state two separate individual fixed effects are accounted for in the regressions, with the downside of excluding NHs from the state with the longest policy exposure.
- c) We also employ the Callaway and Sant'Anna (2021) estimator in a robustness check. This method uses never-treated states as a comparison group. It estimates the treatment effects by comparing treated units to those that never received treatment. This approach accommodates variations in treatment timing across units. We use a specific version of this estimator, which is based on a doubly-robust method, as described by Sant'Anna and Zhao (2020). It combines outcome regression with inverse probability weighting to generate consistent estimates even if one of the models (either the outcome regression or the policy likelihood function) is misspecified.
- d) Eventually, we also estimate a model that controls for pre-policy periods by including the lead terms as covariates (event study framework). This inclusion helps to differentiate the policy's impact from other factors at the state level that might have provoked shifts in the outcomes.

The results of these tests are presented in the upper panel of Tables A5 and A6 in this appendix for the average effect across periods, and Figure 3 (right panel) in the manuscript as well as Tables A7-A9 in this appendix for the dynamic effects.

To ensure the robustness of our approach to statistical inference, we also vary our approach to clustering the standard errors.

First, we use county-year clustering to account for common shocks at the market level. The respective standard errors consider that observations within the same county and year may be correlated, which helps to avoid a potential underestimation of the variability of the estimates.

Second, we apply two-way clustering to capture possible correlations within states over time and across years within states.

Additionally, we employ wild cluster bootstrapping, particularly the error weight Webb method. This technique is effective when the number of clusters is small and addresses heteroscedasticity and within-cluster correlation in the error terms (MacKinnon et al., 2023).

The results for alternative ways of clustering the standard errors are presented in the lower panel of Tables A5 and A6 for the average effects across periods, and Tables A10-A12 for the dynamic effects.

**Appendix D: Tables and figures**

**Table A1: Reallocation of care levels in the end of 2016**

Care levels before 2017	Care levels after 2017
1	1
1	2
2	3
<i>Severe care dependency levels</i>	
3	4
Hardship case	5

**Table A2: Descriptive statistics, by states with and without the policy in 2019**

Variable	Treatment				Control			
	2007		2019		2007		2019	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Beds	79	52	78	43	74	46	77	43
Share of people in severe need of care in...								
Nursing homes <sup>#</sup>	0.48	0.10	0.45	0.07	0.45	0.10	0.44	0.07
Home health care <sup>#</sup>	0.22	0.06	0.21	0.06	0.21	0.06	0.21	0.06
Informal care <sup>#</sup>	0.30	0.08	0.34	0.06	0.34	0.11	0.35	0.07
<i>Secondary outcomes variables</i>								
Single-room share	0.61	0.23	0.79	0.17	0.58	0.19	0.66	0.27
Out-of-pocket payments [EUR/day]	21.05	8.986	26.94	6.459	16.75	2.589	21.77	14.59
Number of nursing homes <sup>#</sup>	23	29	24	29	23	16	30	19
Nursing home entry <sup>#</sup>	0.00	0.00	0.02	0.03	0.00	0.00	0.03	0.04
Nursing home exit <sup>#</sup>	0.02	0.04	0.00	0.00	0.03	0.06	0.00	0.00
<i>Explanatory variables</i>								
Facility type: forms of care...								
Long-term	0.03	0.18	0.03	0.16	0.04	0.19	0.02	0.12
Long-term and short-term	0.09	0.29	0.10	0.30	0.08	0.28	0.05	0.22
Long-term and day care	0.07	0.26	0.10	0.30	0.06	0.24	0.09	0.29
All three forms	0.81	0.40	0.78	0.42	0.82	0.39	0.84	0.37
Provider type...								
Catholic	0.17	0.37	0.16	0.36	0.08	0.27	0.07	0.26
Protestant	0.18	0.38	0.18	0.39	0.16	0.37	0.15	0.35
Private	0.38	0.49	0.38	0.49	0.43	0.50	0.46	0.50
Municipal	0.06	0.23	0.05	0.22	0.04	0.19	0.03	0.17
Other public	0.01	0.11	0.01	0.08	0.00	0.07	0.01	0.08
Rural <sup>#</sup>	0.32	0.30	0.32	0.30	0.28	0.28	0.28	0.30
Population density <sup>#</sup>	52	73	55	80	49	62	53	66
People in severe need of care <sup>#</sup>	5,138	8,909	8,792	155,430	5,809	3,548	11,866	8,035

Note: <sup>#</sup> Variables measured at the county level.

Source: Own calculations based on the German Care Statistics, Statistical Offices of the Länder, [10.21242/22411.2007.00.02.1.1.0 -10.21242/22411.2019.00.02.1.1.0].

**Table A3: Average effects of single-room policy across periods on secondary outcomes**

	(1)	(2)	(3)	(4)	(5)
		Market structure of inpatient nursing care			
	Single-room share	OOP payments	Nursing homes <sup>#</sup>	Nursing home entry <sup>#</sup>	Nursing home exit <sup>#</sup>
Post-policy introduction	0.012*** (0.005)	0.358 (0.233)	-0.536 (0.457)	-0.033 (0.047)	0.086 (0.075)
Controls	X	X	X	X	X
Unit FE	X	X	X	X	X
Wave FE	X	X	X	X	X
N	75,679	75,679	2,849	2,420	2,448

Note: \* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01; Standard errors clustered at the state-year level in parenthesis. <sup>#</sup> County level.  
Source: Own calculations based on the German Care Statistics, Statistical Offices of the Länder, [10.21242/22411.2007.00.02.1.1.0 -10.21242/22411.2019.00.02.1.1.0]

**Table A4: Dynamic effects of single-room policy on secondary outcomes**

	(1)	(2)	(3)	(4)	(5)
		Market structure of inpatient nursing care			
	Single-room share	OOP payments	Nursing homes <sup>#</sup>	Nursing home entry <sup>#</sup>	Nursing home exit <sup>#^</sup>
Post-policy introduction periods (each period = 2 years)					
0	0.008*** (0.003)	0.257 (0.210)	-0.181 (0.435)	-0.111 (0.071)	-0.007 (0.072)
1	0.013*** (0.004)	0.324 (0.240)	-0.663 (0.510)	-0.072 (0.082)	0.267 (0.165)
2	0.021*** (0.005)	0.423 (0.288)	-0.890 (0.570)	0.189 (0.126)	0.013 (0.060)
3	0.029*** (0.006)	0.954** (0.444)	-0.873 (0.683)	-0.065 (0.064)	-0.021 (0.081)
4	0.058*** (0.013)	1.710*** (0.540)	0.380 (0.643)	-0.111 (0.099)	-0.162 (0.129)
5	0.089*** (0.009)	1.650*** (0.572)	0.757 (0.750)	-0.277 (0.168)	-
Controls	X	X	X	X	X
Unit FE	X	X	X	X	X
Wave FE	X	X	X	X	X
N	75,679	75,679	2,849	2,420	2,448

Note: \* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01; Standard errors clustered at the state-year level in parenthesis. <sup>#</sup> County level. <sup>^</sup> By variable construction, the value for the last period in our data is missing.

Source: Own calculations based on the German Care Statistics, Statistical Offices of the Länder, [10.21242/22411.2007.00.02.1.1.0 -10.21242/22411.2019.00.02.1.1.0]



**Table A5: Robustness checks for estimates of the average policy effect across periods**

	Care markets <sup>#</sup>			
	(1)	Share of people in severe need of care in...		
		(2)	(3)	(4)
	Beds	Nursing homes	Home health care	Informal care
<i>Alternative model specifications</i>				
a. Additional controls	-0.935** (0.404)	-0.015*** (0.005)	-0.002 (0.004)	0.017*** (0.005)
N	75,679	2,849	2,849	2,849
b. without North	-1.399*** (0.463)	-0.017*** (0.005)	-0.003 (0.004)	0.020*** (0.006)
Rhine-Westphalia				
N	61,040	2,477	2,477	2,477
c. Callaway and	-1.599** (0.704)	-0.030*** (0.007)	0.005 (0.006)	0.025*** (0.006)
Sant'Anna				
N	75,676	2,849	2,849	2,849
d. pre-policy period	-0.984** (0.492)	-0.018** (0.007)	0.002 (0.004)	0.016** (0.006)
effects (leads)				
N	75,679	2,849	2,849	2,849
<i>Alternative statistical inference</i>				
Coefficient	-1.063	-0.015	-0.002	0.016
a. two-way	(0.541)*	(0.007)**	(0.005)	(0.009)*
b. county	(0.189)***	(0.003)***	(0.003)	(0.003)***
c. wild boot	[-2.106 -0.289]	[-0.003 -0.002]	[-0.010 0.006]	[0.005 0.029]
Controls	X	X	X	X
Unit FE	X	X	X	X
Wave FE	X	X	X	X

Note: \* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01; Standard errors clustered at the state-year level in parenthesis. <sup>#</sup> County level.  
Source: Own calculations based on the German Care Statistics, Statistical Offices of the Länder, [10.21242/22411.2007.00.02.1.1.0 -10.21242/22411.2019.00.02.1.1.0]

**Table A6: Robustness checks for estimates of the average policy effect across periods on secondary outcomes**

	(1)	(2)	(3)	(4)	(5)
		Market structure of inpatient nursing care			
	Single-room share	OOP payments	Nursing homes <sup>#</sup>	Nursing home entry <sup>#</sup>	Nursing home exit <sup>#</sup>
<i>Alternative model specifications</i>					
a. additional control	0.012** (0.005)	0.386* (0.231)	-0.461 (0.379)	-0.036 (0.048)	0.084 (0.074)
N	75,679	75,679	2,849	2,420	2,448
b. without North Rhine-Westphalia	0.013** (0.005)	0.182 (0.259)	0.009 (0.011)	0.008 (0.009)	-0.705 (0.526)
N	61,040	61,040	2,477	2,102	2,129
c. Callaway and Sant'Anna	0.019*** (0.007)	0.435 (0.311)	-0.812 (0.761)	0.002 (0.008)	0.005 (0.004)
N	75,679	75,679	2,477	2,102	2,129
d. pre-policy period effects (leads)	0.013*** (0.005)	0.474* (0.255)	-0.168 (0.406)	-0.043 (0.047)	0.132 (0.105)
N	75,679	75,679	2,849	2,420	2,448
<i>Alternative statistical inference</i>					
a. two-way	(0.008)	(0.342)	(0.682)	(0.037)	(0.063)
b. county	(0.002)***	(0.080)***	(0.181)***	(0.008)***	(0.011)***
c. wild boot	[0.004 0.033]	[-0.155 0.797]	[-1.518 0.333]	[-0.135 0.050]	[-0.054 0.245]
Controls	X	X	X	X	X
Unit FE	X	X	X	X	X
Wave FE	X	X	X	X	X

*Note:* \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ ; Standard errors clustered at the state-year level in parenthesis. <sup>#</sup> County level.  
*Source:* Own calculations based on the German Care Statistics, Statistical Offices of the Länder, [10.21242/22411.2007.00.02.1.1.0 -10.21242/22411.2019.00.02.1.1.0]

**Table A7: Robustness check for dynamic effects of single-room policy: Additional controls**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Primary outcomes				Secondary outcomes				
	Share of people in severe need of care in...				Market structure of inpatient nursing care				
	Beds	Nursing homes <sup>#</sup>	Home health care <sup>#</sup>	Informal care <sup>#</sup>	Single-room share	OOP payments	Nursing homes <sup>#</sup>	Nursing home entry <sup>#</sup>	Nursing home exit <sup>#^</sup>
Post-policy introduction periods (each period = 2 years)									
0	-0.321 (0.266)	-0.009** (0.004)	-0.003 (0.005)	0.012** (0.005)	0.007** (0.003)	0.275 (0.205)	-0.173 (0.373)	-0.109 (0.069)	-0.007 (0.072)
1	-1.077*** (0.264)	-0.017*** (0.006)	0.003 (0.005)	0.014*** (0.005)	0.013*** (0.004)	0.373 (0.235)	-0.599 (0.441)	-0.069 (0.081)	0.267 (0.165)
2	-2.179*** (0.350)	-0.022*** (0.005)	-0.003 (0.005)	0.025*** (0.006)	0.020*** (0.005)	0.480* (0.278)	-0.825* (0.492)	0.193 (0.125)	0.013 (0.061)
3	-2.313*** (0.477)	-0.032*** (0.006)	-0.002 (0.008)	0.035*** (0.008)	0.029*** (0.006)	0.935** (0.460)	-0.814 (0.580)	-0.062 (0.063)	-0.019 (0.080)
4	-4.330*** (0.772)	-0.036*** (0.009)	-0.009 (0.012)	0.045*** (0.009)	0.058*** (0.013)	1.705*** (0.522)	-0.085 (0.556)	-0.112 (0.100)	-0.161 (0.129)
5	-5.913*** (0.622)	-0.054*** (0.009)	0.002 (0.009)	0.052*** (0.010)	0.088*** (0.009)	1.724*** (0.554)	-0.744 (0.687)	-0.287* (0.171)	-
Controls	X	X	X	X	X	X	X	X	X
Unit FE	X	X	X	X	X	X	X	X	X
Wave FE	X	X	X	X	X	X	X	X	X
N	75,679	2,849	2,849	2,849	75,679	75,679	2,849	2,420	2,448

Note: \* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01; Standard errors clustered at the state-year level in parenthesis. <sup>#</sup> County level. <sup>^</sup> By variable construction, the value for the last period in our data is missing.

At period 0, depending on the state's specific month of policy introduction, the reform was in effect between 1 and 23 months. At period 5, the policy was introduced between 10 and 12 years ago.

Source: Own calculations based on the German Care Statistics, Statistical Offices of the Länder, [10.21242/22411.2007.00.02.1.1.0 -10.21242/22411.2019.00.02.1.1.0]

**Table A8: Robustness check for dynamic effects of single-room policy: Without North Rhine-Westphalia**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Primary outcomes				Secondary outcomes				
	Share of people in severe need of care in...				Market structure of inpatient nursing care				
	Beds	Nursing homes <sup>#</sup>	Home health care <sup>#</sup>	Informal care <sup>#</sup>	Single-room share	OOP payments	Nursing homes <sup>#</sup>	Nursing home entry <sup>#</sup>	Nursing home exit <sup>#^</sup>
Post-policy introduction periods (each period = 2 years)									
0	-0.612** (0.308)	-0.011** (0.005)	-0.005 (0.005)	0.016** (0.007)	0.008** (0.004)	0.127 (0.218)	-0.131 (0.503)	0.006 (0.010)	0.004 (0.009)
1	-1.622*** (0.339)	-0.023*** (0.005)	0.006 (0.004)	0.017*** (0.005)	0.012*** (0.005)	0.042 (0.235)	-0.804 (0.629)	0.010 (0.012)	0.008 (0.011)
2	-2.384*** (0.402)	-0.018*** (0.005)	-0.003 (0.005)	0.021*** (0.007)	0.017*** (0.005)	0.099 (0.315)	-1.275* (0.706)	0.012 (0.013)	0.008 (0.010)
3	-2.354*** (0.510)	-0.026*** (0.006)	-0.009 (0.009)	0.036*** (0.010)	0.025*** (0.006)	0.752 (0.479)	-1.519* (0.809)	0.014 (0.014)	0.027** (0.011)
4	-5.667*** (0.444)	-0.025*** (0.008)	-0.032*** (0.008)	0.057*** (0.010)	0.076*** (0.007)	2.169*** (0.459)	0.044 (0.941)	0.042*** (0.015)	-
Controls	X	X	X	X	X	X	X	X	X
Unit FE	X	X	X	X	X	X	X	X	X
Wave FE	X	X	X	X	X	X	X	X	X
N	61,040	2,477	2,477	2,477	61,040	61,040	2,477	2,102	2,129

Note: \* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01; Standard errors clustered at the state-year level in parenthesis. <sup>#</sup> County level. <sup>^</sup> By variable construction, the value for the last period in our data is missing.

At period 0, depending on the state's specific month of policy introduction, the reform was in effect between 1 and 23 months. At period 4, the policy was introduced between 8 and 10 years ago. The coefficient for post-policy period 5 dropped due to collinearity resulting due to the exclusion of North Rhine Westphalia.

Source: Own calculations based on the German Care Statistics, Statistical Offices of the Länder, [10.21242/22411.2007.00.02.1.1.0 -10.21242/22411.2019.00.02.1.1.0]

**Table A9: Robustness check for dynamic effects of single-room policy: pre-policy period effects**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Primary outcomes				Secondary outcomes				
	Share of people in severe need of care in...				Market structure of inpatient nursing care				
	Beds	Nursing homes <sup>#</sup>	Home health care <sup>#</sup>	Informal care <sup>#</sup>	Single-room share	OOP payments	Nursing homes <sup>#</sup>	Nursing home entry <sup>#</sup>	Nursing home exit <sup>#^</sup>
Post-policy introduction periods (each period = 2 years)									
0	-0.286 (0.367)	-0.003 (0.008)	-0.013* (0.007)	0.016 (0.011)	0.007*** (0.003)	0.384 (0.236)	1.533* (0.815)	-0.090 (0.071)	0.000 (0.093)
1	-1.145*** (0.342)	-0.011 (0.010)	-0.007 (0.009)	0.018 (0.012)	0.015*** (0.004)	0.407 (0.245)	1.132 (0.890)	-0.042 (0.093)	0.270* (0.150)
2	-2.286*** (0.415)	-0.015 (0.010)	-0.014 (0.009)	0.029** (0.013)	0.023*** (0.005)	0.525* (0.301)	0.961 (0.931)	0.220 (0.139)	0.016 (0.073)
3	-2.333*** (0.507)	-0.026** (0.011)	-0.013 (0.011)	0.039*** (0.015)	0.031*** (0.006)	1.031** (0.445)	0.967 (-1.010)	-0.030 (0.075)	-0.027 (0.102)
4	-4.369*** (0.751)	-0.034** (0.014)	-0.020 (0.014)	0.055*** (0.016)	0.061*** (0.012)	1.750*** (0.545)	2.163** (0.986)	-0.075 (0.108)	-0.182 (0.149)
5	-6.022*** (0.639)	-0.062*** (0.014)	-0.010 (0.012)	0.072*** (0.017)	0.092*** (0.008)	1.693*** (0.589)	2.551** (-1.072)	-0.239 (0.163)	-
Leads	X	X	X	X	X	X	X	X	X
Controls	X	X	X	X	X	X	X	X	X
Unit FE	X	X	X	X	X	X	X	X	X
Wave FE	X	X	X	X	X	X	X	X	X
N	75,679	2,849	2,849	2,849	75,679	75,679	2,849	2,420	2,448

Note: \* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01; Standard errors clustered at the state-year level in parenthesis. <sup>#</sup> County level. <sup>^</sup> By variable construction, the value for the last period in our data is missing.

At period 0, depending on the state's specific month of policy introduction, the reform was in effect between 1 and 23 months. At period 5, the policy was introduced between 10 and 12 years ago.

Source: Own calculations based on the German Care Statistics, Statistical Offices of the Länder, [10.21242/22411.2007.00.02.1.1.0 -10.21242/22411.2019.00.02.1.1.0]

**Table A10: Robustness check for dynamic effects of single-room policy: County-year clustering**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Primary outcomes				Secondary outcomes				
	Share of people in severe need of care in...				Market structure of inpatient nursing care				
	Beds	Nursing homes <sup>#</sup>	Home health care <sup>#</sup>	Informal care <sup>#</sup>	Single-room share	OOP payments	Nursing homes <sup>#</sup>	Nursing home entry <sup>#</sup>	Nursing home exit <sup>#^</sup>
Post-policy introduction periods (each period = 2 years)									
0	-0.410*	-0.009***	-0.003	0.012***	0.008***	0.257***	-0.181	-0.111***	-0.007
	(0.214)	(0.003)	(0.003)	(0.003)	(0.002)	(0.083)	(0.190)	(0.011)	(0.010)
1	-1.222***	-0.017***	0.003	0.014***	0.013***	0.324***	-0.663***	-0.072***	0.267***
	(0.217)	(0.004)	(0.003)	(0.003)	(0.002)	(0.083)	(0.204)	(0.012)	(0.023)
2	-2.364***	-0.021***	-0.003	0.025***	0.021***	0.423***	-0.890***	0.189***	0.013
	(0.262)	(0.004)	(0.003)	(0.004)	(0.003)	(0.123)	(0.235)	(0.018)	(0.010)
3	-2.414***	-0.032***	-0.002	0.034***	0.029***	0.954***	-0.873***	-0.065***	-0.021
	(0.282)	(0.004)	(0.004)	(0.004)	(0.003)	(0.151)	(0.282)	(0.012)	(0.013)
4	-4.441***	-0.041***	-0.008*	0.049***	0.058***	1.710***	0.380	-0.111***	-0.162***
	(0.399)	(0.006)	(0.005)	(0.005)	(0.004)	(0.170)	(0.393)	(0.017)	(0.019)
5	-6.096***	-0.069***	0.003	0.066***	0.089***	1.650***	0.757*	-0.277***	-
	(0.451)	(0.007)	(0.006)	(0.006)	(0.005)	(0.222)	(0.456)	(0.026)	
Controls	X	X	X	X	X	X	X	X	X
Unit FE	X	X	X	X	X	X	X	X	X
Wave FE	X	X	X	X	X	X	X	X	X
N	75,679	2,849	2,849	2,849	75,679	75,679	2,849	2,420	2,448

*Note:* \* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01; Standard errors clustered at the county-year level in parenthesis. <sup>#</sup> County level. <sup>^</sup> By variable construction, the value for the last period in our data is missing.

At period 0, depending on the state's specific month of policy introduction, the reform was in effect between 1 and 23 months. At period 5, the policy was introduced between 10 and 12 years ago.

*Source:* Own calculations based on the German Care Statistics, Statistical Offices of the Länder, [10.21242/22411.2007.00.02.1.1.0 -10.21242/22411.2019.00.02.1.1.0]

**Table A11: Robustness checks for dynamic effects of single-room policy: two-way clustering**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Primary outcomes				Secondary outcomes				
	Share of people in severe need of care in...				Market structure of inpatient nursing care				
	Beds	Nursing homes <sup>#</sup>	Home health care <sup>#</sup>	Informal care <sup>#</sup>	Single-room share	OOP payments	Nursing homes <sup>#</sup>	Nursing home entry <sup>#</sup>	Nursing home exit <sup>#^</sup>
Post-policy introduction periods (each period = 2 years)									
0	-0.410 (0.362)	-0.009* (0.005)	-0.003 (0.006)	0.012* (0.007)	0.008* (0.005)	0.257 (0.248)	-0.181 (0.549)	-0.111* (0.066)	-0.007 (0.083)
1	-1.222*** (0.460)	-0.017*** (0.007)	0.003 (0.005)	0.014** (0.006)	0.013** (0.006)	0.324 (0.326)	-0.663 (0.759)	-0.072 (0.104)	0.267 (0.220)
2	-2.364*** (0.493)	-0.021*** (0.008)	-0.003 (0.005)	0.025** (0.009)	0.021*** (0.007)	0.423 (0.496)	-0.890 (0.927)	0.189 (0.173)	0.013 (0.038)
3	-2.414*** (0.752)	-0.032*** (0.010)	-0.002 (0.011)	0.034*** (0.012)	0.029*** (0.009)	0.954 (0.770)	-0.873 (1.159)	-0.065 (0.085)	-0.021 (0.119)
4	-4.441*** -1.079	-0.041** (0.016)	-0.008 (0.016)	0.049*** (0.011)	0.058*** (0.017)	1.710** (0.799)	0.380 (0.961)	-0.111 (0.146)	-0.162 (0.105)
5	-6.096*** (0.857)	-0.069*** (0.013)	0.003 (0.009)	0.066*** (0.012)	0.089*** (0.012)	1.650* (0.849)	0.757 (1.168)	-0.277* (0.148)	-
Controls	X	X	X	X	X	X	X	X	X
Unit FE	X	X	X	X	X	X	X	X	X
Wave FE	X	X	X	X	X	X	X	X	X
N	75,679	2,849	2,849	2,849	75,679	75,679	2,849	2,420	2,448

*Note:* \* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01; Standard errors clustered at both the state and year level in parenthesis. <sup>#</sup> County level. <sup>^</sup> By variable construction, the value for the last period in our data is missing. At period 0, depending on the state's specific month of policy introduction, the reform was in effect between 1 and 23 months. At period 5, the policy was introduced between 10 and 12 years ago.

*Source:* Own calculations based on the German Care Statistics, Statistical Offices of the Länder, [10.21242/22411.2007.00.02.1.1.0 -10.21242/22411.2019.00.02.1.1.0]

**Table A12: Robustness check for dynamic effects of single-room policy: wild bootstrap**

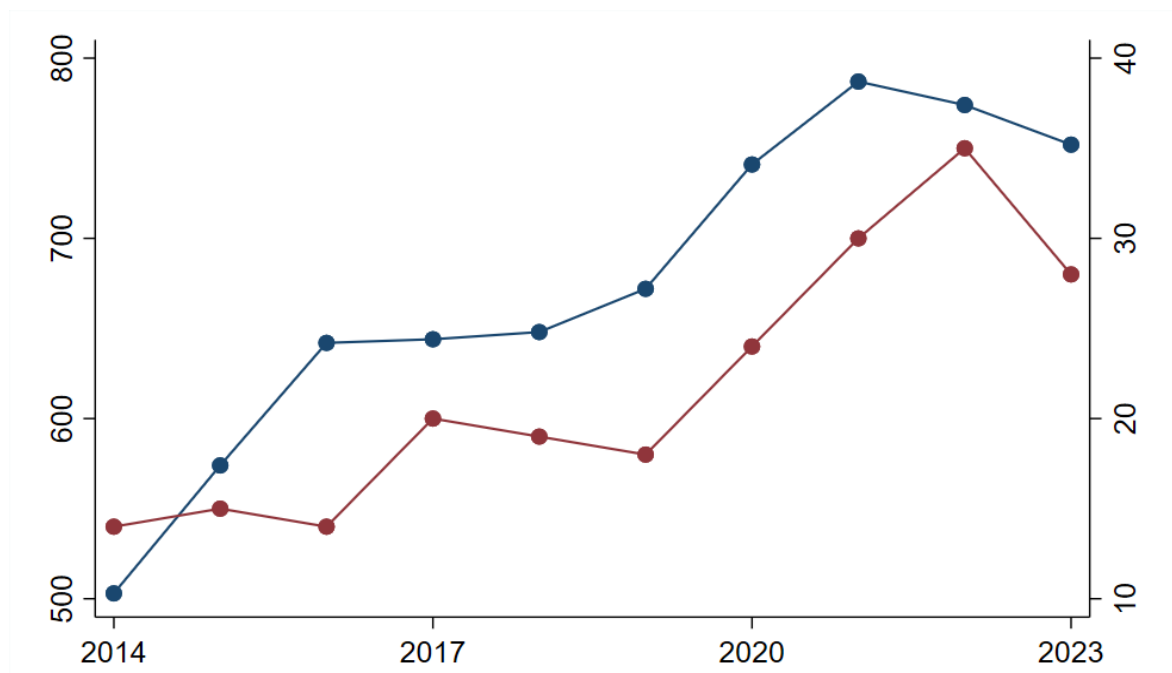
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Primary outcomes				Secondary outcomes				
	Share of people in severe need of care in...				Market structure of inpatient nursing care				
	Beds	Nursing homes <sup>#</sup>	Home health care <sup>#</sup>	Informal care <sup>#</sup>	Single-room share	OOP payments	Nursing homes <sup>#</sup>	Nursing home entry <sup>#</sup>	Nursing home exit <sup>#^</sup>
Post-policy introduction periods (each period = 2 years)									
0	[-1.000 0.217]	[-0.017 0.002]	[-0.013 0.009]	[0.001 0.025]	[0.002 0.014]	[-0.193 0.712]	[-1.097 1.024]	[-0.319 0.080]	[-0.197 0.155]
1	[-1.940 -0.630]	[-0.030 0.000]	[-0.013 0.013]	[0.004 0.024]	[0.005 0.021]	[-0.260 0.808]	[-1.866 0.676]	[-0.362 0.116]	[-0.026 0.902]
2	[-3.140 -1.594]	[-0.034 -0.010]	[-0.013 0.008]	[0.012 0.039]	[0.010 0.031]	[-0.156 0.980]	[-2.200 0.459]	[-0.066 0.719]	[-0.157 0.150]
3	[-3.333 -1.222]	[-0.047 -0.019]	[-0.024 0.016]	[0.017 0.055]	[0.015 0.044]	[-0.045 1.910]	[-2.545 0.719]	[-0.229 0.076]	[-0.227 0.158]
4	[-6.041 -2.558]	[-0.063 -0.016]	[-0.039 0.020]	[0.028 0.068]	[0.025 0.088]	[0.351 2.778]	[-1.543 2.201]	[-0.336 0.139]	[-0.806 0.903]
5	[-7.885 -4.534]	[-0.104 -0.032]	[-0.041 0.040]	[0.025 0.106]	[0.068 0.111]	[0.215 3.170]	[-2.838 3.650]	[-1.075 0.713]	-
Controls	X	X	X	X	X	X	X	X	X
Unit FE	X	X	X	X	X	X	X	X	X
Wave FE	X	X	X	X	X	X	X	X	X
N	75,679	2,849	2,849	2,849	75,679	75,679	2,849	2,420	2,448

*Note:* \* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01. <sup>#</sup> County level. <sup>^</sup> By variable construction, the value for the last period in our data is missing. At period 0, depending on the state's specific month of policy introduction, the reform was in effect between 1 and 23 months. At period 5, the policy was introduced between 10 and 12 years ago.

*Source:* Own calculations based on the German Care Statistics, Statistical Offices of the Länder, [10.21242/22411.2007.00.02.1.1.0 -10.21242/22411.2019.00.02.1.1.0]



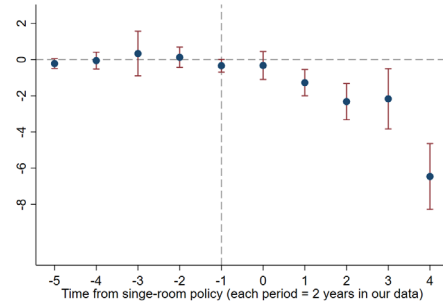
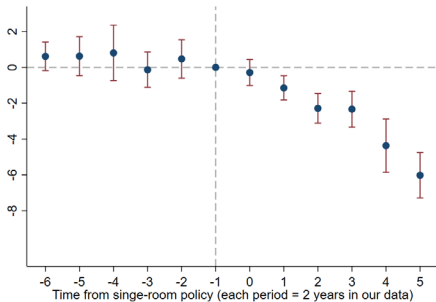
**Figure A1: Publications on person-centered care and single rooms in nursing**



*Note:* Systematic literature search in PubMed using the term 'nursing' in conjunction with 'person-centered care' or 'patient-centered care' (red line, left scale) and 'private room' or 'single room' (blue line, right scale).

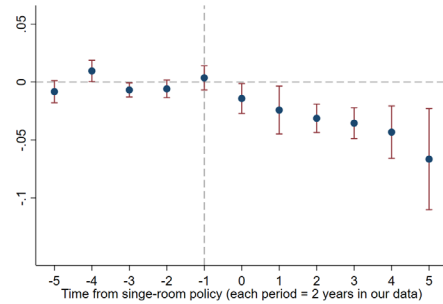
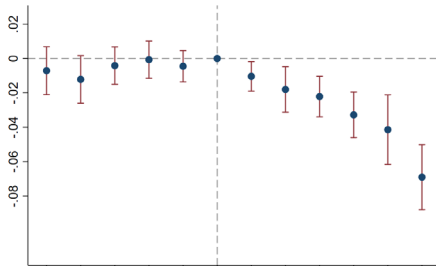
**Figure A2: Event-study effects of single-room policy**

a. Beds<sup>+</sup>

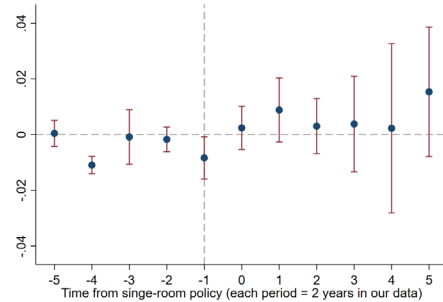
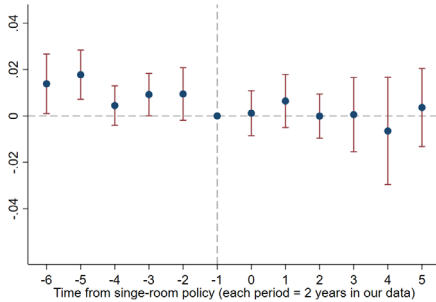


Share of people in severe need of care in...

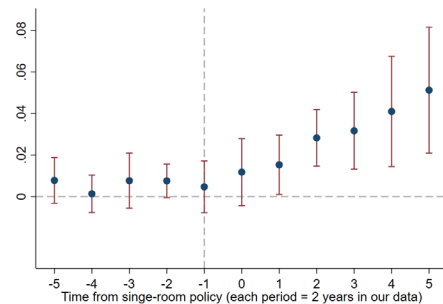
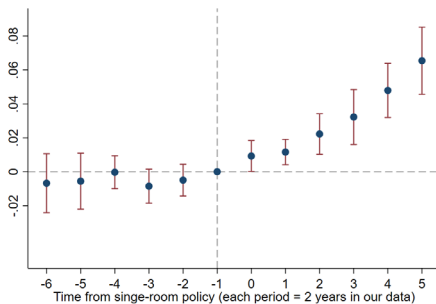
b. Nursing homes<sup>#</sup>



c. Home health care<sup>#</sup>



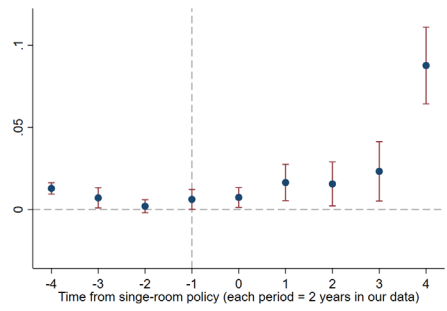
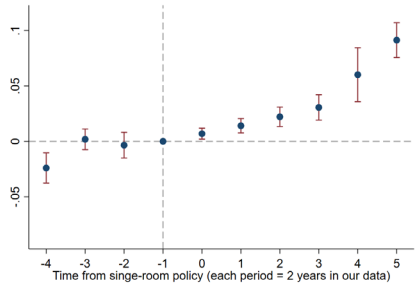
d. Informal care<sup>#</sup>



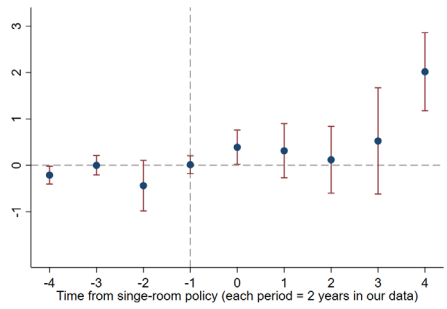
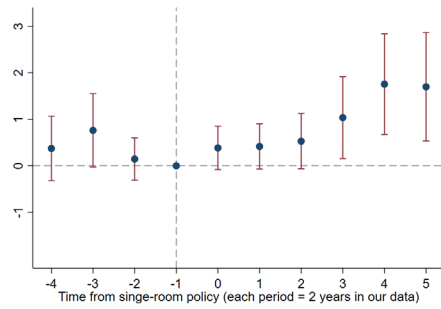
*Note:* The left panel of the figure displays the results of the two-way fixed-effects model. The right panel displays the results of the Callaway and Sant'Anna estimator. Each dot represents a coefficient estimate. Vertical bars denote the 95% confidence intervals, which account for clustering at the state-year level. The x-axis represents periods (in 2-year intervals) relative to the policy's implementation. At period 0, depending on the state's month of policy introduction, the reform was in effect between 1 and 23 months. The first pre-period in the right panel is period -5 given the pivotal role of the baseline year of the first treatment cohort (year 2007 for North Rhine Westphalia). <sup>+</sup>The point estimate for the policy effect in period 5 (10 to 12 years after the reform) is unavailable in the right panel because of the change in the identifier for homes in North Rhine Westphalia. <sup>#</sup> County level.

**Figure A3: Event-study effects of single-room policy on secondary outcomes**

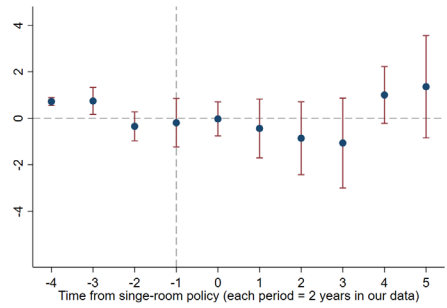
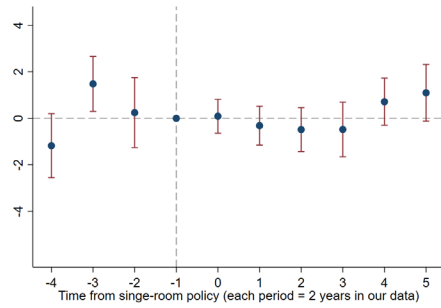
a. Single-room share<sup>+</sup>



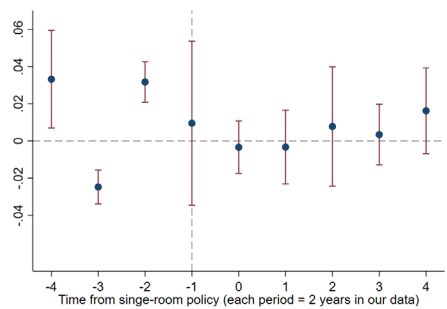
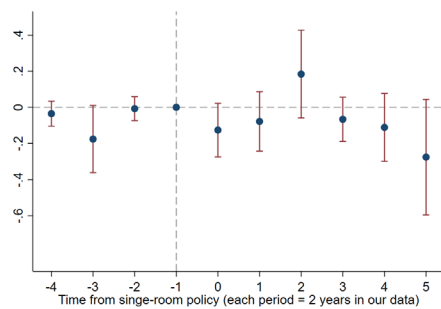
b. OOP payments



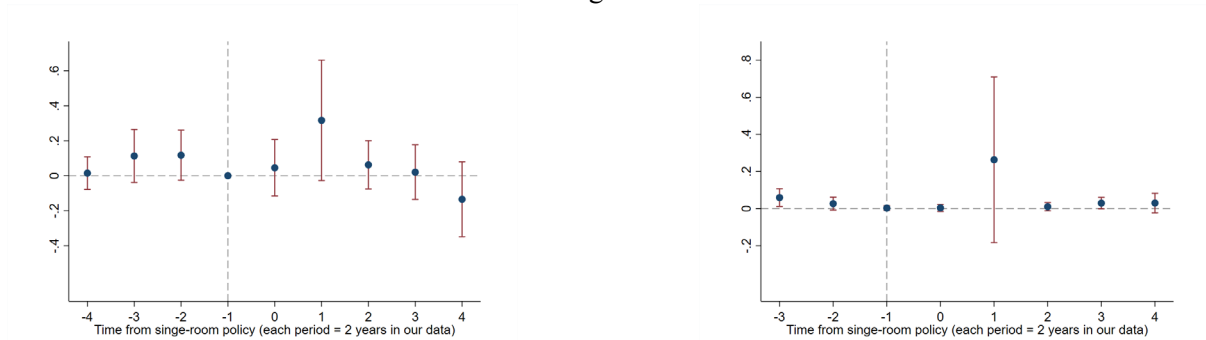
c. Number of nursing homes<sup>#</sup>



d. Nursing home entry<sup>#~</sup>



### e. Nursing home exit<sup>#^</sup>



*Note:* The left panel of the figure displays the results of the two-way fixed-effects model. The right panel displays the results of the Callaway and Sant'Anna estimator. Each dot represents a coefficient estimate. Vertical bars denote the 95% confidence intervals, which account for clustering at the state-year level. The x-axis represents periods (in 2-year intervals) relative to the policy's implementation. The dot and vertical bars displayed at period -4 represent average estimates over this and all preceding periods. The full results are available upon request.<sup>+</sup> The point estimate for the policy effect for period 5 (10 to 12 years after the reform) is unavailable in the right panel because of the change in the identifier for homes in North Rhine Westphalia. # County level. ~ The point estimate effect for period 5 is unavailable in the right panel because, by variable construction, the outcome data for 2007 is missing and the first state started treatment in 2009. As a result, there is no pre-treatment data available for comparison. ^ Since, by variable construction, the first available year for this variable is 2009 rather than 2007, the point estimate for period -4 is missing in the right panel.

### Appendix E: Calculations of direct fiscal effects of the single-room policy

To calculate the direct effects on the long-term care insurance payments, we multiply the payments per nursing home resident in care level 3 (but not at the higher care level with larger payments) of about EUR 1,800 (USD 2,500 in PPP) by the point estimate for the policy's impact after 5 periods, which is a 6.9 percentage point drop in the share of severely care-dependent individuals in nursing home care as opposed to home health care or informal care (panel B of Table 2, column 2).<sup>5</sup> Next, we multiply the insurance payment of EUR 901 (USD 1,253) for informally cared-for individuals in care level 3 (hardship case, §37 SGB XI, value for 2017-2019) by the estimated increase of 6.6 percentage points in the share of severely care-dependent individuals receiving informal care (column 5 of the table).

To calculate the direct effects on social assistance payments, we assume that approximately 40 percent of care recipients are entitled to social security payments due to their low income level. We multiply the average monthly nursing home out-of-pocket copayment of EUR 2,177 (USD 3,024 in PPP) in the control group in 2019 by the estimated reduction in the share of severely care-dependent individuals in

<sup>5</sup> Family members are likely to continue to be involved in informal care even when the care-dependent person receives nursing home care (e.g., Kim and Lim 2015). However, long-term care insurance does not provide financial benefits for informal care in this case, as these benefits are conditional on informal care being provided exclusively.

nursing home care due to the policy. We consider that the same 40 percent individuals would receive an additional lump sum of EUR 125 in informal care (§ 45b SGB XI, 2017-2024). Based on these components, we conservatively calculate the direct net fiscal gains to be  $EUR (1,800 + 0.4 \times 2,177) \times 0.069 - (901 + 0.4 \times 125) \times 0.066 = EUR 121.5$  (USD 169 in PPP) per month per individual with severe care dependency.<sup>6</sup>

#### **Appendix F: Upper-bound scenario for the indirect fiscal effects of the single-room policy**

To derive an upper-bound scenario for the indirect fiscal effects of the single-room policy, we follow Schmitz and Westphal (2017), who identify significant employment effects of informal caregiving on the intensive margin (reduction in working hours). These effects arise in the absence of the single-room policy when family members increase their working hours upon nursing home admission of the care-dependent individual, as this plausibly reduces the time spent on informal caregiving.<sup>7</sup> However, by restricting nursing home access, the policy may prevent this increase in working hours, thereby leading to a higher likelihood that family members remain in part-time employment.

Based on the estimation results of Schmitz and Westphal (2017), we assume that the single-room policy increases the probability of working part-time (relative to full-time employment) by approximately 4 percentage points. To adopt a very conservative approach and for simplicity, we assume that a family member who remains at reduced working hours due to informal care does not work at all. We suppose that this estimated effect applies to one family member per severely care-dependent individual switching from formal to informal family care. Following Korfhage and Fischer-Weckemann (2024), we further suppose that retirement effects are negligible in the short term. We assume that a family member of a care-dependent individual who does not work is comparable to the average worker in Germany, who receives a gross labor income of EUR 4,000 (USD 5,555 in PPP).<sup>8</sup> According to the Federal Ministry of Finance (2024), the average worker pays an income tax of 14 percent and a solidarity tax of 0.8

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<sup>6</sup> We use purchasing power parities exchange rates of 2024 provided by IMF (2024).

<sup>7</sup> Note, however, that Kim and Lim (2015) report statistically insignificant effects of facility care on the intensity of informal care among families with a severely care-dependent member.

<sup>8</sup> The average monthly gross labor income in the last observation period of our analyses, i.e., 2019, amounts to EUR 3,994 (German Federal Statistical Office, 2024). We use purchasing power parities exchange rates of 2024 provided by IMF (2024).

percent on the monthly income. Social security contributions, as reported by Liebig (2024), amount to 39.2 percent of gross income, comprising 18.6 percent for the pension system, 2.5 percent for unemployment insurance, 14.6 percent for social health insurance, and 3.05 percent for long-term care insurance.<sup>9</sup> This results in total monthly fiscal revenues of EUR 2,160 (USD 2,999 in PPP) per worker. Additional fiscal effects arise from public expenditures for social benefits and active labor market programs, which the average worker receives during periods of inactivity. Assuming the receipt of standard social benefits (and not temporary higher unemployment benefits), the monthly public expenditure would total EUR 1,040 (USD 1,444 in PPP) per individual outside the labor market.

In this upper-bound scenario, we calculate the indirect fiscal costs of the single-room policy to be EUR 8.5 (USD 11.8 in PPP) per person per month with care dependency at level 3 or higher.<sup>10</sup> Given that the direct net fiscal gains exceed these upper-bound indirect fiscal costs by more than 14 times, the adverse employment effects on the intensive margin would need to persist for an extended period to offset these benefits.<sup>11</sup> Specifically, the effects would need to continue for about 14 times the duration of the forgone nursing home stay of the care-dependent family member. With an average nursing home stay lasting approximately nine months (Barmer 2024), the labor market effects would need to continue for roughly eleven years to exceed the direct net fiscal gains. When calculating with discounted fiscal effects, this time window expands even further. However, there is no empirical evidence supporting such prolonged effect persistence. For instance, according to Schmitz and Westphal (2017), the employment effects of informal care turn statistically insignificant in the seventh year after the start of the informal care episode. This suggests that the policy's indirect costs are unlikely to outweigh its favorable direct fiscal effects.

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<sup>9</sup> We use information from 2019. The sickness-fund specific contributions are not considered.

<sup>10</sup> We multiply the monthly public expenditure with the estimated impact on the probability of not working full-time, i.e.,  $\text{EUR } (2,160 + 1,040) \times 0.04 \times 0.066 = \text{EUR } 8.45$ .

<sup>11</sup> We divide the net fiscal benefits by the fiscal costs, i.e.,  $\text{EUR } 121.5 / \text{EUR } 8.5 = 14.3$ .

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