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ABSTRACT

We construct a database of public pension policy changes with motivation and implementation information for ten OECD countries. Structural pension reforms, motivated by long-run sustainability concerns, often come with prolonged phase-in periods. In response to pension retrenchments implemented immediately, people close to retirement stay in the work force longer. News about future pension retrenchments with implementation lags, however, is likely to lead this group to exit the labor market. This decline in the labor force participation rate is particularly strong for reforms with long lags, ones that introduce fundamental policy changes, and where citizens have lower trust in the government.

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1 Introduction

Over the last half century, public spending on old-age pensions in OECD countries has been increasing, albeit at a varying pace across countries, as shown in Figure 1.[1] With aging societies, policymakers have increasingly focused on pension retrenchment reforms to keep their pension systems solvent. The unprecedented fiscal interventions in response to the Covid-19 pandemic will further weigh on governments' fiscal capacity and may motivate future pension reforms.

In this paper, we focus on the following questions: What impact do structural pension reforms have on the labor market and pension expenditures? Since many pension reforms come with prolonged phase-in periods, do these effects vary depending on the implementation lags? We address these questions employing rich panel data that covers a large set of countries across several decades.

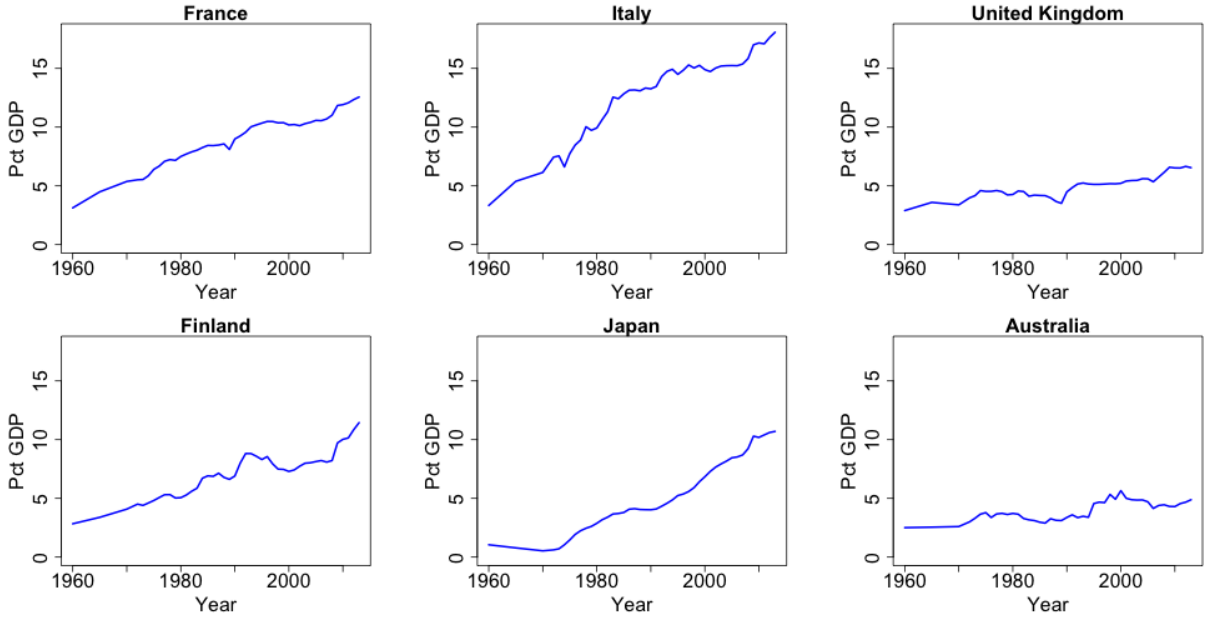
We first construct a new data set and document changes in public pension policy for ten OECD countries between 1962 and 2017.[2] By mainly relying on annual/bi-annual OECD Economic Surveys for each country and supplementing with legislative documents from country-specific sources, we collect information on four aspects: 1) the sign of pension changes, whether they made pension programs more or less generous; 2) policy tools associated with changes in pension policy, whether through changes in benefit formulas, coverage, indexation policy, or retirement age; 3) motivation behind policy changes; and 4) implementation lags, which is the time elapsed between when a policy change is initially enacted and when it is fully implemented. The latter two aspects have received little attention in the literature; to the best of our knowledge, our data set provides the first documentation of pension reforms for OECD countries with policy motivation and implementation information, which are essential for our empirical analysis.

Firstly, having information on motivation is crucial for us to study the causal effects of pension policy changes on labor market decisions and pension spending. When estimating macroeconomic effects, a fundamental issue is the endogeneity of policy changes to prevailing economic conditions. In documenting the motivation behind pension policy changes, we distinguish between policies driven by short-run cyclical or purchasing power concerns from those driven by long-run forces, such as fiscal sustainability, which can be thought of as structural pension reforms. The latter type of policy changes are at the heart of the narrative identification and, in the spirit of Romer and Romer (2010), allow us to make inference on

[1] Figure 1 plots pension spending for 6 countries with data available starting in 1960. For most countries, old-age pension spending data is available only after 1980.

[2] The data set includes Australia, Belgium, Denmark, Finland, France, Italy, Japan, New Zealand, Spain and the United Kingdom, and we discuss the reasons behind the choice of these countries in Section 3.

Figure 1: Public spending on old-age pensions has been rising across countries, even though the pace varies.



the causal effects of public pension policy changes in the short to medium run.

Secondly, implementation lags associated with structural pension reforms are the focus of our empirical analysis. These lags are typically long, close to a decade on average. We distinguish between pension policy changes that are implemented immediately following announcements from those implemented with lags, which allows us to explore the effects of pension reform on the labor market during the prolonged phase-in periods.[3]

With the new data set, we employ local projection methodology of Jordà (2005) to study the impact of structural pension reforms on the labor market and pension spending. We find that structural pension reforms, depending on whether they come with phase-in periods or not, can have a substantially different impact on the labor decisions of people who are close to retirement, as well as on the government budget. If structural pension retrenchments are implemented immediately, labor force participation rates (LFPR) for groups between the ages of 55 and 64 years rise. Less generous pension benefits, in combination with a higher LFPR for the older population, lead to a decline in the old-age pension spending. In response to an announcement about structural pension retrenchment that will be phased in over time, however, this marginal group of population are more likely to exit the labor market.

[3]Our analysis is focused on the short to medium run impacts of pension reform announcements. While it would be interesting to asses the long-run consequences, we would potentially run into endogeneity issues, as structural reforms are motivated by long-run concerns. In addition, we also face data limitations to assess whether the reforms ultimately achieve their objectives, as not all reforms in our data are fully implemented.

Therefore, government spending on old age pensions increases, rather than decreases, over the medium run.

Importantly, the decline in the LFPRs of people close to retirement in response to a lagged pension retrenchment is particularly strong for reforms that come with exceedingly long lags, in the order of 15 years or longer, and ones that change the fundamental aspects of pension systems, such as retirement age and contribution years. In addition, the level of trust that people have in the government also plays an important role, as the LFPR response is significantly and persistently negative in countries with low credibility.

Why would people close to retirement respond differently to pension policy changes with and without phase-in periods? The two types of pension changes can affect the marginal group through potentially different channels. The first is the *income effect* channel. With less generous pension benefits under retrenchments, agents may choose to stay in the labor force longer to save more for their retirement. This channel applies to pension changes in general, regardless of whether they are phased in or implemented immediately. The second is the *foresight* channel. If pension retrenchments are announced ahead of time, agents may respond to the news by retiring earlier if these reforms would take away certain pension options that are available to retirees in the pre-reform regime. This channel applies only to pension changes with phase-in periods. The third is the *uncertainty* channel. Pension retrenchments can demonstrate governments' political willingness and fiscal need to scale back pension systems and, therefore, may prompt people close to retirement to update their priors on the likelihood of future reforms and reconsider their retirement decisions. This uncertainty channel can be particularly powerful for reforms that change the fundamental aspects of the pension system.

Our finding confirms that the *income effect* channel prevails in response to pension changes without lags. When governments scale back their pension systems, people close to retirement push back their retirement to stay in the labor force longer, as they face lower future pension benefits. For pension changes with relatively short lags, the *foresight* channel largely offsets the *income effect* channel, leading to a muted response in the LFPRs of people close to retirement. For pension changes with prolonged lags, however, the *uncertainty* channel dominates, as the LFPRs of the marginal group see a significant decline in response to this type of pension retrenchment. The majority of reforms with exceedingly long lags make fundamental changes to the pension systems, revealing governments' political willingness to undertake reforms and leading people to update their beliefs about future policy changes. In particular, we find that the decline in the LFPRs is much larger in countries where people have lower trust in the government.

Our paper contributes to the literature and policy debates along the following lines.

Firstly, we create a new data series on pension reforms with motivation behind those policy changes as well as information about implementation plans. Some existing databases have documented pension policy changes for OECD countries. Beetsma, Klaassen, Romp, and van Maurik (2020) construct a database of pension reforms using narrative methods for several OECD countries for the period 1970-2017 based on the NATLEX database of the International Labor Organization, the International Social Security Association database, the European Commission's LABREF database, the OECD and other sources.[4] Fondazione Rodolfo Debenedetti (fRDB) also has data on reforms of public pension systems in Europe starting in the mid-1980s. However, none of these data sets provide the motivation behind pension policy changes or information about policy implementation and, to the best of our knowledge, our data set provides the first documentation of these important aspects.

Secondly, our data set goes back to the early 1960s, while the existing literature has largely focused on pension reforms since 1990s. The longer data set uncovers that besides an aging society, the expansion in pension programs between 1960s and 1980s played an important role in the rapid increase in pension spending across countries. Over this period, pension programs offered more generous payments to the elderly population and also extended them to a broader segment of population, motivated partially by cyclical reasons and partly by purchasing power concerns. The expansion, however, significantly increased pension liabilities. In order to keep their pension systems solvent, governments have undertaken significant pension retrenchment reforms since the 1990s, many of which come with prolonged implementation lags. These phase-in periods are needed to ease the impact of pension reforms on retirees by providing them time to adjust their retirement plans. In addition, implementation lags make pension retrenchments more satiable for the public, as they are politically challenging to enact.

Last but not least, our empirical analysis provides important policy insights on how to design pension reforms. Pension policy changes that are implemented immediately after announcements can encourage people close to retirement to stay in the labor force longer, alleviating fiscal sustainability concerns. However, it may not be possible or desirable to conduct fundamental pension reforms without phase-in periods. In this case, pension retrenchments that mitigate the *foresight* channel, for instance by linking pension retrenchment measures to the birth-year of an individual, can contain the decline in the LFPRs of people close to retirement. More importantly, governments with high credibility can better anchor people's expectations about pension system and reduce uncertainties associated with future pension

[4]The International Labor Organization's NATLEX, a database of national labor, social security and related human rights legislation, provides information starting in the 1970s. The LABREF database, managed by the European Commission in cooperation with the Employment Committee, has all labor market reforms starting in 2000.

reforms, thus dampening the negative impact from the *uncertainty* channel.

The paper is structured as follows. Section 2 explains how our paper fits into the existing literature and Section 3 explains how we compile the data set. In Section 4, we explore the evolution of pension policy changes, showing that pension retrenchments in recent decades often come with prolonged phase-in periods. Section 5 explains the empirical approach. Section 6 shows that the impact of structural pension retrenchments on the labor market and pension spending depends on whether reforms come with implementation lags or not. Section 7 shows various robustness checks, while Section 8 concludes.

2 Literature Review

Our paper contributes to a growing literature that employs narrative methods to identify variations in policy variables of interest and motivations behind them to isolate 'exogenous' events. Notable examples include Romer and Romer (1989) and Romer and Romer (2004) for constructing monetary policy shocks based on the minutes of the Federal Open Market Committee, Ramey (2011) for compiling defense news shocks based on articles from Business Week, and Romer and Romer (2010) for constructing narrative tax shocks based on tax legislative documents. More recent works include Guajardo, Leigh, and Pescatori (2014) and Alesina, Favero, and Giavazzi (2015) who identify fiscal consolidation events for a large set of countries.

Given our focus on pension spending, our paper ties to the macroeconomic empirical literature related to social spending programs. Using a narrative approach, Romer and Romer (2010) find that a permanent increase in social security benefits leads to a significant but short-lived increase in consumption, while temporary changes have no significant effects. In closely related work to our paper, Beetsma, Klaassen, Romp, and van Maurik (2020) construct a database of pension reforms using narrative methods for several OECD countries for the period 1970-2017. Their main finding is that business indicators are important for the timing of pension policy changes, with contractionary measures more likely during bad times and expansionary measures less so.[5] Importantly, they do not discuss motivation and implementation lags associated with these policy changes, which are the main crux of our paper.

A wealth of empirical literature focus on individual pension reforms by employing rich micro-data and a difference-in-difference approach. Attanasio and Brugiavini (2003) and Attanasio and Rohwedder (2003) study the impact of social security reforms on private savings and consumption behaviors. Related to the labor market, Mastrobuoni (2009) and

[5]Beetsma, Klaassen, Romp, and van Maurik (2020) also show that demographic developments dictate the trend of pension policy changes but do not affect dynamics in the short-run.

Behaghel and Blau (2012) evaluate the effects of a cohort-specific increase in retirement age on retirement behaviors in the United States, after the reform was fully implemented. Using administrative data, Staubli and Zweimueller (2013) show that an increase of minimum retirement age in Austria saw a reduction in retirement, as well as an increase in employment. Hernæs, Markussen, Piggott, and Røed (2016) find that the removal of an earnings test in Norway led to an increase in labor supply within the affected population. Our paper complements these papers by studying the impact of pension reforms on LFPRs prior to or during the implementation periods. Importantly, our analysis highlights that people close to retirement respond differently based on how far in advance the policies are announced.

In addition, there is a large literature studying the macroeconomic impact of pension reforms through the lens of theoretical models. Blundell, French, and Tetlow (2016) review the evidence on the role of incentives, including public pension policies for retirement decisions. The volume of Gruber and Wise (2004) adopts a micro estimation approach and provides a country-by-country analysis of social security program incentives and retirement behavior.[6] Their simulations show that changes in social security program provisions can have large effects on the LFPRs of older employees. Through calibrated life-cycle models, Diaz-Gimenez and Diaz-Saavedra (2009) and Imrohoroğlu and Kitao (2012) find that pension retrenchments that are implemented immediately raise LFPRs and reduce pensions pending, which is consistent with our finding on pension reforms without implementation lags. Bütler (1999),Gomes, Kotlikoff, and Viceira (2012), and Kitao (2018) study the impact of delayed pension reforms on the aggregate economy.

Finally, we rely on OECD publications as a primary source for identifying pension policy changes across a panel of countries, and therefore our paper is also related to previous studies which have used similar publications for identification purposes. For instance, Romer and Romer (2017) construct a semi-annual measure of financial distress for 24 OECD countries based on country-specific OECD Economic Outlooks. Duval and Furceri (2018) employ the OECD Economic Surveys for 26 individual advanced economies to build a data set of labor and product market reforms and study their effects on output, employment and productivity.

3 New Measure on Pension Policy Changes

We document changes in pension policy for 10 OECD countries - Australia, Belgium, Denmark, Finland, France, Italy, Japan, New Zealand, Spain and the United Kingdom - from 1962 to 2017. The number of countries is limited by the broad scope of work associated with

[6]The micro estimation approach allows for a calculation of present value of individuals' pension wealth, providing insight on actuarial fairness and neutrality associated with pension system. We rely on macroeconomic data and abstract from explicit discussion on actuarial neutrality.

each country. We choose these ten countries as they are diverse along several dimensions, and therefore could potentially serve as representatives for countries that are missing in our data set. Firstly, these geographically diverse countries – from the Continental Europe including Scandinavian countries, to Asia and Australia – cover a range of different pension systems.[7] These systems, as well as demographic developments, have led to vastly different pension spending across the ten countries, ranging from 5% of GDP in Australia to close to 20% in Italy. Secondly, these countries have also had different experiences with pension reforms. Some countries have successfully implemented far-reaching pension reforms (such as Belgium), while other countries still face challenges in reducing their pension spending despite repeated efforts with multiple pension reforms (such as Italy).[8]

3.1 Data Sources In compiling the data set, we rely on country-specific OECD Economic Surveys (the Surveys thereafter) published at an annual or bi-annual frequency. The Surveys discuss key economic challenges, policy changes that address those challenges, and, more recently, policy recommendations from the OECD to the targeted country.[9]

Discussions related to pension policy have been gaining prominence in the Surveys over the years. The average length of the Surveys across the 10 countries increased markedly from 80 pages in 1970 to 136 pages in 1991, and then 144 pages in 2010. Discussions on pension policy, nevertheless, have increased at an even faster pace. In 2010 Surveys, the word of 'pension(s)' was mentioned over 70 times on average across countries, compared to only 3 times in 1970 and 32 times in 1990.

The format of the Surveys has also changed over time. Before 1973, the Surveys only provided general discussions on fiscal policy. From 1973 to 2002, the Surveys provided chronologies of major economic policy events for most countries in our sample, including changes in pension policy. Since 2003, the Surveys have provided in-depth discussions on economic challenges and policy recommendations. Section B in the Appendix provides excerpts from the surveys during the three distinct time periods and further explains how we extract information from the Surveys.

In addition to the Surveys, we use a wide range of supplemental country-specific doc-

[7]For instance, early retirement programs were not important for countries like Japan and Australia, but they played a significant role in expanding the pension system in Continental European and Scandinavian countries.

[8]In addition, we have abstracted from a couple of major countries for idiosyncratic reasons. For instance, we excluded the United States, because Romer and Romer (2016) take a similar approach as our paper and have done a comprehensive study of social security policy changes in the U.S. They also point out that since 1991, the social security system has not seen any major changes. We also excluded Germany, as the unification in 1990 complicates the data collection.

[9]For some countries, like Australia and New Zealand, the OECD Surveys were less informative and we relied more heavily on legislative documents.

uments. For European countries, we cross check our data set with the NBER series on social security programs and retirement around the world, including Fraikin, Jousten, and Lefebvre (2018) for Belgium, Bingley, Gupta, Jorgensen, and Pedersen (2014) for Denmark, Lassila and Valkonen (2002) for Finland, Blanchet, Bozio, Rabate, and Roger (2019) for France, Franco (2002) and Brugiavini and Peracchi (2014) for Italy, Vegas Sánchez, Argimón, Botella, and González (2013) and Garcia-Gomez, Garcia-Mandico, Jimenez-Martin, and Castello (2018) for Spain, and Blake (2002) and Banks and Emmerson (2018) for the United Kingdom. For non-European countries, we use Nielson (2010) and Herscovitch and Stanton (2008) for Australia, and John and Willmore (2001) for New Zealand as reference. Also, we cross check our data set with Beetsma, Klaassen, Romp, and van Maurik (2020), in which the authors compile pension reform measures using the NATLEX database of the International Labor Organization, the International Social Security Association database, the European Commission's Labour Market Reform database, and other sources.

3.2 Approach We take a narrative approach similar to that of Romer and Romer (2010, 2016) for tax and transfer policy changes in the United States, and Ramey and Shapiro (1998) and Ramey (2011) for defense spending changes in the United States. We extract changes in pension policy by reading through discussions related to subjects such as pensions, retirement, and social security in the Surveys for the 10 countries between 1962 and 2017.[10] We collect information along four distinct aspects.

Sign: We first document the sign of pension changes, whether they made pension programs more or less generous. In general, it is straightforward to decide on the direction of pension changes. For instance, expanding the coverage of old-age pension or lowering the statutory retirement age makes pension program more generous. On the other hand, scaling back an early retirement program makes the pension system less generous.

Nevertheless, it is much more challenging to determine the budgetary impact of pension policy changes, and therefore we employ a dummy approach. The Surveys do not provide consistent estimates on the budget impact related to specific changes in pension policy, particularly with many of them phased in over a long period of time. More importantly, pension policy changes can significantly alter people's behaviors in the short and long term, in particular for those who are close to retirement, as we will further explore below. The dynamic and endogenous reactions distinguish changes in pension policy from those in defense spending and, to a less degree, those in tax policy. Therefore, it is very challenging to

[10]The publication start dates for the Surveys vary across countries: Belgium, Denmark, France, Spain and the United Kingdom started in 1962, while Italy in 1963, Finland in 1969, Japan in 1964, Australia in 1972 and New Zealand in 1975.

provide a budgetary estimate for each pension policy change as the literature typically does for changes in taxes and government spending, for instance in Romer and Romer (2010) and Ramey (2011). Instead, we take the dummy approach by constructing pension dummies and assigning an intensity value to each dummy, distinguishing reforms with multiple policy changes from those with a single policy change.[11] For example, the Belgium government passed a comprehensive reform in 2015, which included five major changes in pension policy. In our data set, we classify the 2015 Belgium reform as "-5", as all five policy changes made pension system less generous.[12]

Motivation: Next we identify the motivation behind each pension policy change by classifying them under three broad categories.

Some pension changes were motivated by concerns related to *purchasing power*, as they were intended to maintain or improve the purchasing power of retirees, or ensure living standards of the beneficiaries. For instance, in 1974 the Belgium government decided to link social welfare benefits to changes in the general standard of living in addition to their linkage to price index. In 2000, pension was increased in Australia as part of a package to compensate for the introduction of a goods and services tax.

Some changes were driven by *cyclical* reasons, as they were undertaken to stimulate the economy in a recession or in response to the near-term economic conditions. For instance, the Belgian government created three early retirement programs from 1975 to 1978 and expanded those programs in the early 1980s to stimulate economic growth by creating job openings for younger workers following a recession. In 1984, the Finnish government decided to skip the indexation adjustment of pensions as it adopted a counter-cyclical restrictive policy stance.

Last but not least, we categorize some pension changes as *structural* policy changes, as they have been taken to address long-run issues like fiscal sustainability and aging demographics. For instance, the Belgian government rolled back early retirement programs gradually between 1997 and 2019 by increasing the minimum age for early retirement from 55 to 63 years through a sequence of reforms.

[11] This approach was commonly employed in the earlier literature identifying monetary and fiscal shocks, see for example, Romer and Romer (1989), Ramey and Shapiro (1998), and Burnside, Eichenbaum, and Fisher (2004). More recently, the dummy approach is employed, with or without intensity, in various applications, particularly for cross-country analysis, such as the financial distress measure of Romer and Romer (2017), labor and product reforms documented by Duval and Furceri (2018), and capital controls database constructed by Fernandez, Klein, Rebucci, Schindler, and Uribe (2016).

[12] Section B in the Appendix explains how we construct pension dummies in more detail. We also have more discussion about the role of these intensity measures in our estimation results and an example of how they line up with data in Section 5.2.

Policy Tools: We also document policy tools associated with changes in pension policy. Although the specific tools vary, they can largely be categorized into one of the four types:

Changes associated with pension *coverage*, which include changes in the number of service years required for retirement or changes in regulations related to means or assets test. For instance, in 2006, Belgium announced a plan to increase the number of service years required to qualify for early retirement from 25 to 30 years by 2008 and from 30 to 35 years by 2012. In 1975, Australia abolished its means test for retirees between 70 and 74 years.

Changes related to *benefit formulas*, which include direct changes to pension payments or changes in number of years that form the calculation basis for pension payments.[13] For example, pension benefits in Japan were increased from 2,300 to 3,300 Yen per month in 1972.

Changes in pension payment *indexation*, which involve moving away from indexing benefits to wages or earnings and toward indexing benefits to prices. For instance, in 1992, the Italian government announced a switch in the indexation of pensions from wages to prices.

Changes in the pension *eligibility age* at which workers can retire. For example, in 2000 Finland decided to raise the age limit of the individual early retirement pension from 58 to 60 years for those born after 1944. In 2015, the Denmark government decided to limit the average time of individuals spending in retirement to 14.5 years, and therefore it would adjust the retirement age in response to changes in life expectancy every five years.

Implementation Lags: Lastly, we track implementation lags, which is the time elapsed between when a policy change is initially enacted and when it is expected to be fully phased in.[14] Mertens and Ravn (2011) and Mertens and Ravn (2012) highlight the importance of differentiating unanticipated and anticipated tax changes, as preannounced but not yet implemented tax cuts give rise to contractions in output. Implementation lags in pension policy changes are significantly longer than those documented in tax changes, which can be important as we investigate the economic impact of pension reforms.

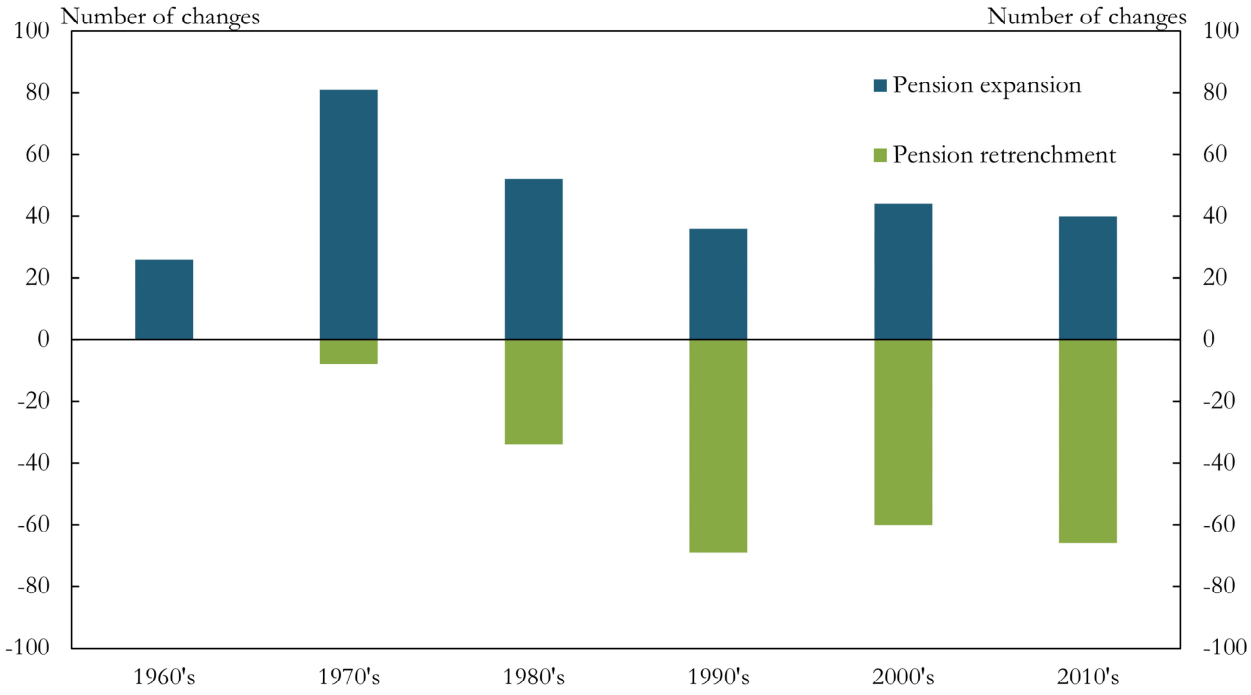
4 Overview of Pension Policy Changes

This new data set shows that changes in pension policy have come in waves: many countries that expanded their pension systems between 1960s and 1980s have scaled them back since

[13]This category includes changes on accrual of pension rights, pension payment calculations, as well as direct changes on benefit payments, both temporary and long-term. Given data limitations, we are unable to analyze these different types of changes separately.

[14]In some cases, we only know when the policy change was fully phased in, but have no knowledge of the expected phase-in period at the time of enaction. Under those circumstances, we use the eventual phase-in period as the implementation lag.

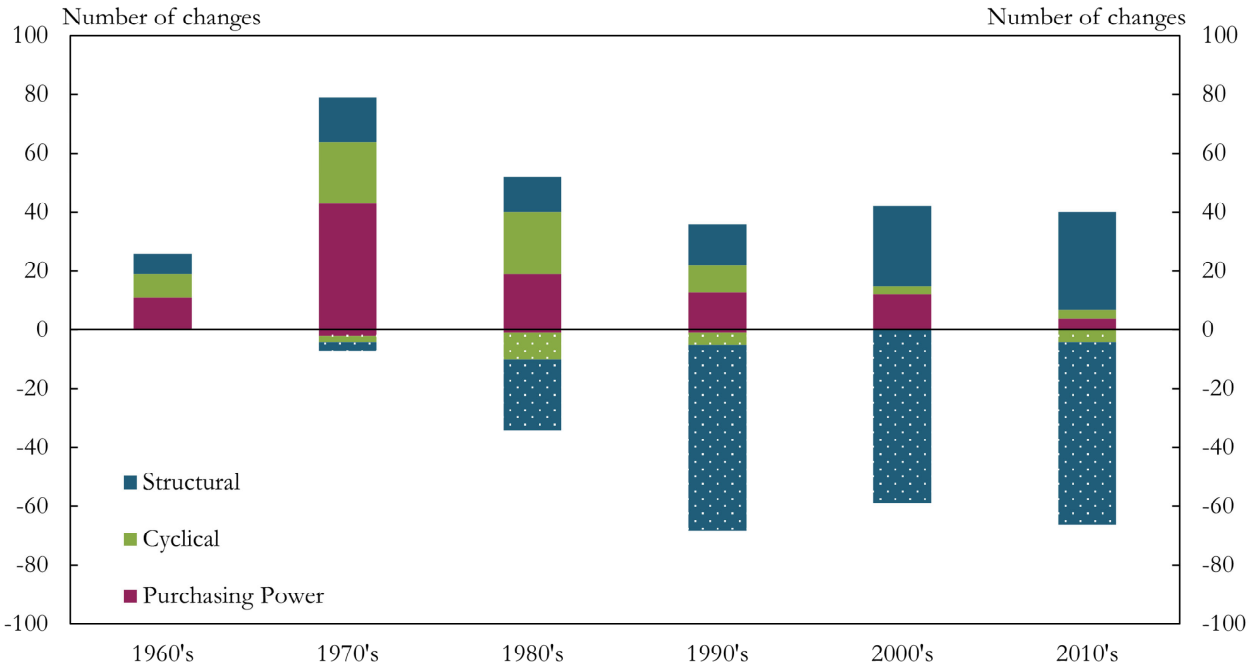
Figure 2: Changes in pension policy have come in waves with expansions to pension systems between 1960s-80s following by retrenchments since the 1990s. Each bar shows the number of policy changes during each decade. Blue bars represent policy changes that made pension scheme more generous, while green bars show pension retrenchments that were adopted to scale back pension schemes.



the 1990s. Figure 2 shows that the period between 1960s and 1970s was entirely dominated by pension expansions, as countries in our data set passed more than 100 policy changes during the two decades by lowering retirement age, broadening pension coverage, providing more favorable indexation, and raising benefit payments. The turning point arrived in the 1980s, with some countries continuing to expand their pension systems while others started to dial back. The pace of pension retrenchments peaked in the 1990s: together, these countries adopted close to 70 policy retrenchment changes from 1990 to 1999, partly driven by actions taken by European countries in order to qualify joining the European Union. More recently, countries have adopted a similar number of pension retrenchments in 2000s and 2010s. It is notable that countries have been adopting both expansionary and contractionary changes to pension systems since 1990s – even though they have been continuing to scale back their pensions system, the pace of pension expansions has also remained at an elevated level during the past three decades.

Focusing on the motivation behind pension policy changes, we find that pension expansions in the early decades were typically driven by cyclical and purchasing power considera-

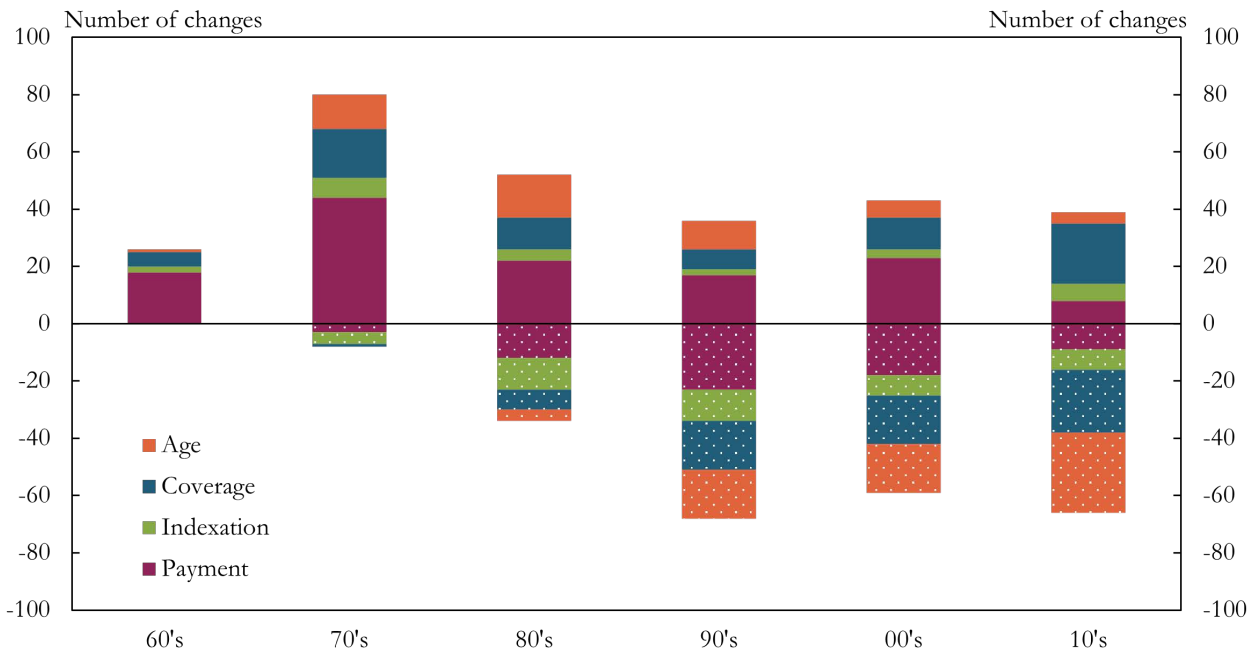
Figure 3: Motivations associated with pension policy changes. Expansions between 1960s and 1970s were largely driven by cyclical and purchasing power considerations, while recent policy changes since the 1990s have been dominated by structural reforms.



tions, while policy changes since the 1990s have been dominated by structural reforms. As shown in Figure 3, about half of pension expansions between 1960s and 1980s were driven by considerations related to purchasing power and living standards of retirees. Japan is a prominent example, as the government increased the old-age pension from 3% of average earnings of workers in 1972 to 10% in 1975.[15] In addition, about one third of pension expansions during the same period were motivated by cyclical reasons, as many European countries created and expanded early retirement programs to combat economic recessions and high unemployment during this period. Since the 1990s, changes in pension policy, including both expansions and retrenchments, have been largely driven by long-run structural concerns. For instance, the French government passed an important reform package in 2003, raising the minimum number of contribution years and scaling back pension benefits. At the same time, it also raised the minimum pensions and introduced an early retirement program for people who started working at a young age, making pension system more generous for some beneficiaries.

[15]The old-age pension payment was 2,300 yen per month in 1972 and increased to 10,000 yen in 1975, compared to average earnings of workers of 100,000 yen per month at the time (OECD Economic Surveys of Japan, 1972 and 1973).

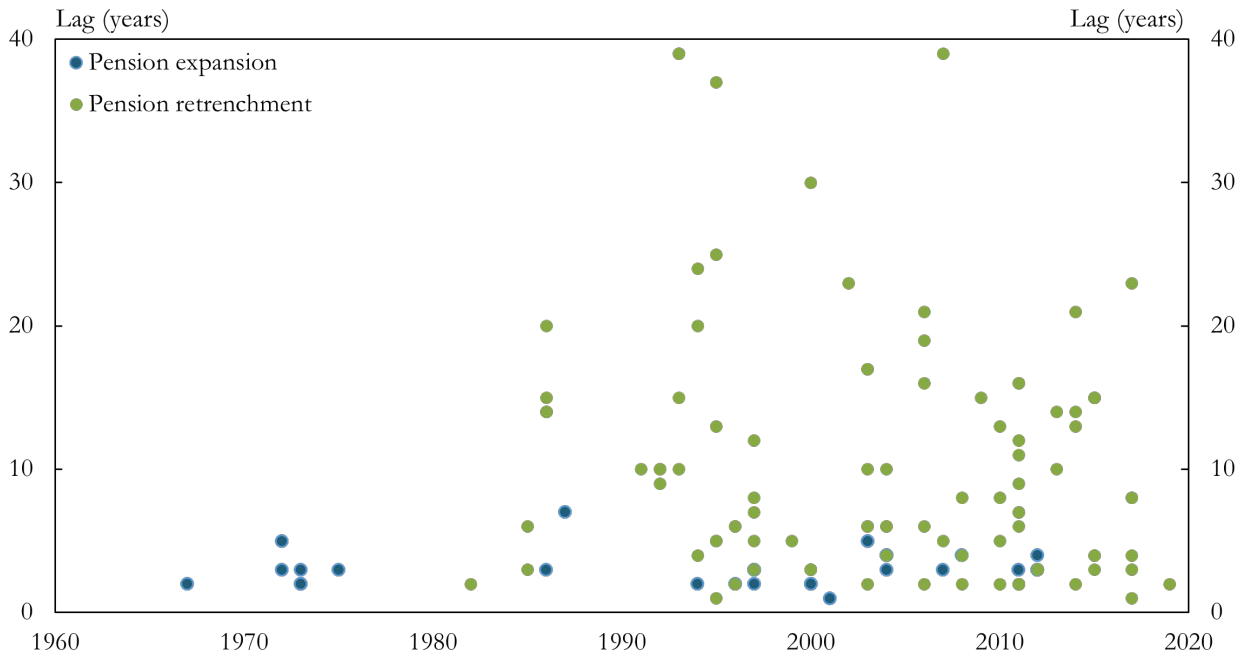
Figure 4: Policy tools associated with pension changes. Pension payments, retirement age, and pension coverage have played an important role over the years.



Compared to the notable shift in motivation over time, changes in policy tools during the past six decades have been more muted. Governments lowered retirement age and broadened pension coverage in 1970s and 80s, as show in Figure 4. Those policy tools have also played a significant role in pension retrenchments since the 1990s. More than half of the pension changes in the 1960s and 70s were through changes in pension payments or benefit calculation formulas, which remained important in recent decades.

Turning to implementation lags, we find that pension retrenchments often come with significant phase-in periods. In our data set, we have identified 152 pension changes with implementation lags since 1962, out of which over 80 percent are pension retrenchments. Figure 5 shows that phase-in periods for those policy changes have a wide range with an upper bound of 39 years and an average of close to 9 years, where each dot represents the phase-in period associated with one change. The majority of lagged policy changes are pension retrenchments, as shown in green dots. The 1993 pension reform in Finland can shed light on the gradual pace of implementing pension policy changes. As an attempt to end the favorable pension treatment of civil servants, the government introduced an increase in the retirement age of public sector workers from 63 to 65 years. The change, however, was introduced very gradually with the transition period expected to end in 2032, as it only applies to new civil servants. In 1995, the government sped up the reform by applying the

Figure 5: Pension implementation lags (measured in years). Each dot represents the implementation lag associated with one policy change. Green dots are associated with pension retrenchments, while blue dots are for pension expansions.



new change to civil servants aged 55 or below. The transition, nevertheless, would still take 10 years.

We provide three case studies to further illustrate the challenges of adopting pension retrenchment reforms and the potential impact of structural changes on the labor market. The evolution of early retirement programs in Continental Europe has provided a good lab in that regard. In the late 1970s and early 1980s, many European countries created and expanded early retirement programs in response to recessions and high unemployment, particularly among the youth, which significantly increased pension liabilities. Despite tremendous political challenges, those programs have been rolled back over the years in many countries.

4.1 Belgium The early retirement programs in Belgium had a significant impact on the labor market and pension spending. The government created and expanded early retirement programs in the 1970s and 80s to stimulate economic growth. The unemployment rate rose from a little above 2 percent in 1974 to close to 11 percent in 1983. In an attempt to reduce the unemployment rate, older workers were offered early retirement pensions, so that their jobs could be released to young workers. Belgium introduced three early retirement programs: in 1975, the Conventional Early Retirement Pension was introduced, allowing

laid-off workers over age 60 to receive an allowance in addition to unemployment benefits; in 1976, the Statutory Early Retirement Pension was enacted and applied to male workers age 60 and female workers age 55 if they were replaced by persons under age 30; and finally the Special Early Retirement Pension was introduced in 1978 to enable older people out of work for more than a year to take early retirement. As a result, the population in early retirement programs was more than 4 percent of total labor force by the late 1980s.[16]

Since then, those programs have been scaled back, but at an extraordinarily slow pace. Spending on early retirement as a share of GDP has been trending down since the mid 1980s in Belgium, driven by a series of pension retrenchments. In 1987, early retirement age eligibility for women was raised from 55 to 60 years. However, one step backward was taken in 1994 when the age limit for early retirement was lowered to 55 years for two years; during the same period, the early retirement spending ticked up. In 1997, the early retirement age limit was raised from 55 to 58 years. Then the government announced a rise in the age limit to 60 years in 2006 (phased in by 2008), to 62 in 2012 (phased in by 2015), and to 63 years in 2015 (phased in by 2019). These pension retrenchment reforms lowered government spending on early retirement successfully but very gradually, from 1.4% to less than 0.5% of GDP over 30 years.

4.2 Denmark The early transitional retirement scheme in Denmark, which was active only for a short period, highlights that a change in pension policy can potentially have a significant impact on the LFPR of workers close to retirement. The program, which applied to long-term unemployed (12 months or more) aged between 50 and 59 years, was introduced in 1992 and expanded in 1994. Entrance to the scheme, however, was closed in early 1996. LFPR for the population between 50 and 59 years declined sharply from 81 percent in 1992 to 72 percent in 1996.[17] The early retirement spending, on the other hand, increased from 0.6 percent of GDP in 1992 to more than 1 percent in 1996. The rise was particularly sharp following the expansion in 1994. It shows a high elasticity between the change in LFPR of older workers and the change in pension spending.

4.3 France The early retirement program in France conveys a similar message. In 1981, the French government extended the income guarantee for early retirement, and also provided incentives for firms to introduce early retirement through solidarity contracts. Government spending on "incentive to withdraw from labor market" increased from 0.4 percent of GDP to 1.3 percent between 1981 and 1985. The LFPR for the group between 55 and 59 years

[16]Further details are shown in Figure A.1 in the Appendix.

[17]Figure A.2 in the Appendix shows the evolution of these variables.

declined by 8 percentage points from 62.8 to 54.8 percent during the same period.[18] This case highlights that at the margin, changes in pension policy can significantly shift people's incentive to stay in or exit the labor force.

5 Effects of Structural Pension Reforms: Empirical Approach

In this section, our goal is to estimate the impact of pension policy changes on the labor market and public pension spending, and the key to estimation is the identification strategy. We follow the tradition in the narrative literature, see Romer and Romer (2010), and focus solely on structural changes in pension policy that are motivated by long-term concerns, rather than cyclical or purchasing power considerations.

5.1 Major Structural Pension Policy Changes

We categorize structural changes on pension policy into two groups, major or marginal changes, using the following criterion: whether the policy change broadly affects the population close to retirement in the age group of 55 to 65, or only affects a small segment of that population.[19] We also specifically rely on information about the policy tools employed – age, indexation, coverage, and benefit formulas – to differentiate between major and marginal changes. Our rules of thumb can be summarized as follows.

Firstly, all explicitly temporary changes are categorized as marginal. For instance, in 1998, the Finnish government decided to reduce the minimum retirement age for part-time retirement from 58 to 56 temporarily for two years. We categorize this change as marginal.

Secondly, changes in *eligibility age* and *indexation*, which typically affect people close to retirement broadly, are major policy changes, unless these policies only affect a small segment of that population.[20] For instance, Denmark in 2006 decided to raise the age threshold for public pension by one year in 2024 and 2027 thereby going up from 65 to 67. In 2010, the United Kingdom imposed a "triple lock", as pensions would be indexed to the greater of growth in prices (as measured by the Consumer Price Index), growth in earnings, or 2.5%. Both policy changes had a broad impact on the old-age pension system and therefore are categorized as major policy changes.

Thirdly, within *coverage*, changes regarding required contribution years are usually major, as they are typically taken jointly with changes in retirement age. For instance, in 2003 the French government decided to increase the minimum contribution period for receiving a full

[18] This is shown in Figure A.3 in the Appendix.

[19] Ideally we would like to use the budgetary impact of each policy change to differentiate between the two groups, but it is very challenging to do, as explained in Section 3.2.

[20] As an example, in 2017 Finland reduced the earliest age for benefit accrual and pension insurance for employees 18 to 17 years old, which is categorized as marginal.

pension from 40 years in 2009 by one quarter per year reaching 41 years by 2012, and 42 years in 2020. In addition, imposing or removing means testing is also a major policy change.[21]

Finally, changes on *benefit formulas* are considered major if they are deemed to have persistent or permanent impact on retirees, such as accrual of pension rights or pension payment calculations. For instance, Spain decided to reduce the replacement ratio in 2013, and initial pension amounts were to be affected by a "sustainability factor" that accounted for life expectancy. This policy change is considered major. On the other hand, one-off changes on pension payments or changes that affect a small segment of populations are marginal. For instance, the Italian government in 2004 decided to give a bonus to workers who continued working beyond acquiring pension rights between 2005-2007. This one-off change is considered marginal.

In addition, we also cross-check against many other sources, as specified in Section 3.1, and use them to further validate and identify which policy changes were perceived as being major from the perspective of policymakers and agents in the economy. In the empirical analysis, we focus on major structural pension changes in the baseline case in Section 6 and extend to all structural changes in a robustness check in Section 7.4.

5.2 Construction of Policy Change Intensity Measure

In this section, we provide further details about the construction of the pension policy change intensity measures. Our basic approach in constructing this measure is that a retrenchment is counted as "-1" and an expansionary change takes a value of "+1". Thus, the intensity measure captures the scope of pension policy changes in a given year for a given country.

We distinguish major structural changes that are implemented immediately following announcements from those with phase-in periods in order to study the impact of implementation lags on the transmission of pension reforms through the economy. Figure 6 illustrates the time series of the two policy dummies. Out of all major structural policy changes, close to 70 percent are phased in, while the rest are implemented without lags. For those with implementation lags, the average phase-in period is slightly longer than 10 years as shown in Figure A.4 in the Appendix, which is longer than the average for all pension policy changes together as shown in Figure 5.

A pension reform package that includes policy changes both with and without lags is assigned with two intensity policy dummies. For instance, in 2000 the Japanese government passed three major policy changes to its pension system to alleviate fiscal burdens: 1) the

[21] Adjustments (not installation or removal) on means testing are considered on a country-by-country basis. In many countries, they are considered marginal as they only affect people on the margin of the means test. In Australia and New Zealand, however, means testing is an important policy tool, and the associated changes are considered major.

once-every-5-year wage-indexing of benefits was eliminated; 2) a 5 percent reduction of Employees Pension Insurance (EPI) benefits was phased in for new beneficiaries; 3) finally, the minimum age to receive a full EPI benefit would be raised from 60 to 65 years over a 12-year period starting in 2013 (2018 for women) and fully phased in by 2025 (2030 for women). The first change was implemented right after the announcement and is captured by the "-1" dot in 2000 in top panel of Figure 6, the no-lag dummy series. The two retrenchment changes related to benefits and retirement age, which were gradually phased in over time, are reflected by the "-2" dot in 2000 in the bottom panel, the lag dummy series.[22] Note that in the recent decades, we observe many more reform packages with high intensity measures being implemented with lags.

When we are constructing these intensity measures, we run into some issues where discretion might be required. Firstly, it is possible to have both expansionary and retrenchment measures occurring in the same year. It does not pose a problem for our analysis when the expansionary measures that accompany retrenchment measures tend to be smaller, or marginal by our classification. This is a more common occurrence in our data set, as policy makers adopt marginal expansionary measures to make major retrenchment measures relatively more satiable for the public.[23] In our baseline specification, we focus on major structural retrenchment measures and do not consider these accompanying positive marginal policy changes.[24]

Secondly, the alternative case of major retrenchments being accompanied by major expansions is uncommon in our sample. In these rare cases, the major expansionary measures are often implemented immediately, while the major retrenchment changes are phased in. Therefore, it is easy to accommodate them in our set-up as we differentiate between policy changes with and without lags. For instance, within the 1985 pension reform in Spain, the retrenchment policy changes on pension rights and benefit formula were phased in gradually, while the expansionary policy of abolishing working status requirement was implemented immediately. In this case, the dummy on major structural changes with lags takes a value of "-2" and the one without lags takes a value of "+1". There are a handful of examples, in which policy changes with different signs in the same year are all subject to implemen-

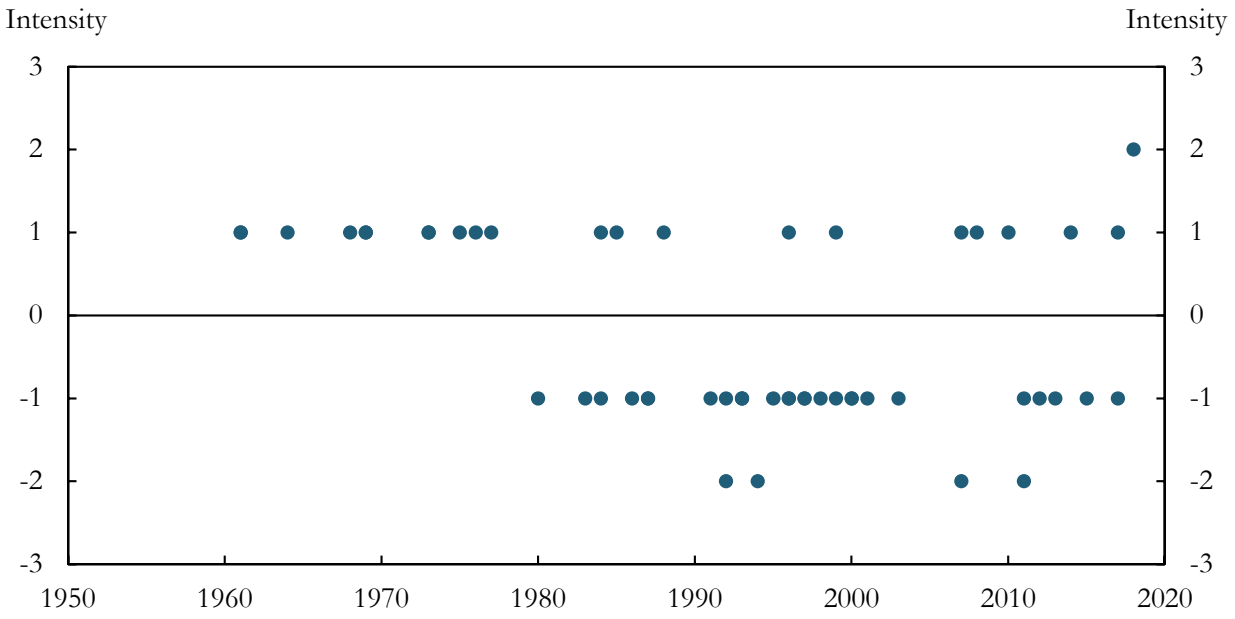
[22]Each dot in figure 6 may capture multiple dummy observations if multiple countries have the same reform dummy in the same year.

[23]For example, the 2004 reform in Italy had major retrenchment policy changes related to eligibility criterion, including a progressive increase in retirement age. But there were some expansionary changes, including provisions of imputed contributions for persons with disabilities, as well as "super bonus" for workers who acquired their pension rights between 2005 and 2007 and decide to continue working afterwards. The latter two policy changes are classified as marginal under our definition.

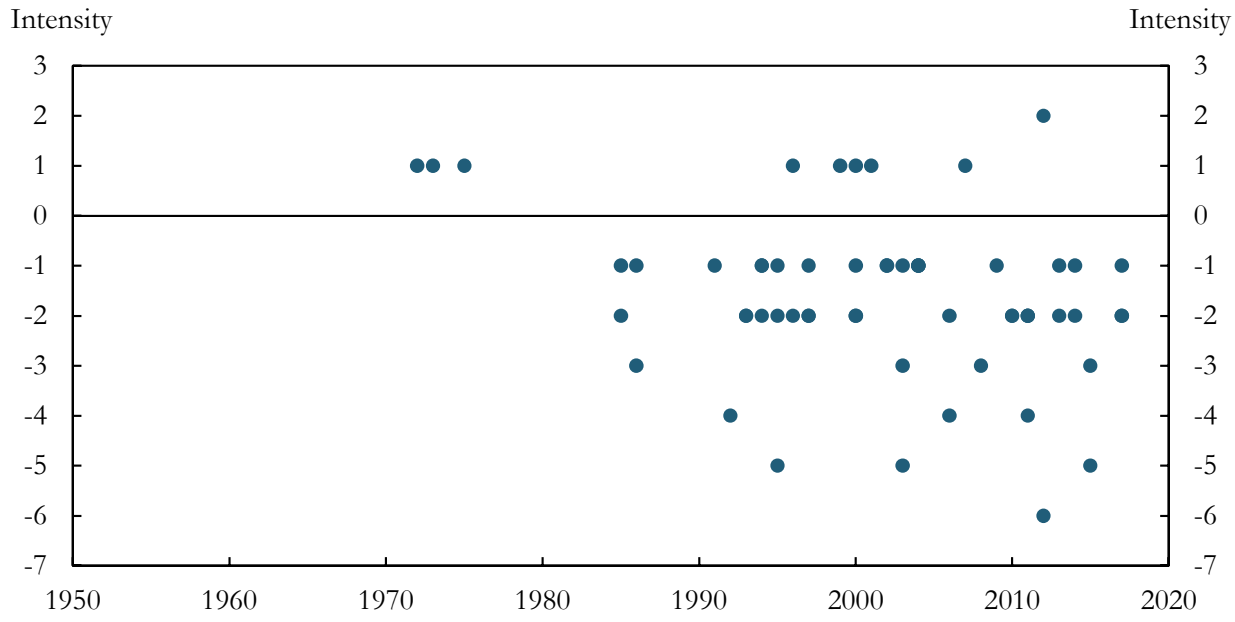
[24]As noted above, in Section 7.4, we consider a robustness check where we consider *all*, both major and marginal, structural changes in pension policy.

Figure 6: Major structural pension policy change measures without and with implementation phase-ins.

(a) Measures without phase-in periods



(b) Measures with phase-in periods



tation lags. For instance, the United Kingdom had three major structural policy changes in 2007. Two changes are expansionary, including restoration of the earnings-link for basic state pension and a reduction in the number of years of contributions required for a full basic state pension. At the same time, there was a retrenchment policy change of a progressive increase in the retirement age. In this case, since they are all implemented with lags, in our baseline specification we have a dummy of "+1" for our major structural reforms with lags. However, we are able to distinguish between these reforms in our additional analysis, when we separate between major changes with lags based on tools and implementation lags.

The intensity measure is our attempt to capture the scope of a reform package with multiple policy changes, since it is challenging to assess the projected budgetary impact from pension reforms as discussed in Section 3.2. In order to gauge the overall success of our approach, we consider the case of Italy which saw a series of major pension reforms in the 1990s and 2000s. Considering all major structural reforms together, both with and without lags, the 1992 Amato and 1995 Dini reforms dominated the reforms that came after, according to our major reform intensity measure. Based on contemporaneous OECD and country legislative files, Alesina, Barbiero, Favero, Giavazzi, and Paradisi (2017) and document the projected budgetary impact as a percent of GDP for these changes in pension policies in the given year and for up to 5 years out.[25] Those budgetary estimates are a good candidate for us to cross check our dummy approach, admittedly they abstract from potentially important long-run impact of these policies.[26] As detailed in Section C in the Appendix, our reform measure lines up reasonably well with the projected budgetary impact from their study. This example is reassuring in establishing that the relative magnitude of our structural policy dummy with intensity can do a reasonably good job in matching the scope or assessed projected budgetary impact of pension reforms.

We also test the exogeneity of major structural policy change measures to short-run economic conditions. Table 1 shows the Granger causality test results for these structural changes with and without implementation lags. The regressions include one lag of the pension policy change and the aggregate variable, along with country and year fixed effects. Notably, these structural changes, regardless of with or without implementation lags, can not be predicted by lagged aggregate variables that capture the state of the economy, including the unemployment rate, the growth rate of real GDP, OECD recession indicator, or the CPI

[25] Alesina, Barbiero, Favero, Giavazzi, and Paradisi (2017) extend the narrative data set of fiscal consolidations by Guajardo, Leigh, and Pescatori (2014) for 18 OECD countries and, in addition, distinguish consolidation measures based upon government spending cuts, transfers cuts and tax hikes. Many of their transfer cuts for these OECD countries include pension retrenchment measures.

[26] This would be a particularly relevant issue for reforms with long implementation lags. For instance, the 1995 reform made the switch towards a notional defined-contribution system and was projected to have the largest impact on pension expenditures after 2025, according to the OECD (see details in Appendix C).

	Major No lag	Major With lags
GDP growth	0.734	0.211
Inflation	0.5774	0.243
Unemp. Rate	0.301	0.260
OECD recession	0.588	0.587
Pension spend./GDP	0.962	0.556
LFPR-marginal	0.441	0.936
Share of Elderly pop	0.192	0.041

Table 1: Granger causality tests. This table shows the p-values associated with the Granger causality tests where a high p-value implies that it is not possible to reject the hypothesis that the aggregate variable does not predict the pension reform measure. Each entry shows the result of regressing our pension reform measure (of a given type) on one lag of the reform measure and the aggregate variable, along with country and year fixed effects. The aggregate variables are the labor force participation rate for the age group between 55 and 64, pension spending as share of GDP, unemployment rate, growth rate of real GDP, share of elderly population, CPI inflation, and government deficit as share of GDP. The regression for all macro variables are run based on earliest data availability for each country, which is not uniformly starting in 1960 for all.

inflation. This is a further validation of our identification strategy. We also test Granger causality for some additional variables, some of which we will be analyzing in the coming sections. There is no evidence of structural changes being Granger caused by LFPR for the age group between 55 and 64 years and old-age pension spending as a share of GDP. The only variable that shows some degree of significance is the share of elderly population for major structural changes with lags, potentially capturing demographic pressures driving major structural reforms. We control for this variable in our regressions that follow.

5.3 Motivation for the Empirical Framework The key research question of our empirical analysis is: how do structural pension reforms, motivated by long-run sustainability concerns, affect the LFPR of population close to retirement? Pension retrenchment reforms can potentially affect the retirement decisions of the marginal group of age 55 to 64 through many different mechanisms.

As pensions are the main source of income for many retirees, pension retrenchments are likely to be accompanied with negative income effects, inducing people to stay in the labor force longer to save more for their retirement. The micro data literature that focus on ex-post evaluations of pension reforms provide supporting evidence for this channel. For instance, Mastrobuoni (2009), Staubli and Zweimueller (2013) and Hernæs, Markussen, Piggott, and

Røed (2016), among others show that scaling back pension benefits, once fully implemented, lead to an increase in the labor supply of the affected population.

While income effects apply to pension policy changes in general, reforms that are implemented with lags can potentially affect people close to retirement through additional channels. The first channel is through foresight behavior. As discussed above, our data set shows that structural pension reforms, motivated by long-run sustainability concerns, are often implemented with substantial lags. If pension reforms are announced well ahead of time, agents may respond to news about those future policy changes by adjusting their retirement behavior if these future reforms are not actuarially neutral. Papers, such as Friedberg (2000) and Manoli and Weber (2016), find that beneficiaries bunch in substantial numbers at policy threshold kinks, which highlights that a pension policy change that is not actuarially neutral can create incentives for people at the margin to explore the discrepancies. The macro literature on fiscal policy has also highlighted the importance of foresight. Ramey (2011) shows an output response to military buildup news prior to the rise in government spending. Mertens and Ravn (2012) also show a response of private activity post-announcement but pre-implementation for lagged tax changes. Relatedly, Leeper, Walker, and Yang (2013) formally illustrate that this fiscal foresight can bias econometric estimations.

Secondly, pension retrenchments, in particular more fundamental reforms, could illustrate governments' political willingness and fiscal need to scale back pension systems and, therefore, may create uncertainty on the outlook of future reforms. Those uncertainties may prompt people close to retirement to reconsider their retirement decisions. Conceptually, the following equation formalizes the idea that the *perceived* total pension benefits ($EB_{t|T_r}$) that individuals think they will receive after retirement depend on the pension benefits under the current law (b_{T_i}), the likelihood they expect to receive those promised benefits (p_{T_i}), as well as when they will retire (T_r).

$$\begin{aligned} EB_{t|T_r} &= E_t\left(b_{T_r} + b_{T_r+1} + ...\right) \\ &= p_{T_r} b_{T_r} + p_{T_r+1} b_{T_r+1} + ... \end{aligned}$$

Importantly, a fundamental pension reform can change people's beliefs about the likelihood of p_{T_i}, even if it does not change benefits, b_{T_i} for some populations, say through grandfather clauses. By changing the perceived uncertainty associated with future policy changes, even actuarially neutral reforms can change the retirement decisions of the marginal group.

Papers, such as Luttmer and Samwick (2018), show that there is a substantial degree of perceived policy uncertainty from individuals in terms of future Social Security benefits. Through the lens of a reputation model, Backus and Driffill (1985) show that a stabilization

macroeconomic policy, if it raises uncertainty about future policy, may have counterproductive impacts on the economy. Similarly, if fundamental pension reforms revise people's perceived uncertainty about their future pension benefits, it may change their retirement decisions and have implications for the aggregate economy.[27]

5.4 Econometric methodology We apply the local projection method proposed in Jordà (2005) to estimate the effects of structural pension policy changes on variables of interest. This requires estimating a series of regressions for each variable at each horizon, h. Motivated by potentially different channels at work as described in the previous section, we distinguish between structural pension policy changes without implementation lags from those with lags, the latter of which can be thought of as news shocks about pension changes to be implemented in the future.

$$\begin{aligned} z_{i,t+h} &= \alpha_{i,h} + \gamma_{t,h} + \beta_{n,h} R_{i,t}^{nolag} + \beta_{l,h} R_{i,t}^{lag} + \sum_{j=1}^{J} \delta_{n,h}^{k} R_{i,t-j}^{nolag} + \sum_{j=1}^{J} \delta_{l,h}^{k} R_{i,t-j}^{lag} \\ &\quad + \sum_{j=1}^{J} \theta_{h}^{k} z_{i,t-j} + \sum_{j=1}^{J} \lambda_{h}^{k} y_{i,t-j} + \varepsilon_{i,t+h}, \text{ for } h = 0, 1, 2, ... \end{aligned} \tag{5.1}$$

where $i = 1, ...N$ denotes the countries under consideration. Here z is the macroeconomic variable of interest. R is the pension intensity measure that we have created using the narrative approach, with R^{nolag} for changes without implementation lags and R^{lag} for those with lags.[28] α is the country fixed effect to control for country-specific time-invariant factors, while γ is a time fixed effect in order to control for economic developments that affect all countries in a given year. We also include lags of the pension dummy and the variable of interest on the right hand side, where we consider $J = 2$ in our baseline specification. Here $\varepsilon_{i,t+h}$ is an idiosyncratic error term.

The coefficient β_h represents the response of the variable z at period of $t + h$ to the respective pension dummy at period t, capturing the average response across countries and time to policy changes without lag ($\beta_{n,h}$) and to those with lags ($\beta_{l,h}$). The impulse responses are constructed as a sequence of the β_h's estimated in a series of separate regressions for each horizon. In addition, we also include life expectancy and the share of elderly population in

[27] Theoretical papers using calibrated life-cycle models do not have a clear-cut answer in terms of how uncertainties of future pension reforms would affect labor supply. Bütler (1999) and Gomes, Kotlikoff, and Viceira (2012) show that a delayed resolution of pension policy uncertainty would increase labor supply through precautionary motives. Kitao (2018), on the other hand, shows that individuals would work less in this case, as a delayed reform leads to higher expected receipt of pension benefits.

[28] The time subscript on the reform dummy, t, correspond to the year of the announcement. In the case of reforms implemented with no lags, it is also the year of implementation.

the total population in the set of control variables, y, in order to account for the fact that countries face aging populations with varying degrees over time.

We run our regressions from 1980 onwards, given the availability of data on old-age pension spending and LFPRs by age group.[29] The sample of 1980 onwards captures all of the structural pension retrenchments and a majority of structural pension expansions in our full sample, as shown in Figure 6. By setting the horizon $h = 1, ..., 10$ in Equation 5.1, our estimation captures the impact of structural pension changes on labor market for 10 years, calibrated to match the average length of phase-in periods associated with major structural policy changes. Thus, our estimates reflect the response of the labor force and pension variables during the period between the initial announcement and the implementation.

6 Effects of Structural Pension Reforms: Empirical Results

In this section, we present the results on how pension reforms impact public spending on old-age related pensions and the LFPR of population close to retirement, using the approach outlined in the previous section.

Figure 7 shows that structural public pension policy changes, depending on whether they come with phase-in periods or not, can have different impact on people who are close to retirement. In response to news about pension retrenchment in the future (blue solid line), this group of population are more likely to exit the labor market prior to changes being implemented, leading to a decline in their LFPRs. For the group between 55 and 59 years, the response is insignificant on impact, but declines over time and reaches its trough 7 years after the fiscal news. For the group between 60 and 64 years, who are closer to retirement, the response is more front-loaded, as the LFPR drops on impact and the decline reaches 0.4 percentage points 2 years following the fiscal news. As a result, we see a sustained drop in the overall LFPR for the population between 55 to 64 years.[30]

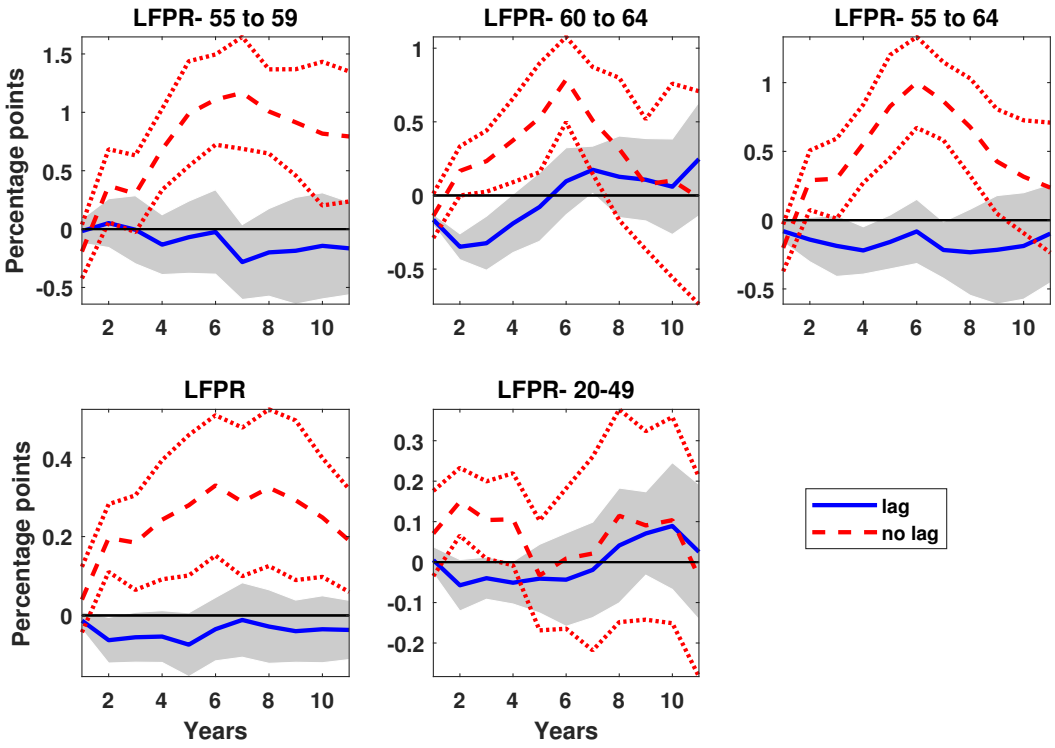
On the other hand, in response to a retrenchment policy change being implemented immediately (red dashed lines), people close to retirement stay in the work force longer to compensate for the decline in their pensions. Compared to the group between 60 and 64 years, the rise in the LFPR for the group between the age of 55 and 59 years is more pronounced: an increase of 1 percentage points at the peak compared to 0.75 percentage points for the group between 60 and 64. The increase in the LFPRs is hump-shaped, particularly for those between the age of 60 and 64, rather than remaining elevated for the entire ten

[29]The primary data source is the OECD Database. More details on the data and sources are given in Table A.1.

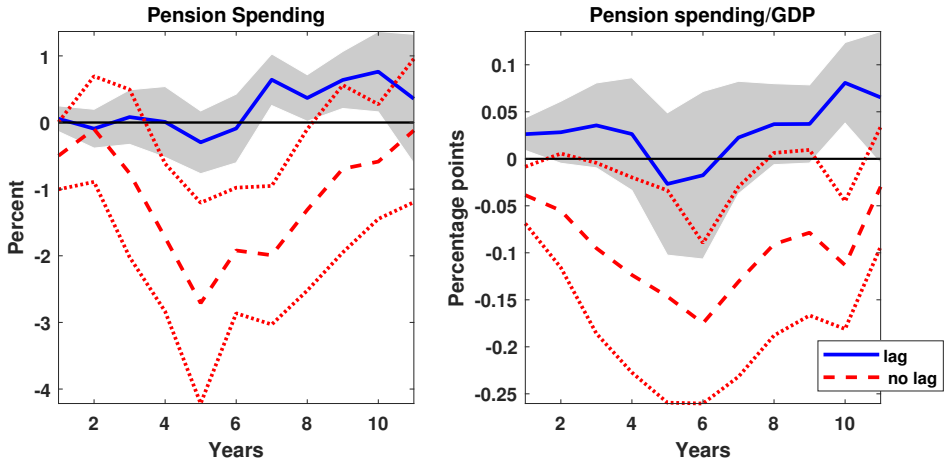
[30]The response of LFPR are the average dynamic response over time for people in the given age group, rather than cohort-specific responses as in micro data analysis.

Figure 7: Responses of labor market and pension spending to structural pension retrenchments for data between 1980 and 2017. The blue solid lines show the responses to reforms implemented with lags and red dashed lines correspond to reforms implemented without lags. The corresponding bands show one standard deviation confidence bands.

(a) Labor force participation rates



(b) Old-age pension spending



year horizon considered.[31]

Regardless of the phase-in periods, structural reforms have an insignificant impact on the LFPR of young and mid-aged population between age 20 and 49 years across almost all horizons. Therefore, the responses of the LFPRs of the elderly population transmit to the aggregate LFPR, which rises in response to policy changes implemented with no lags but declines in response to changes with phase-in periods.

Structural policy changes with implementation lags can thus have implications for the government fiscal position. When pension retrenchments are implemented immediately, less generous pension benefits, in combination with higher LFPRs for the elderly population, lead to a decline in the cumulative growth rate of old-age pension spending, reaching close 3 percent at its trough as shown in panel b of Figure 7. On the other hand, as some people in the marginal group exit the labor market in response to pension retrenchment news, government spending on old age pensions does not change much in the short-run and slightly increases, rather than decreases, over the medium run.[32] In terms of pension spending-to-GDP, an average pension retrenchment reform with no lag leads to a decline of about 0.16 percentage points about 6 years after the reform is enacted. On the other hand, in response to reforms with implementation lags, the pension spending-to-GDP ratio rises by between 0.03 to 0.05 percentage points at various horizons.[33]

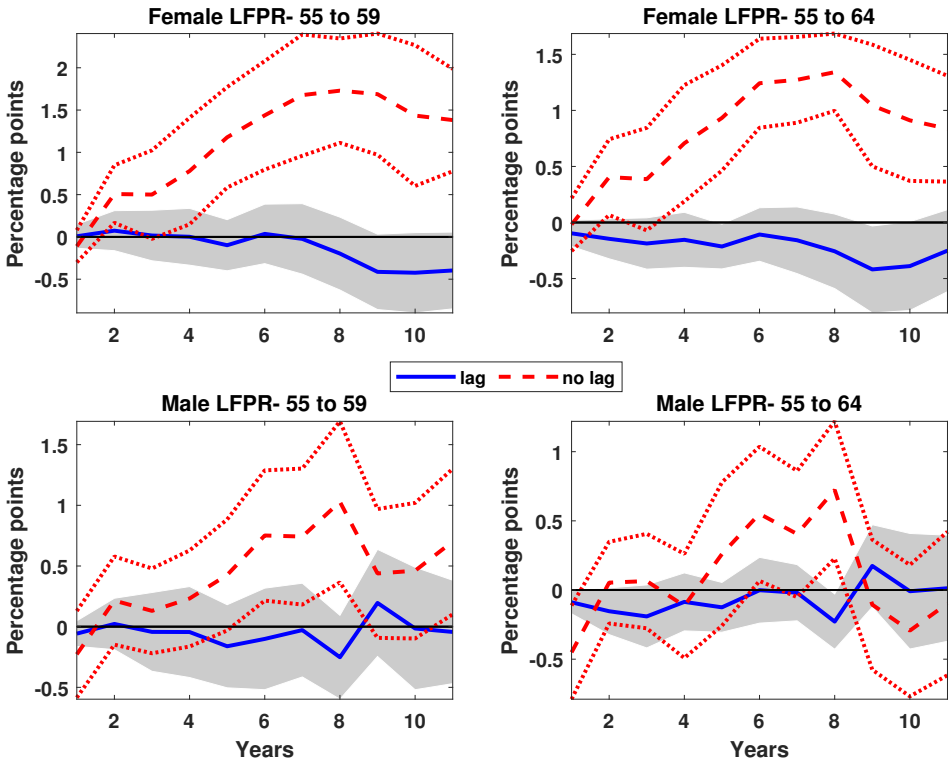
We admittedly do not quantify the long-run budgetary impact of these pension reforms, particularly for those implemented with lags, which can well be different from the short- and medium-run and potentially produce major savings after the phase-in period. This is due to several considerations. Firstly, our narrative identification is based on the idea that these major structural policy changes are driven by long-run concerns such as fiscal consolidations. By extending the analysis to much longer horizon, we are likely to run into issues of endogeneity. Secondly, many of the major structural reforms in our sample,

[31]This dynamic response can be potentially attributed to the nature of policy changes. Among policy changes without phase-in periods 30 percent are associated with changes in indexation, while only 15 percent of them change the retirement age. In contrast, only 5 percent of major reforms with phase-in periods change indexation, and more than 35 percent of them adjust retirement age. Changes in indexation rules tend to be more transitory, while changes in retirement ages or required contribution years are less likely to be reversed.

[32]We abstract from discussing the present value of pension liability, as it is challenging to even gauge the cash flow impact of pension reforms, as detailed in Section 3.2 and Section C. Therefore we don't explicitly consider pension actuarial neutrality or fairness in our regressions, which is often discussed in papers using micro data, for instance Gruber and Wise (2004).

[33]The responses are shown with a one standard error band, where the standard errors are estimated using a clustered-robust covariance matrix estimator. We show 90% confidence bands in Figure A.6 in the Appendix, and while the responses for pension spending overlap, but those of the LFPR between 55 and 64 years are still statistically significantly different across many horizons. This is further validated by formally testing whether the coefficients for reforms implemented with and without lag are equal and we can reject the hypothesis of equality at the 10% level (and at 5% level for a subset) for LFPR between 55 and 64 for horizons between 4 and 8 years after the shock.

Figure 8: Gender breakdown of the responses in the labor market to structural pension retrenchments. The blue solid lines show the responses to reforms implemented with lags and red dashed lines correspond to reforms implemented without lag. The corresponding bands show one standard deviation confidence bands.



particularly age and contribution based, come with very long implementation lags. Some of them were introduced in 2000s and 2010s and, therefore, have not been fully phased in by the end of our sample. Finally, we also have econometric considerations, as the estimated responses are likely to be much less precise if we consider longer horizons.[34]

In addition to different age groups, we further examine whether the distinct effects of policy changes with and without lags are driven by gender. Many countries in our sample started with lower retirement ages for women, and some of the policy changes may specifically target women workers. Figure 8 shows that the LFPRs between the ages of 55 and 64 years, of both men and women, rise in response to pension retrenchments enacted without lag and fall in response to those with lags. However, the LFPRs for women are much more responsive to policy changes, as their estimates are more statistically significant. This finding is consistent

[34]Currently we show impulse responses for up to 10 years after the announcement of a reform. In order to estimate impulse responses at horizon j, the local projection estimation requires getting rid of the last j observations from the sample, and therefore the longer-run responses are constructed with even more limited samples.

with the observation that women have a larger labor supply elasticity, see the estimates from literature reviews in Filer, Hamermesh, and Rees (1996) and Jacobsen (2007), as well as recent evidences in OECD countries from Luksic (2020). Studies focusing on individual pension reforms have also found that labor supply decisions of women are more sensitive.[35]

Why would people close to retirement respond differently to pension policy changes with versus without phase-in periods? In Sections 6.1 - 6.5, we explore the potential channels at play.

6.1 Transmission Channels Pension retrenchment reforms can potentially affect labor decisions for people close to retirement through three distinct channels: an income effect channel, a foresight channel, and an uncertainty channel.

Our finding that the LFPRs of people close to retirement increase in response to a immediate retrenchment on pension policy is consistent with the *income effect* channel. Retirees face lower future pension benefits when governments enact policy changes to scale back their pension systems. Lower expected incomes in the future prompt people to push back their retirement plans and stay in the labor force longer.

Importantly, the income effect channel applies to pension retrenchments in general, regardless of whether they are phased in or implemented immediately. For retrenchments with phase-in periods, however, the *foresight* and the *uncertainty* channels can also be at play, which may offset or even reverse the impact from the *income effect* channel.

If announced reforms take away certain pension options in the future, the foresight channel may prompt people to exit the labor market and lock in their current benefits during the phase-in period. For instance, in 1997 the Spanish government decided to increase the calculation period for pension payments from the last 8 to 15 years, effective in 2002. The news of the pension reform may create incentives for people who were eligible for retirement in the old regime to retire early and earn higher pensions. Policy changes that are not actuarially neutral and implemented with lags can create incentives for agents to claim their current benefits. This fiscal foresight channel is similar to the anticipation effects of tax changes identified in Mertens and Ravn (2011) and Mertens and Ravn (2012), who find that preannounced but not yet implemented tax cuts give rise to contractions in output.

Turning to the uncertainty channel, it is most relevant for reforms that change the fundamental aspects of pension systems and, therefore, typically come with prolonged phase-in periods. These types of reforms demonstrate governments' political willingness and fiscal

[35]For instance, Vere (2011) shows that among married couples, an increase in Social Security income in the United States reduces wives' labor supply more than husbands'. Also, Staubli and Zweimueller (2013) show that pension reforms in Austria that raised the early retirement age increased employment to a larger degree among women than men.

need to scale back pension systems and, therefore, may prompt people close to retirement to update their priors on the likelihood of future reforms and reconsider their retirement decisions. The importance of this channel may depend on how people perceive the credibility of the government and, as a result, pension reforms. In a country with low trust in the government, a fundamental pension reform would be more likely to raise uncertainty about the pension system and create incentives for people to exit the labor force.

The 1995 Dini reform in Italy can shed light on the uncertainty and the foresight channels, as well as their interactions. The reform made great strides towards a contribution-based pension system in an attempt to put the system on a more financially viable footing. The change, nevertheless, would only be completely phased in by 2032. The exceedingly long transition associated with the 1995 reform, joint with the subsequent reforms in an attempt to speed up the progress,[36] may have prompted people close to retirement to exit the labor market earlier. The OECD Economic Survey of Italy (2007, pg 95 and 96) observes, "*Constant tinkering with reforms has only exacerbated such uncertainty. For example, frequent revision of the pension reform may have pushed people into early retirement because they want to lock in benefits. ... Many workers decided to retire as early as possible as a consequence of the public perception about the direction of change and uncertainty about the reform process. Indeed, the defined-benefit scheme is not actuarially fair, and it has thus been economically convenient to retire as early as possible.*" These consequences of the pension reforms in Italy have also been discussed by others. For example, through the lens of an overlapping-generations model, Santoro (2006) shows that the early announcement of Italian pension reform in 1992 led to a drop in employment rate of workers aged 55 and older.

Taken together, the income effect channel applies to all pension policy changes, regardless of whether they are phased in or implemented immediately. The foresight channel is likely to be at play for policy changes implemented with lags. The uncertainty channel, however, is only relevant for most fundamental pension reforms that typically come with exceedingly long phase-in periods. While Figure 7 demonstrates the relevance of the income effect channel in pension changes without lags, we further study the relative importance of the three channels for lagged pension reforms in the next few sections.

6.2 Length of Implementation Lags

In order to explore the foresight and uncertainty channels, we investigate whether the response to fiscal news depends on the length of phase-

[36] Major pension reforms in Italy started in 1992 (Amato reform) and continued in 1995 with the adoption of a contribution based regime (Dini reform), though with a lengthy transition period. Since pension expenditure continued to rise more rapidly than expected, the Prodi Agreement of 1997 brought forward the harmonisation of public and private pension regimes and also accelerated the increase in the early retirement age. This was followed by the 2004 Maroni-Tremonti reform which made the eligibility requirements more stringent.

in periods. Implementation lags vary widely in our data set from a couple of years to close to 40 years, and we split the lagged reforms into those with phase-in periods shorter than 15 years from those with longer lags.[37] About one third of major structural changes are implemented without lags, about 50 percent are phased in within 15 years, and the rest come with implementation lags of 15 years or longer.[38] Therefore, we include three types of dummies in Equation 5.1: policy changes without lags, lagged changes with shorter phase-in periods, and lagged reforms with long phase-ins.

Figure 9 shows that the responses to fiscal news are much stronger for reforms with longer lags. In the case of major reforms with shorter implementation lags (green dot-dashed lines), the responses – both the LFPR for population close to retirement and pension spending – are largely muted. On the other hand, in response to reforms with longer lags (solid blue lines), the LFPR goes down significantly, more than 1 percentage point at the trough, relative to 0.4 percentage points in our baseline case shown in Figure 7. The pension spending response is consistent with the LFPR response: public spending on pensions increases in the short to medium run, as more people exit the labor market.

For pension changes with shorter lags, the foresight channel and the income effect channel work in opposing directions. On one hand, lower expected pension incomes may prompt people to work more and stay in the labor force longer, through the income effect channel. On the other hand, as pension retrenchments are announced ahead of time, people respond to news of lower pension incomes with *future* policy changes by retiring earlier. In this case, the income effect and the fiscal foresight channels appear to offset each other, leading to a muted response in the LFPRs of people close to retirement.[39]

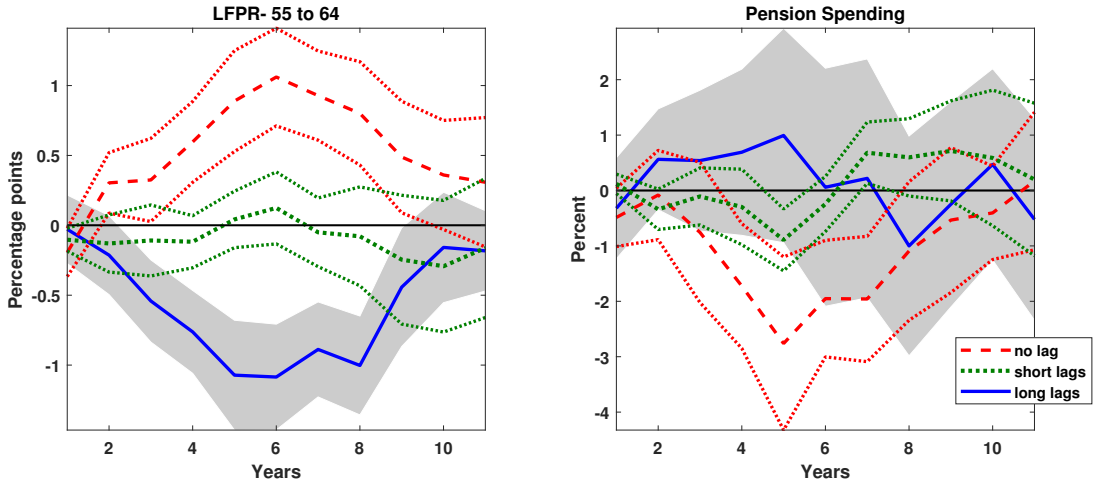
For pension changes with long lags, however, the uncertainty channel is significantly more

[37] It is not feasible to interact the reform dummy explicitly with the length of the phase-in periods, as it is quite common in our data set to have multiple policy changes in a given country for a given year with different implementation lags. Conceptually, it is difficult to come up with a weighted average phase-in period in those cases. Our approach of grouping together policy changes with long and short lags sidesteps that challenge and allows us to group them based on those baskets, even if they occur in the same year in the same country. The responses look very similar if we use 10 years as a threshold, given that the average implementation lags for major reforms in our sample is slightly longer than 10 years.

[38] About 10 percent of major changes are implemented with lags of unknown lengths. We include them in the group of policy changes with shorter implementation lags. To the extent some of these policy changes may actually have long phase-in periods, our estimates provide a lower bound on the impact of pension reforms with long lags.

[39] Another way to consider the importance of this forward looking channel is to consider pension policy changes that are cohort-specific, where the direct foresight channel shouldn't be important. We separate major structural reforms implemented with lags, into ones that *explicitly* link pension changes to the birth-year of an individual and those that do not. We find supporting evidence for the foresight channel, as the decline in the LFPRs of people close to retirement is largely driven by lagged policy changes that are not cohort specific. However, given the small number of policies in that are explicitly cohort-specific, the response to those policies are estimated with large confidence bands. For these reasons, we do not include the results in the paper but they are available upon request from the authors.

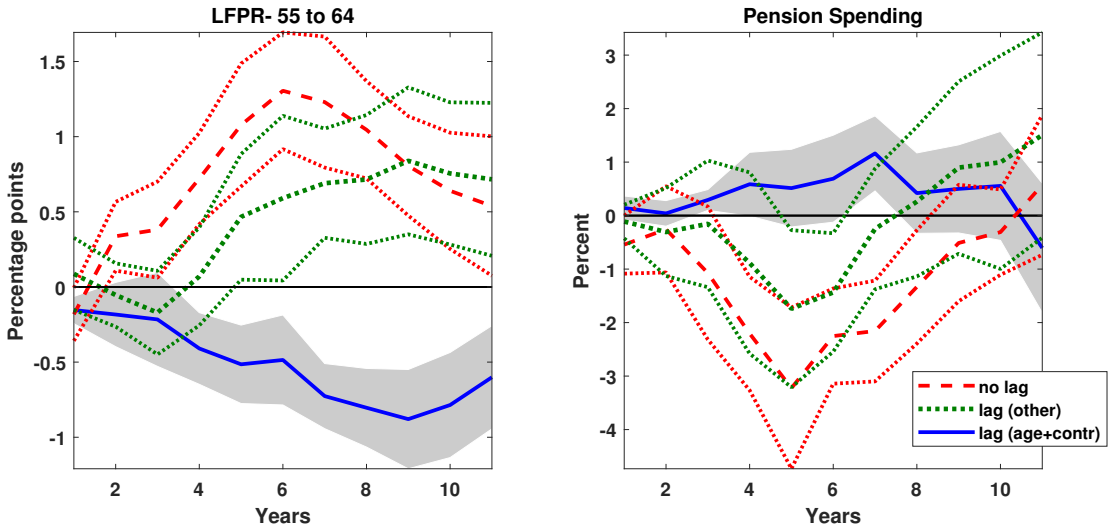
Figure 9: Responses of labor market and pension spending to structural pension retrenchments for data between 1980 and 2017. The figure shows responses to lagged reforms with implementation lags of 15 years and longer (blue solid lines), reforms implemented with lags less than 15 years (green dot-dashed lines) and reforms implemented without lags (red dashed lines).



important than the foresight channel. According to the fiscal foresight channel, reforms with longer phase-in periods, of the order of 15 years and longer, should be less relevant to the marginal group today than those with shorter lags. Therefore, people close to retirement should react more strongly to pension changes with shorter, rather than longer lags. On the other hand, the uncertainty channel would play a dominant role in pension reforms with long lags. Many of these policy changes are likely fundamental reforms to the pension system, and therefore the exceedingly long phase-in periods are put in place to make them more palatable for the public. As they demonstrate governments' political willingness and fiscal need to scale back pension system, they also prompt people close to retirement to reconsider their retirement decisions. Figure 9 highlights that the uncertainty channel dominates both the income effect and the foresight channels in the case of pension reforms with long lags.

6.3 Policy Tools We next investigate whether the response to fiscal news depends on policy tools. Within lagged major structural changes, one third are related to modifying benefit formulas or indexation rules, while the other two thirds are associated with changes in retirement ages or required contribution years. Splitting lagged reforms based on these tools is finer than the baseline, but still broad enough to ensure reasonable inference in our econometric analysis. Therefore, we include three types of reform dummies in Equation 5.1: policy changes without lags, lagged changes associated with changes in age and contributions, and lagged changes using other policy tools.

Figure 10: Responses of labor market and pension spending to structural pension retrenchments for data between 1980 and 2017. The figure shows responses to age- and contribution-based reforms implemented with lags (blue solid lines), all other lagged reforms (green dot-dashed), and reforms implemented without lags (red dashed lines).



The green dot-dashed lines in Figure 10 show that in response to lagged reforms using other policy tools, the LFPR of the marginal group increases at the medium to longer horizon despite an initial muted response on impact. This response highlights that when the government makes changes to pension system through tools like indexation and benefit payments rather than age or contribution requirements, the income effect channel dominates the foresight and the uncertainty channels.

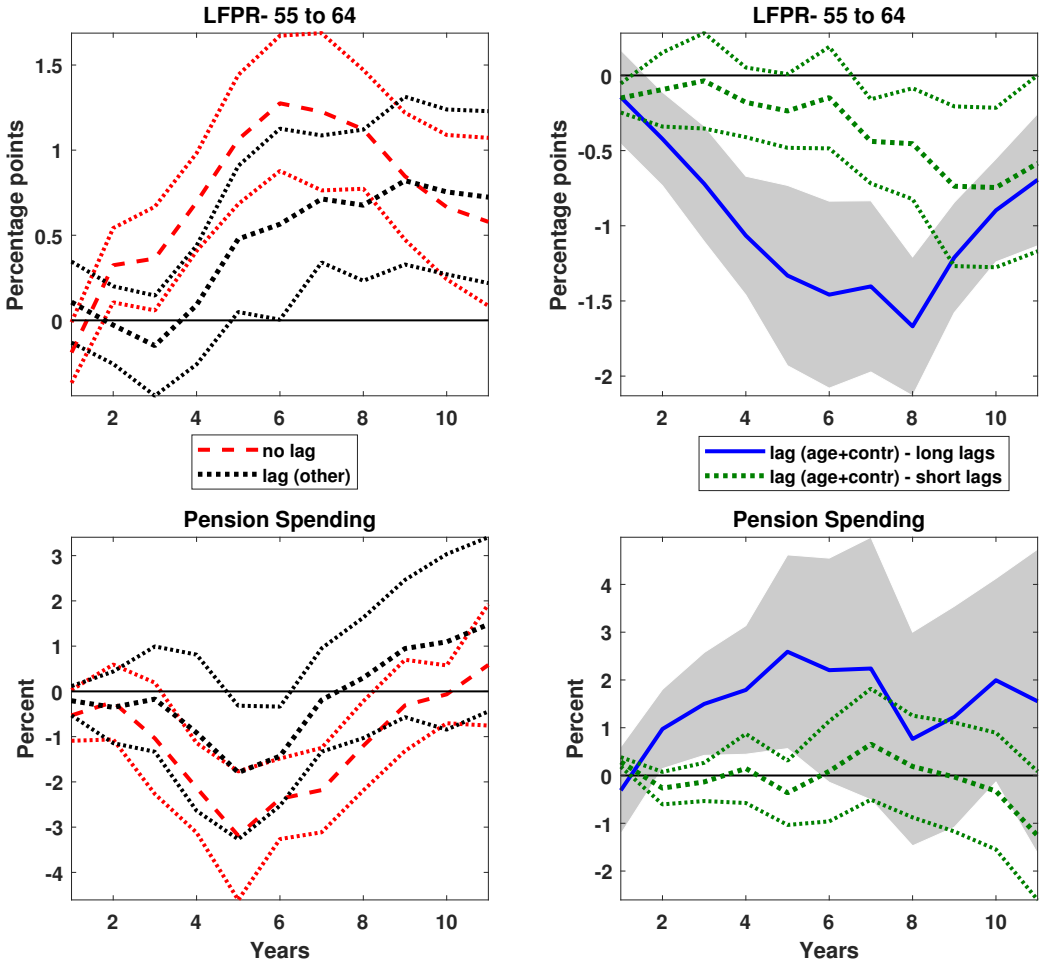
On the other hand, the responses to age- and contribution-based reforms with lags (blue solid lines) are similar to, but more pronounced than, our baseline responses to *all* lagged reforms. The drop in the LFPR of the marginal group reaches 0.8 percentage points at its trough, while the pension spending turns positive after year 2. In addition, these responses are more precisely estimated and statistically significant at more horizons compared to the baseline results. Potentially, both the uncertainty and the foresight channels contribute to the negative response of LFPR, offsetting the income effect channel.

In the next section, we further split the age- and contribution-based reforms by their implementation lags, in order to explore the relative importance of the uncertainty versus the foresight channel.

6.4 Interaction Between the Length of Implementation Lags and Policy Tools

In this section, we investigate whether age- and contribution-based reforms have

Figure 11: Responses of labor market and pension spending to structural pension retrenchments for data between 1980 and 2017. The figure shows responses to age- and contribution-based reforms with long implementation lags of 15 years and longer (blue solid, right panel), age- and contribution-based reforms with short implementation lags of less than 15 years (green dot-dashed lines, right panel), all other lagged reforms (black dotted, left panel), and reforms implemented without lags (red dashed lines, left panel).



different impact depending on the length of implementation lags. Overall, 85 percent of the reforms with longer lags are associated with changes in age and contribution, while the share is 60 percent for reforms with shorter lags. In Equation 5.1, we consider 4 different types of policy changes: changes with no lags, age- and contribution-based reforms with short lags (less than 15 years), age- and contribution-based reforms with long lags (15 or longer years), and lagged reforms based on other tools.[40]

Figure 11 highlights the different responses to age- and contribution-based reforms with short versus long lags. In response to age and contribution based reforms, the LFPR of people close to retirement falls regardless of implementation lags, but the magnitudes vary. Specifically, reforms with short lags see a mild decline in the LFPR across most of the horizon. In response to reforms with long phase-in periods, however, the LFPR decline is a lot more significant, reaching 1.5 percentage point at the trough. The comparison highlights that the uncertainty channel is particularly prominent in the case with fundamental pension reforms through changes in retirement age and contribution requirements.

6.5 Government Credibility In reading narrative accounts about pension reforms, one recurring theme is that how people perceive the government can potentially play an important role in the transmission of these reforms. Particularly, the perception can impact the propagation of uncertainties associated with pension reform announcements made by the government. One tangible way that we can capture those perceptions is to measure the credibility of a government in the eyes of its citizens.

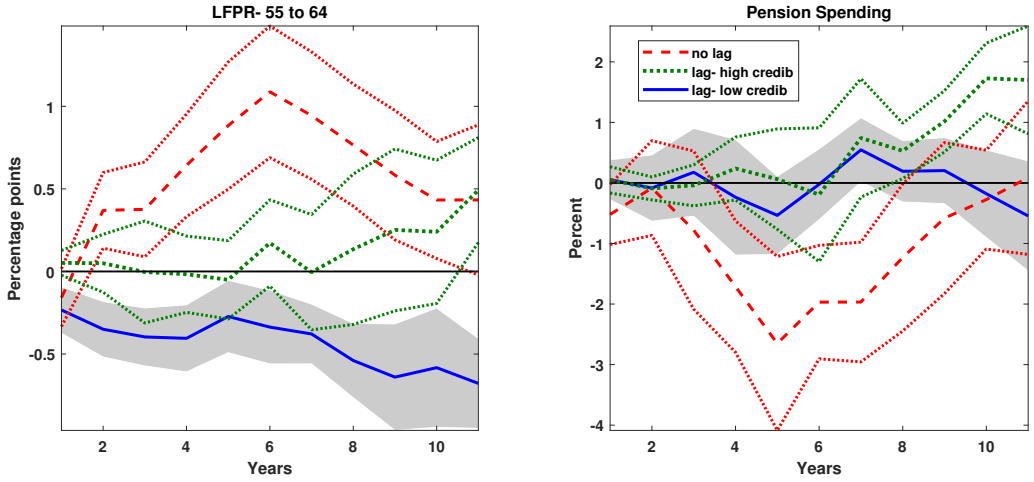
First, we match our data with the measure of "trust in government" provided by the OECD, referring to the share of people who report having confidence in the national government. As the data is available from 2006-2020, we construct a credibility score for each country by taking the average of country-specific measures across time.[41] The score has a wide range, varying from 27.8 for Italy to 60.0 for New Zealand. The ten countries in our data set are divided into high/low credibility groups as being above/below the median credibility score. This classification leads to Australia, Belgium, Denmark, Finland and New Zealand as high credibility countries while France, Italy, Japan, Spain and UK are grouped as being low credibility.

Next, we re-run our regressions by incorporating this credibility information. Figure

[40] Given the small number of policy changes based on other tools and a majority of them being implemented with short lags, it is not feasible to divide them between short and long lags for estimation purposes.

[41] This measure is available for a limited sample period and has limited variation over time. Since we divide countries into only two groups, taking the average or using the time-varying measure does not make a difference. We have also considered the World Values Survey, which provides lower frequency measures of "confidence in government" for many of the countries in our sample and is available since the late 1980s in multiple waves. This alternative measure leads to a similar classification of countries as in our baseline case.

Figure 12: Responses of labor market and pension spending to pension reforms implementation with lags in low credibility countries (blue solid), in high credibility countries (green dot-dashed lines, right panel), and reforms implemented without lags (red dashed lines).



12 shows the response to pension reforms implemented with lags for the set of high and low credibility countries, along with major reforms implemented with no lags. In term of the LFPR for 55-64 year olds, the left panel shows an insignificant response to major structural changes with lags in high credibility countries, while the response is significantly and persistently negative in countries with low credibility. The comparison highlights that the level of trust in the government plays an important role in the labor decision of those close to retirement in response to lagged major reforms.

As discussed in Section 6.2 - 6.4, pension policy changes through different policy tools and with different implementation lags have a different impact on the LFPRs, even if they are all phased in. A natural question is, whether the differences across high- versus low-credibility countries as shown in Figure 12 simply reflect differences in the types of reforms adopted by these countries. The answer is no. The distribution of pension policy changes based on policy tools and implementation lags is remarkably similar across the two groups of countries.[42] Both sets of countries have the same share of reforms with no lags; and for reforms with lags, the distribution across age and contribution based reforms versus others is also very similar.

Finally, we take a step further to answer the following question: Can government credibility alone explain the decline in the LFPR of 55-64 in response to pension changes with lags? Or do the types of pension changes still matter? In order to disentangle these effects, we separate policy changes with phase-in periods based on policy tools and country credibility.

[42]This is shown in Table A.2 in the Appendix.

Figure 13: Responses of labor market and pension spending to age and contribution based pension reforms implementation with lags in low credibility countries (blue solid, right panel) and in high credibility countries (green dot-dashed lines, right panel), and reforms implemented without lags (red dashed lines, left panel) and all other reforms implemented with lags (black dashed, left panel).

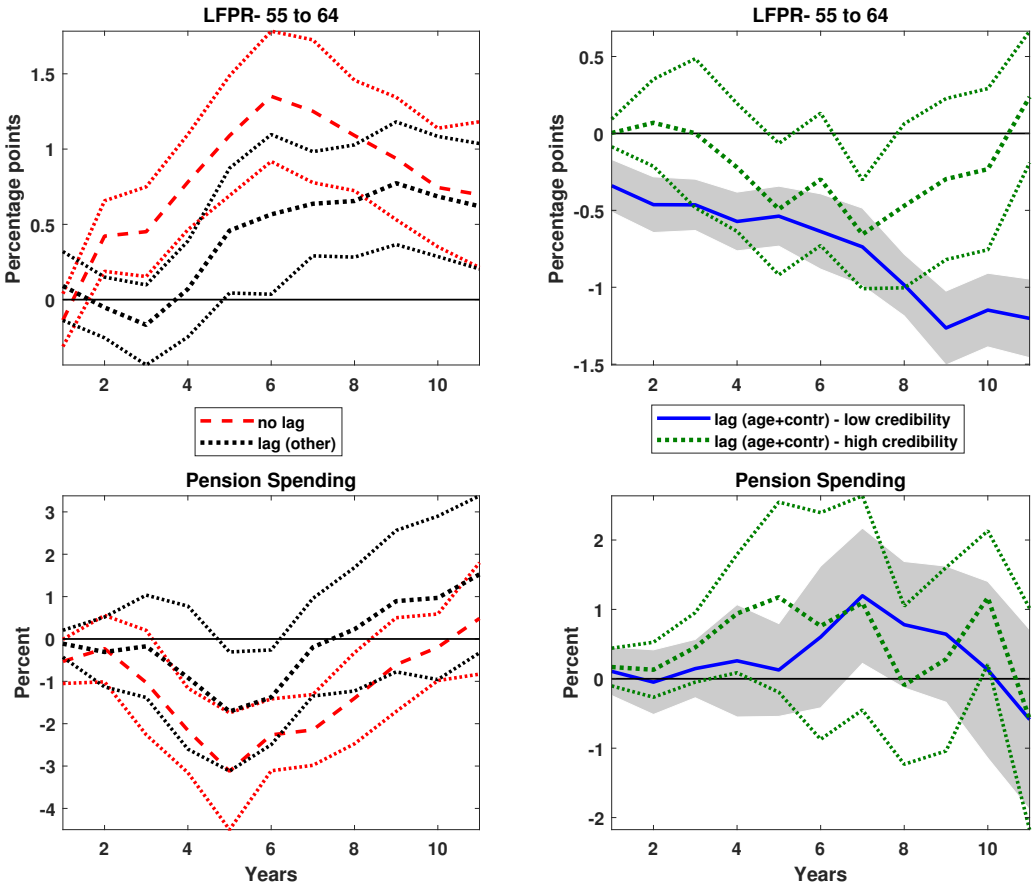


Figure 13 show that in response to phased-in pension reforms through age and contributions, the LFPR of those close to retirement falls across both sets of countries. Thus, the type of pension changes still matters, even after accounting for government credibility. However, this fall in the LFPR is small and peaks at 0.5 percentage points among high-credibility countries, but it is large and persistent in low-credibility countries, peaking at close to 1.25 percentage points. This comparison shows that the propagation of the same type of reforms – age and contributed based reforms with lags – is affected by the trust in the government or its perceived credibility, and governments with higher credibility can dampen the uncertainty channel.

Our analysis in Sections 6.2 - 6.5 provides important policy insights on how to design pension reforms. Pension policy changes that are implemented immediately after announcements can encourage people close to retirement to stay in the labor force longer, alleviating fiscal sustainability concerns. However, it may not be possible or desirable to conduct fundamental pension reforms without phase-in periods. In this case, taking cohort-specific reforms by linking pension retrenchment measures to the birth-year of an individual can likely mitigate the *foresight* channel and, thus contain the decline in the LFPRs of people close to retirement. More importantly, governments with high credibility can better anchor people's expectations about the pension system and reduce uncertainties associated with future pension reforms, thus dampening the negative impact from the *uncertainty* channel.

7 Robustness Checks

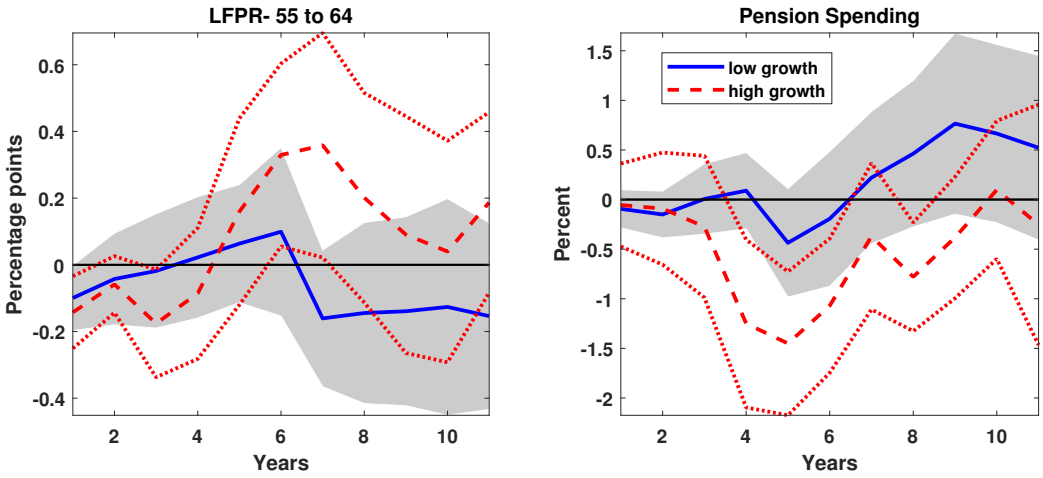
In the following section, we explore the robustness of the distinct impact of structural retrenchments with and without implementation lags on the relevant labor market variables and public pension spending.

7.1 Accounting for the State of the Economy Our structural policy changes are motivated by long-run sustainability concerns, rather than current macroeconomic conditions. However, one might wonder if the policy changes implemented with and without lag have different characteristics based on the state of the economy when they are enacted. Both types of structural changes are on average more likely to be enacted in good times than bad times.[43] Close to 60 percent of both types of reforms are introduced when GDP growth rates are above the country-specific average growth rate. This finding is robust to alternative definitions of good and bad times, including OECD recession indicators, as well as considering unemployment rate above and below the country-specific averages.[44]

[43]This is shown in Figure A.5 in the Appendix.

[44]Beetsma, Klaassen, Romp, and van Maurik (2020) find that pension retrenchments are more likely during business cycle downturns, while pension expansions are more likely during good times. Compared to

Figure 14: Responses to all major structural reforms enacted during high GDP growth periods (red dashed) and low growth periods (blue solid).



We take one step further to test whether the responses to policy changes are different based on the state of the economy when they are enacted. Figure 14 compares the responses of all major structural changes enacted during high-growth periods (red dashed lines) versus low-growth periods (blue solid lines). Firstly, since we include all major structural changes, the responses of LFPRs are now largely muted as they are the average responses to policy changes with and without implementation lags. The comparison between Figures 7 and 14 highlights the importance of differentiating policy changes along the dimension of implementation lags. Secondly, there are no statistical differences in the responses of LFPR and pension spending across both high- and low-growth periods, confirming that the distinct responses captured in the baseline case are driven by implementation lags rather than the underlying state of the economy.[45]

As a further robustness check, we include economic activity indicators as an additional control variable in our regression Equation 5.1. In Figure 15, the top panel shows the cases with lagged GDP growth rate and OECD recession indicator as control variables. Our baseline results are virtually unchanged.[46]

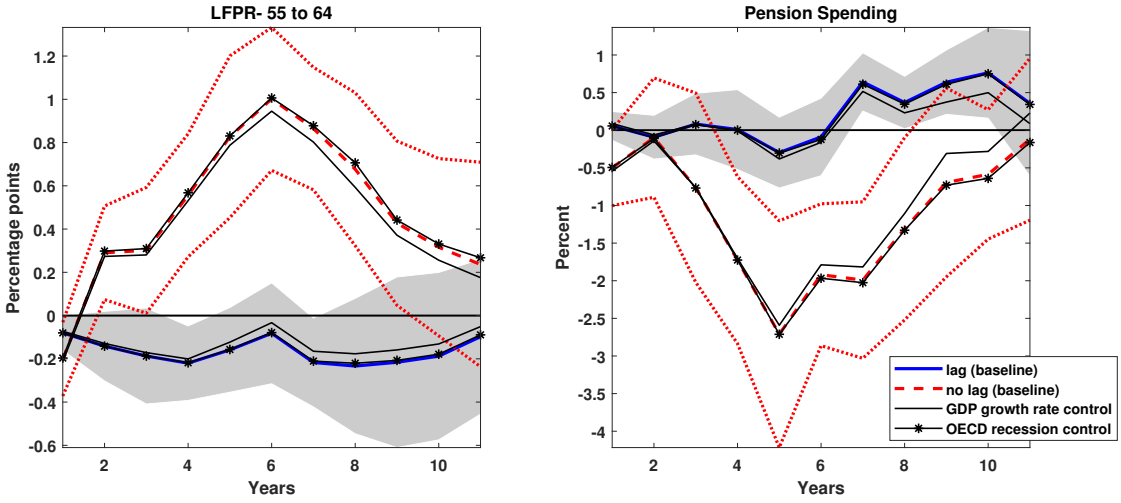
our approach, the major difference is that we focus on structural reforms that are motivated by long-term concerns, while they include all pension policy changes that may have different motivations behind them.

[45]When we distinguish between major reforms with lags enacted in good versus bad times, we do not find significant differences across those responses. For major reforms with no lags, the LFPR of the marginal population tends to rise more during bad times than in good times, but the differences are not statistically significantly different across most horizons.

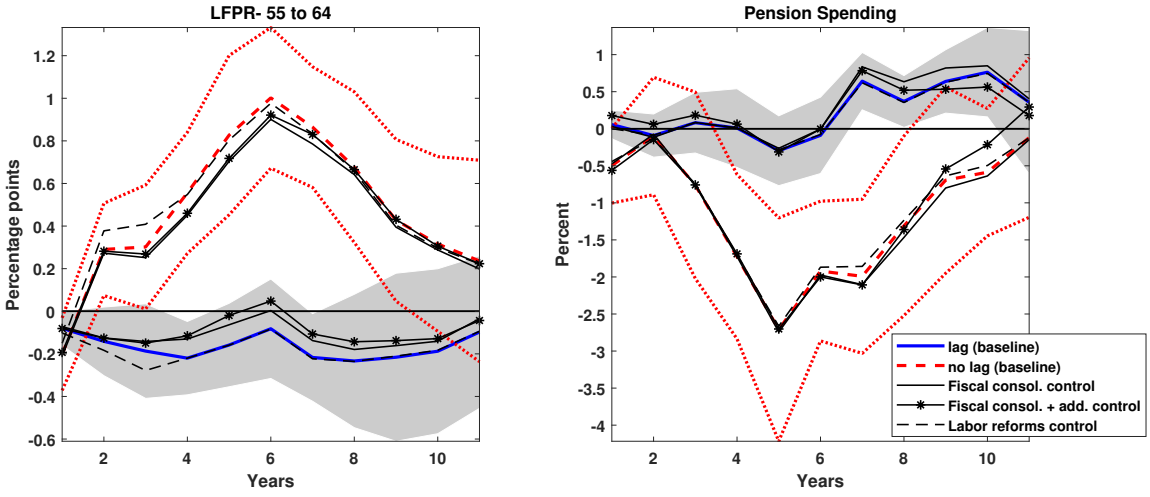
[46]Figure 15 shows the case where we include one lag of the economic activity variable, but the figures look very similar if we put in the contemporaneous values as controls.

Figure 15: Robustness to controlling for additional variables: the blue solid lines show the responses to reforms implemented with lags and red dashed lines correspond to reforms implemented without lags in the baseline case with corresponding one standard deviation confidence bands. The top panel shows additional specifications when controlling for state of the economy, including GDP growth rate and OECD recession indicator. The bottom panel shows results for controlling for fiscal consolidation events, fiscal consolidation dates with additional fiscal controls and lastly labor market reforms.

(a) State of the economy controls



(b) Fiscal consolidation and labor market reform controls



7.2 Accounting for Coincidence of other Fiscal Consolidation Measures

One could be concerned that the responses to our structural policy measures are confounded by other fiscal austerity actions taken during the same period. Most countries have witnessed a wave of pension retrenchments since 1990s. Many of them have also conducted other fiscal austerity measures during the same period, motivated by concerns over sustained budget deficits or dictated by the Maastricht Treaty with the formation of the European Union.

We first check whether our policy dummies overlap with other fiscal consolidation measures in the literature. Guajardo, Leigh, and Pescatori (2014) present the budgetary impact of fiscal consolidations, in terms of changes in both expenditures and revenues, which are not motivated by short-term or cyclical concerns between 1978 and 2009. Their data set considers 13 OECD countries, which includes all of the countries in our data set except New Zealand. For the most part, the correlation between our major reform dummies and their fiscal consolidations plans is low. Some countries have no overlap, such as Denmark and Spain. For other countries, like Italy and Finland, the correlation is as high as 0.3 and 0.4 respectively.[47]

We include the fiscal consolidation shock from Guajardo, Leigh, and Pescatori (2014) as a control variable in our estimation.[48] The bottom panel of Figure 15 shows that our baseline results for the LFPRs of the marginal groups and pension spending are preserved for both changes implemented with and without lags.

In addition to accounting for fiscal consolidations, we also include other fiscal variables such as the growth rate of government spending and tax revenues as controls. One concern might be that changes in pension spending could crowd in/out other types of spending, or are accompanied by major tax changes, which are potentially relevant for the marginal groups. The bottom panel of Figure 15 shows that our baseline results are robust to the inclusion of all these fiscal controls.

7.3 Accounting for Coincidence of other Major Labor Reform Measures

In addition to public pension policy, the LFPRs for people close to retirement might also be affected by labor market reforms. Using the OECD Surveys as a primary source, Duval and Furceri (2018) have recently constructed a database of product market and labor reforms

[47] This is true for major structural reforms all grouped together and also if we separately consider changes with and without lags. The overlap between fiscal consolidation events and public pension reforms in Italy is for the years 1992, 1995, 1997 and 2004. The pension reforms were initiated as a part of the medium-term fiscal program, aimed at stabilising the public debt as a percentage of GDP. One major driving force was the lira being forced out of the ERM in 1992, which was followed by the Amato Government announcing an unprecedented package of fiscal restraint, including public pension reform. The coincidence of fiscal consolidation events and pension reforms in Finland is also during the early 1990s.

[48] We use the lag of the fiscal consolidation shock, but results are unaffected if we put in the contemporaneous value or additional lags of this variable as controls.

spanning 1970-2013 for 26 OECD countries. We use all the labor reforms documented in their data appendix that apply to regular workers, including employment protection legislation reforms and unemployment benefit reforms. With the exception of Denmark, there is very little overlap between major pension dummies in our data set and their labor market reforms. In Denmark, the correlation is 0.3 for major pension policy changes with lags and 0.17 for those implemented without lags.[49] Importantly, as shown in the bottom panel of Figure 15, the responses of pension spending and LFPRs of marginal workers do not change when the labor market reform dummy is included as an additional control variable.

7.4 Alternative Specification of the Pension Reform Shock In the baseline case, we have made two assumptions to improve identification and thus inference of our structural reform dummies. Firstly, as discussed in Section 3.2, we assign intensity to structural reforms to account for the fact that some reforms are more comprehensive with multiple policy changes. Secondly, as discussed in Section 5.2, we only consider major structural changes to pensions, excluding marginal ones. In this section, we relax them to see how these assumptions, driven partially by our judgement, affect our results.

We first abstract from assigning intensity to reform dummies. Specifically, we assign all structural reform dummies as being in the set of $\{-1, +1\}$, so that we treat all major reforms the same, regardless of multi-dimensional policy reforms or one policy change by itself. The top panel of Figure 16 shows that our results are robust overall. The responses of pension spending and the LFPR of 55-64 years have slightly larger confidence bands in the case of reforms implemented with lag (blue solid lines).

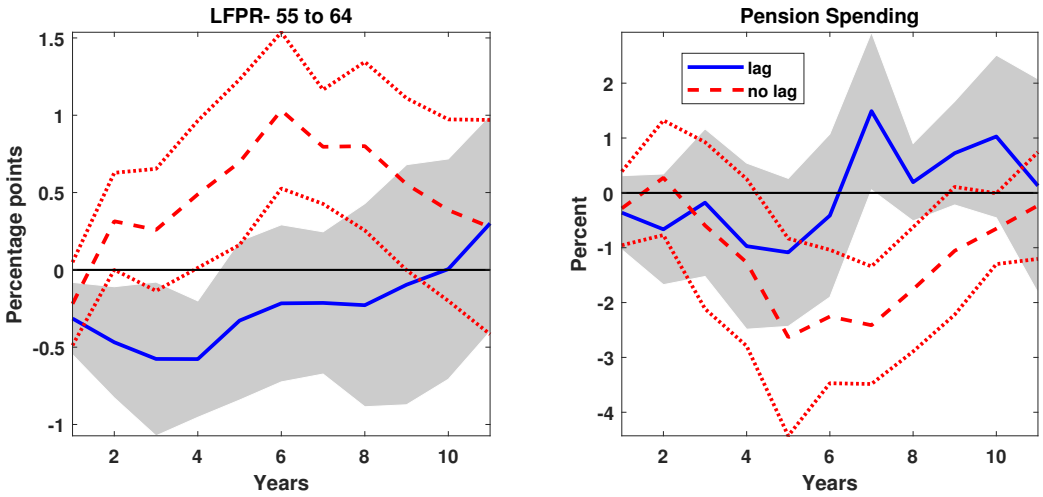
Next, we include all changes in pension policy that are motivated by long-term concerns, both major and marginal ones. Considering the fact that some of the marginal ones are small policy changes, we put 50% weight on the marginal policy changes; otherwise, giving equal weights to all policy changes may yield a very noisy measure of structural reforms.[50] The responses of the labor market variables and pension spending to the broader reform dummies are shown in the bottom panel of Figure 16. It is not surprising that confidence bands are much larger in this case, since minor policy changes are given significant weight. The qualitative results, however, still hold, as the LFPRs of marginal groups and pension spending respond differently in response to reforms with and without lags at a subset of horizons.

[49] The overlapping years with labor and public pension reforms are 1996, 2000 and 2011.

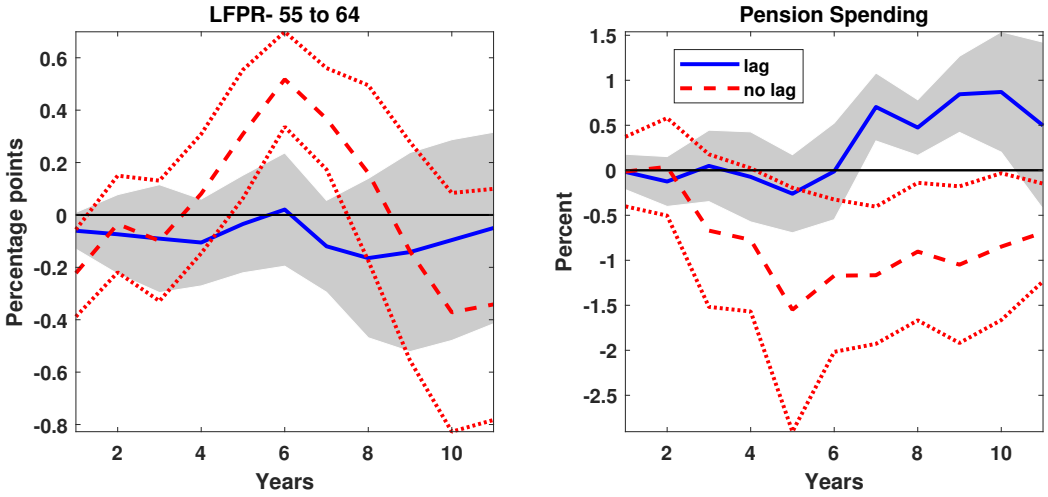
[50] For example, in 2010 the French government eliminated the option for parents with three children to leave the work force with pensions after 15 years' service. This is a marginal change to pension in our database, as it only affects a small fraction of pensioners. In the same reform act, the minimum legal retirement age was raised from 60 to 62 years, which is classified as a major change.

Figure 16: Robustness to alternative definitions of the pension reform measure: the blue solid lines show the responses to reforms implemented with lags and red dashed lines correspond to reforms implemented without lags. The grey bands show one standard deviation confidence bands

(a) Excluding intensity



(b) Major and marginal policy changes



8 Conclusion

By tracking pension policy for 10 OECD countries over the past several decades, we document that a rapid expansion of pension systems between 1960s and 80s was followed by successive retrenchments since 1990s. Structural pension reforms, which are motivated by long-run fiscal sustainability concerns, often come with long implementation lags.

We find that people close to retirement have distinctly different responses to pension retrenchments with phase-in periods from those without. Notably, the LFPRs of those close to retirement rises in response to pension retrenchments with no implementation lags and fall in response to pension retrenchment news. Importantly, the decline in the LFPRs in response to lagged pension retrenchments is particularly strong for reforms that come with exceedingly long lags, of the order of 15 years or longer, and ones that change the fundamental aspects of pension systems, such as retirement age and contribution years. In addition, the level of trust that people have in the government plays an important role, as the response of the LFPR is significantly and persistently negative in countries with low credibility.

Our empirical analysis provides important policy insights on how to design pension reforms. Pension policy changes implemented without lags can encourage people close to retirement to stay in the labor force for longer, alleviating fiscal sustainability concerns. However, it may not be possible or desirable to conduct fundamental pension reforms without phase-in periods. In this case, policy makers can mitigate the fall in the LFPRs of people close to retirement by designing pension retrenchments to limit the foresight channel and by proposing actuarially neutral policy changes or linking them to the birth-year of an individual. More importantly, it is vital to recognize that if the citizens have trust in the government and view them as being credible, it helps to better anchor their expectations and reduce perceived uncertainties associated with future pension reforms, dampening the negative impact on the LFPR from the uncertainty channel.

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SUPPLEMENTARY APPENDIX

Public Pension Reforms and Retirement Decisions: Narrative Evidence and Aggregate Implications

Huixin Bi and Sarah Zubairy

A Additional Figures and Tables

Data	Description	Data Source
LFPR	Labor force participation, aggregate, by age: 20-49, 55-59, 60-64, 55-64, gender and age: Female/Male 55-59, 60-64, 55-64	OECD
Pension spending	Old age public spending as % of GDP	OECD
GDP	National accounts, expenditure approach, GDP	OECD
CPI	Consumer price index	OECD
Government spending	National account, expenditure approach, government expenditure	OECD
Tax revenues	Total tax revenues as percent of GDP	OECD
Elderly pop. share	People aged 65 and over as share of total pop.	OECD
Life expectancy	Life expectancy at birth, total (years)	World Bank
Fiscal consolidation	Fiscal consolidation variable	Guajardo et al. (2014)
Labor reform dummy	Emp. protection legislation reforms and unemployment benefit reforms for regular workers	Duval & Furceri (2018)

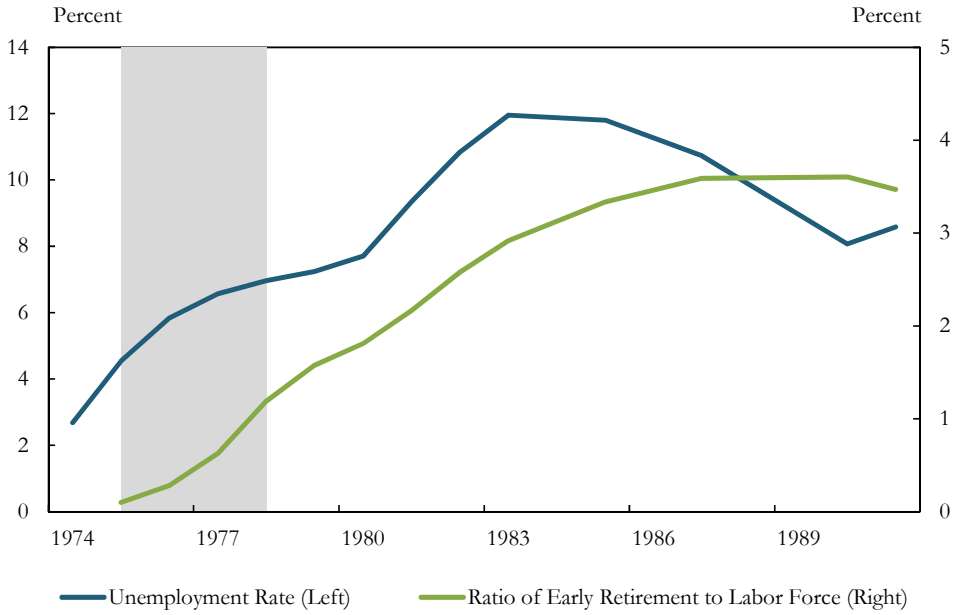
Table A.1: Our analysis is conducted for the sample period 1980-2018, as the old-age pension spending data starts in 1980. The LFPR data starts at later dates for some countries: in 1983 for Belgium and Denmark, 1984 in UK and 1986 in New Zealand. All other data covers this time period unless indicated in the text.

	Low-credibility group	High-credibility group
No lags	0.33	0.33
Age & contr. lags	0.44	0.46
Other lags	0.24	0.21
Short lags	0.54	0.44
Long lags	0.13	0.19
Age & contr. short lags	0.33	0.31
Age & contr. long lags	0.11	0.15

Table A.2: Public pension policy distributions across low- vs. high-credibility country groups. It shows the percentage of each type of public pension policy reform in the two sets of countries. For instance, the shares for reforms with no lags, age and contribution based reforms with lags, and other reforms with lags round to 1. High-credibility countries: Australia, Belgium, Denmark, Finland and New Zealand; low-credibility countries: France, Italy, Japan, Spain and UK.

Figure A.1: Belgium: early retirement programs had a significant impact on the labor market and pension spending.

(a) Early retirement programs were introduced in response to rising unemployment rate in the late 1970s. The gray bar highlights the introduction of three early retirement programs in 1975, 1976 and 1978. The blue line shows the unemployment rate, and the green line shows the population in early retirement as a share of the total labor force.



(b) Early retirement programs have been scaled back since the late 1980s, and the spending on early retirement as a share of GDP has been trending down at a very gradual pace. The dashed lines show that retrenchment measures were taken in 1987 (A), 1997 (C), 2006 (D), 2012 (E), and 2015 (F), while an expansionary measure was taken in 1994 (B).

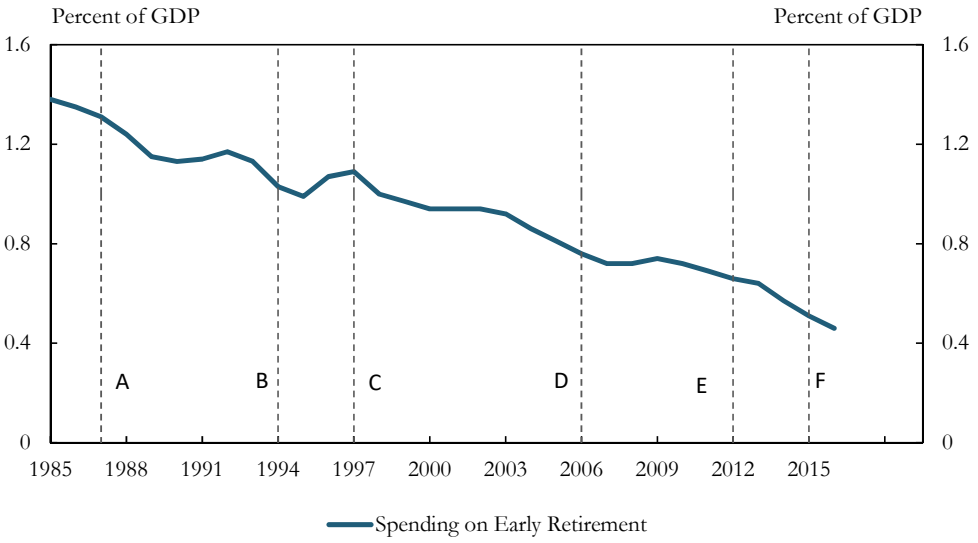


Figure A.2: Denmark: the early transitional retirement scheme and the LFPR for elderly population. The early program was introduced in 1992 and expanded in 1994, with entrance to the scheme shutting off in 1996. The blue line shows the LFPR for population between age 50 and 59 years, and the green line shows the early retirement spending as share of GDP.

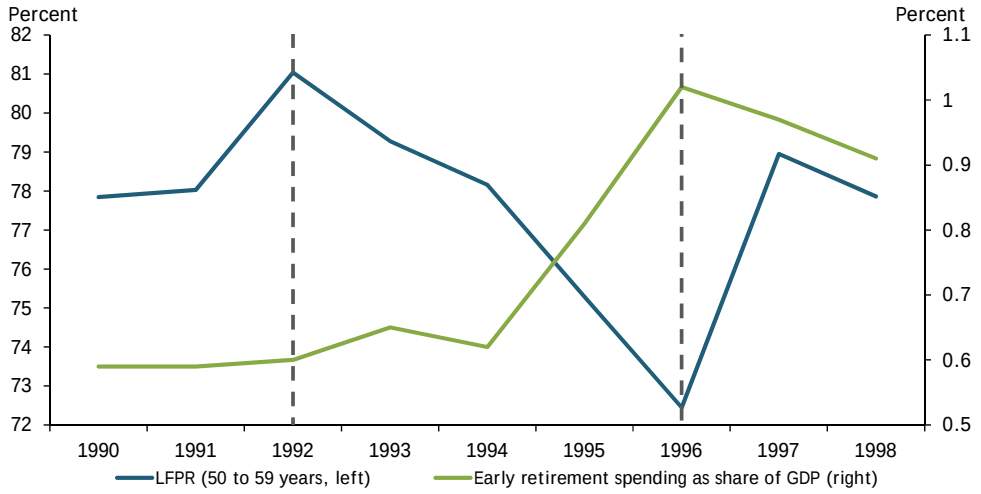


Figure A.3: France: the early retirement program and the LFPR for elderly population. Incentives to encourage early retirement were provided in 1981. The blue line shows the LFPR for population between age 55 and 59 years, and the green line shows the early retirement spending as share of GDP.

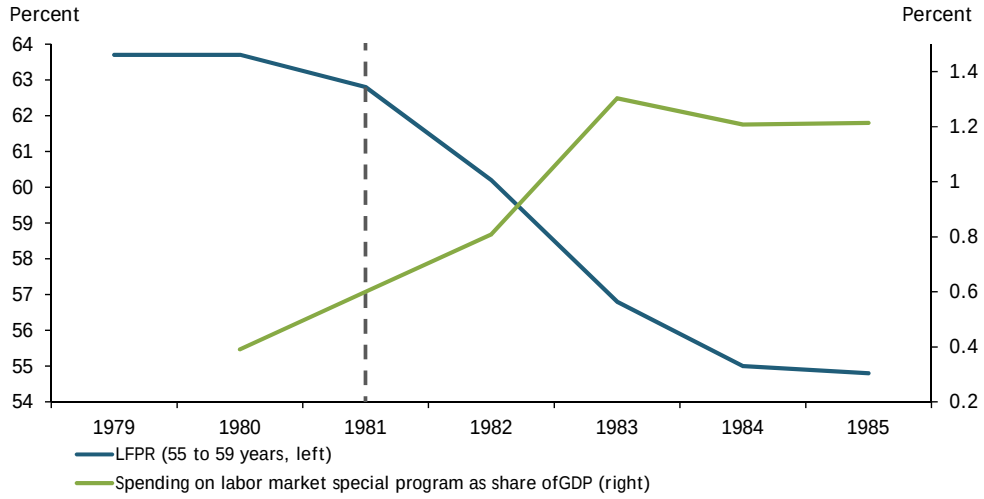


Figure A.4: Implementation lags associated with major structural pension changes (measured in years). Each dot represents the implementation lag associated with one policy change. Green dots are associated with pension retrenchments, while blue dots are for pension expansions.

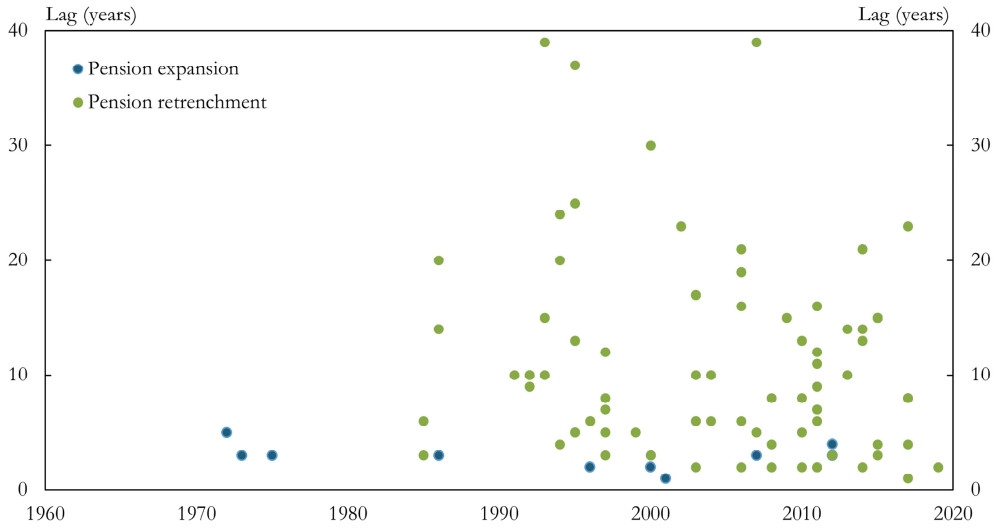


Figure A.5: Distribution of all major structural reforms: lag (blue bars) and no lag (orange bars), enacted across good (solid bars) and bad times (patterned bars). High/low GDP growth and unemployment are periods where GDP growth and unemployment rate are above/below the country-specific sample average.

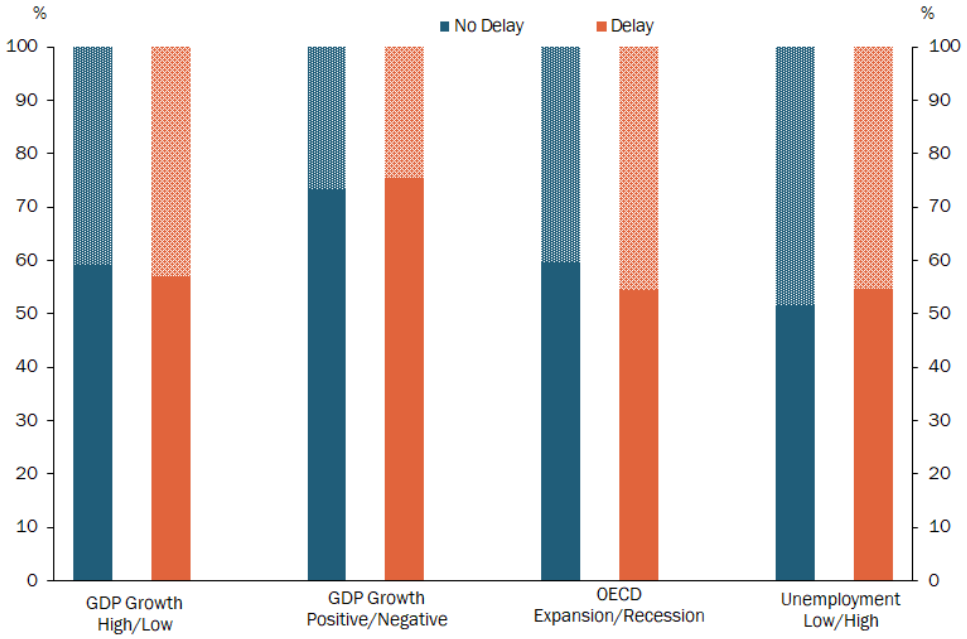
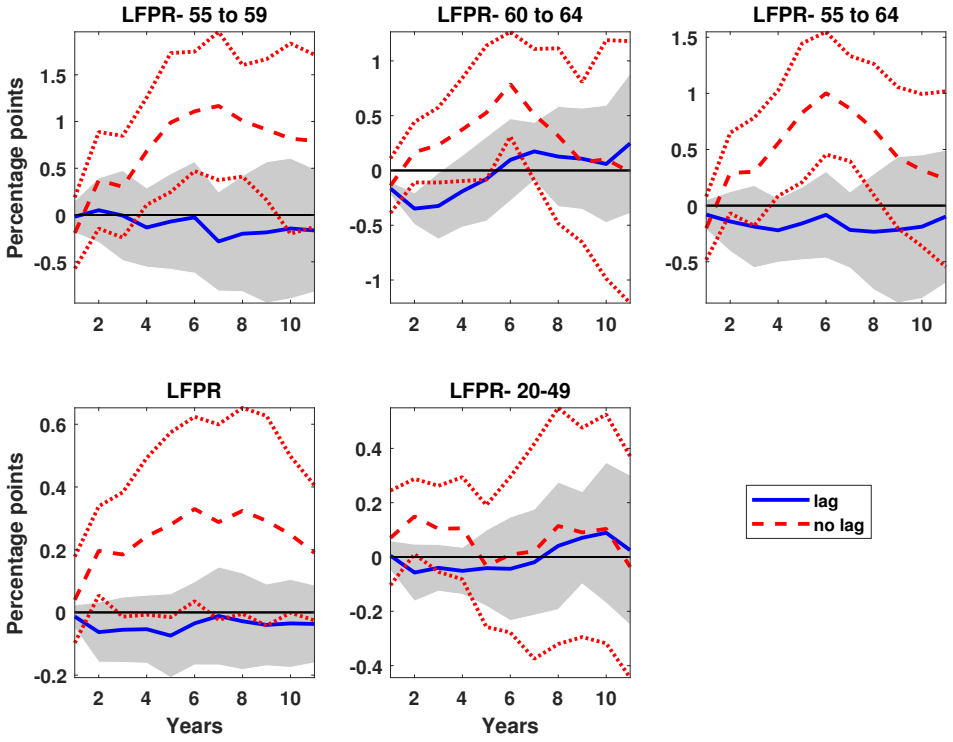
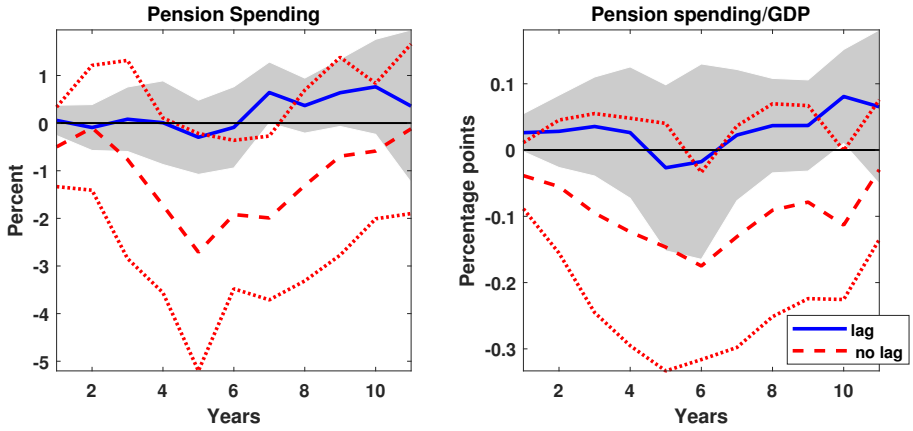


Figure A.6: Responses of labor market and pension spending to structural pension retrenchments for data between 1980 and 2017. The blue solid lines show the responses to reforms implemented with lags and red dashed lines correspond to reforms implemented without lags. The corresponding bands show 90% confidence bands.

(a) Labor force participation rates



(b) Old-age pension spending



B Examples of Pension Policy Changes

In this section, we use three examples associated with pension policy changes in Belgium to explain how we extract information from the OECD Economic Surveys, and how we classify policy changes along the four aspects as laid out in Section 3.2.

B.1 Pension Change in 1968 According to the Survey of Belgium in 1970, the government formulated monetary and fiscal policy "with a closer view to the needs of short-term demand management" in the last couple of years. As shown in Figure B.1, while capital outflow required a shift to restrictive monetary policy in 1968, fiscal policy were eased to cope "with the slack in fixed investment." Government adopted a wide range of measures, including increased pension payments, to support economic activity. We consider that the government expanded pension benefits through higher payments, and classify the change as motivated by cyclical concerns and implemented without lags.

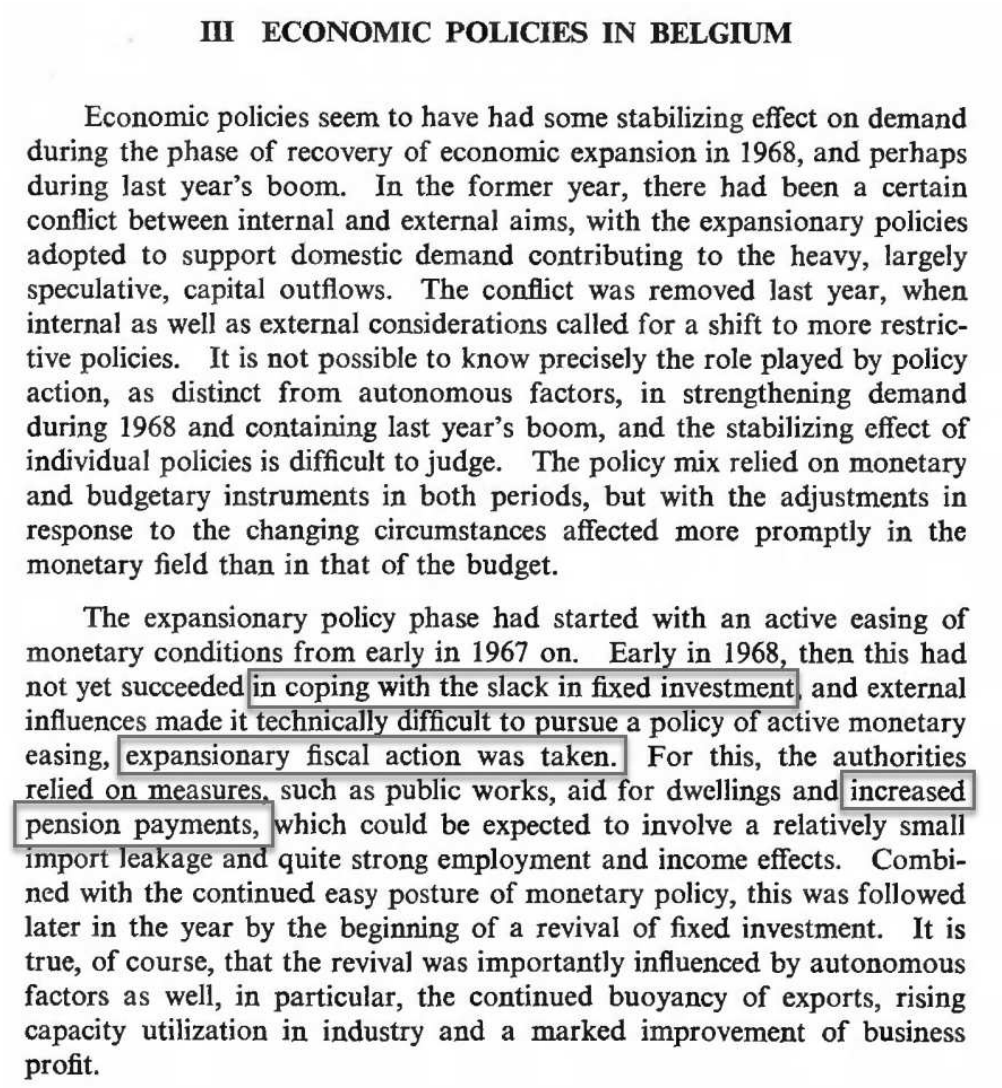
B.2 Pension Change in 1994 The Survey of Belgium in 1995 provides a calendar of main economic events for the year 1994, as illustrated in Figure B.2. In December 1994, a major change in early retirement age was passed against the backdrop of historically high unemployment rate, 12.9 percent as the end-June official figure. The Survey further elaborated: "The interprofessional agreement (accord interprofessionnel) for 1995-96 concluded by the social partners late last year gave priority to the defence and promotion of employment." The new agreement includes a range of policy changes, including a larger reduction in social contributions for firms that created more jobs, a new 'hiring plan' targeting the long-term unemployed, and lowering the age limit for early retirement for two years. We classify the change as motivated by cyclical concerns and implemented without lags. It was an expansionary policy change through lowering retirement age.

B.3 Pension Change in 2015 The Survey of Belgium in 2017 provides an in-depth discussion on the pension reform of 2015, which was viewed as "an important step towards long-term fiscal sustainability." As shown in Figure B.3, the reform took a wide range of measures, including

1. The statutory retirement age would be increased from 65 to 66 years in 2025 and to 67 years in 2030. This measure changes retirement age with a phase-in period of 10 to 15 years.

2. Early retirement conditions was made more stringent. The minimum age and number of career years required to qualify for early retirement would progressively increase:

Figure B.1: The Surveys provided general discussion on fiscal policy prior to 1973. Example: the Survey report for Belgium (1970).



III ECONOMIC POLICIES IN BELGIUM

Economic policies seem to have had some stabilizing effect on demand during the phase of recovery of economic expansion in 1968, and perhaps during last year's boom. In the former year, there had been a certain conflict between internal and external aims, with the expansionary policies adopted to support domestic demand contributing to the heavy, largely speculative, capital outflows. The conflict was removed last year, when internal as well as external considerations called for a shift to more restrictive policies. It is not possible to know precisely the role played by policy action, as distinct from autonomous factors, in strengthening demand during 1968 and containing last year's boom, and the stabilizing effect of individual policies is difficult to judge. The policy mix relied on monetary and budgetary instruments in both periods, but with the adjustments in response to the changing circumstances affected more promptly in the monetary field than in that of the budget.

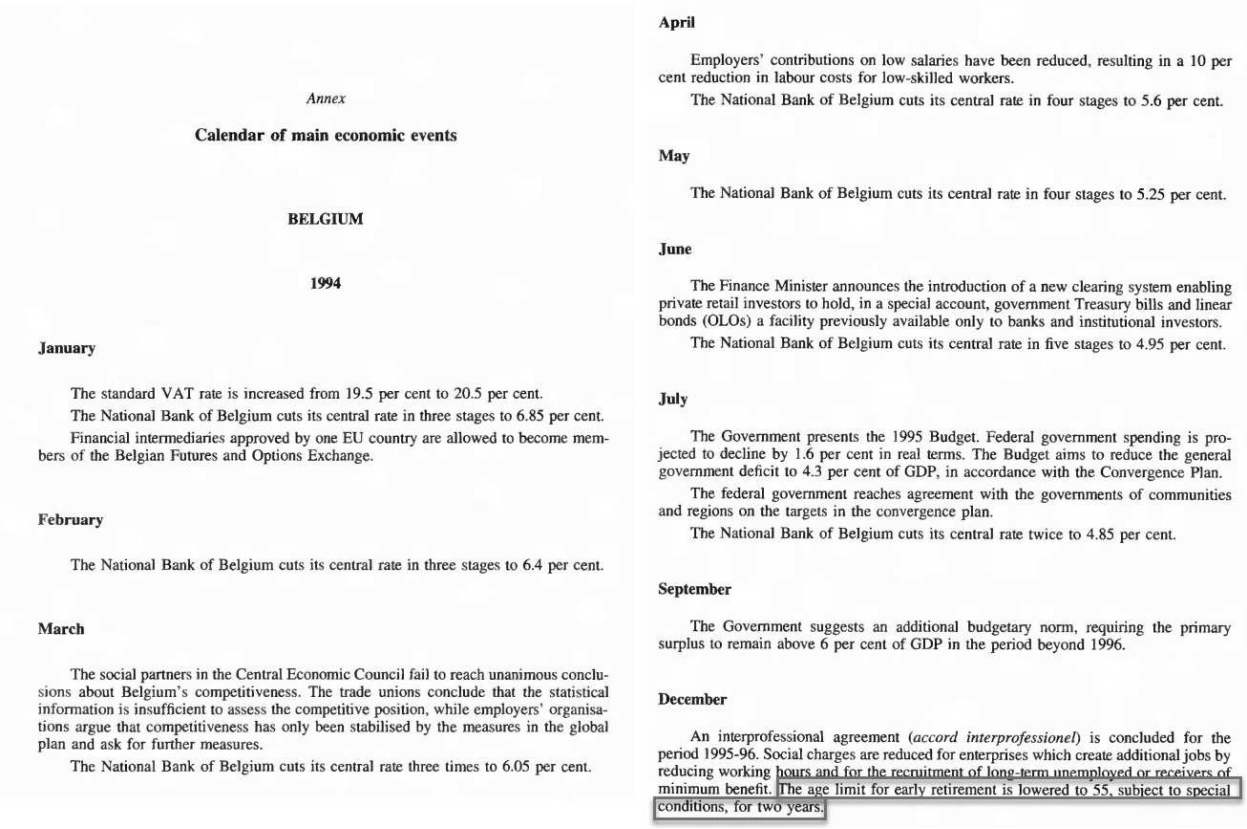
The expansionary policy phase had started with an active easing of monetary conditions from early in 1967 on. Early in 1968, then this had not yet succeeded in coping with the slack in fixed investment, and external influences made it technically difficult to pursue a policy of active monetary easing, expansionary fiscal action was taken. For this, the authorities relied on measures, such as public works, aid for dwellings and increased pension payments, which could be expected to involve a relatively small import leakage and quite strong employment and income effects. Combined with the continued easy posture of monetary policy, this was followed later in the year by the beginning of a revival of fixed investment. It is true, of course, that the revival was importantly influenced by autonomous factors as well, in particular, the continued buoyancy of exports, rising capacity utilization in industry and a marked improvement of business profit.

starting from 62 years and 40 years respectively in 2016, they would increase to 62.5 and 41 years in 2017, then to 63 and 41 years in 2018 and finally to 63 and 42 years in 2019. We classify it into two changes, that associated with retirement age, and that related to contribution years. Both changes would be fully implemented within 4 years.

3. The terms for pre-pension benefits was also made more stringent. The minimum age was increased from 60 years to 62 years in 2015, subject to transitional arrangements. This measure changes retirement age with implementation lags.

4. In addition, the possibility to use a complementary pension to retire earlier and to bridge the income gap until being eligible to a full pension was abolished, subject to

Figure B.2: The Surveys provided chronologies of major economic policy events between 1973 and 2002. Example: the Survey report for Belgium (1995)



Annex

Calendar of main economic events

BELGIUM

1994

January

The standard VAT rate is increased from 19.5 per cent to 20.5 per cent.

The National Bank of Belgium cuts its central rate in three stages to 6.85 per cent.

Financial intermediaries approved by one EU country are allowed to become members of the Belgian Futures and Options Exchange.

February

The National Bank of Belgium cuts its central rate in three stages to 6.4 per cent.

March

The social partners in the Central Economic Council fail to reach unanimous conclusions about Belgium's competitiveness. The trade unions conclude that the statistical information is insufficient to assess the competitive position, while employers' organisations argue that competitiveness has only been stabilised by the measures in the global plan and ask for further measures.

The National Bank of Belgium cuts its central rate three times to 6.05 per cent.

April

Employers' contributions on low salaries have been reduced, resulting in a 10 per cent reduction in labour costs for low-skilled workers.

The National Bank of Belgium cuts its central rate in four stages to 5.6 per cent.

May

The National Bank of Belgium cuts its central rate in four stages to 5.25 per cent.

June

The Finance Minister announces the introduction of a new clearing system enabling private retail investors to hold, in a special account, government Treasury bills and linear bonds (OLOs) a facility previously available only to banks and institutional investors.

The National Bank of Belgium cuts its central rate in five stages to 4.95 per cent.

July

The Government presents the 1995 Budget. Federal government spending is projected to decline by 1.6 per cent in real terms. The Budget aims to reduce the general government deficit to 4.3 per cent of GDP, in accordance with the Convergence Plan.

The federal government reaches agreement with the governments of communities and regions on the targets in the convergence plan.

The National Bank of Belgium cuts its central rate twice to 4.85 per cent.

September

The Government suggests an additional budgetary norm, requiring the primary surplus to remain above 6 per cent of GDP in the period beyond 1996.

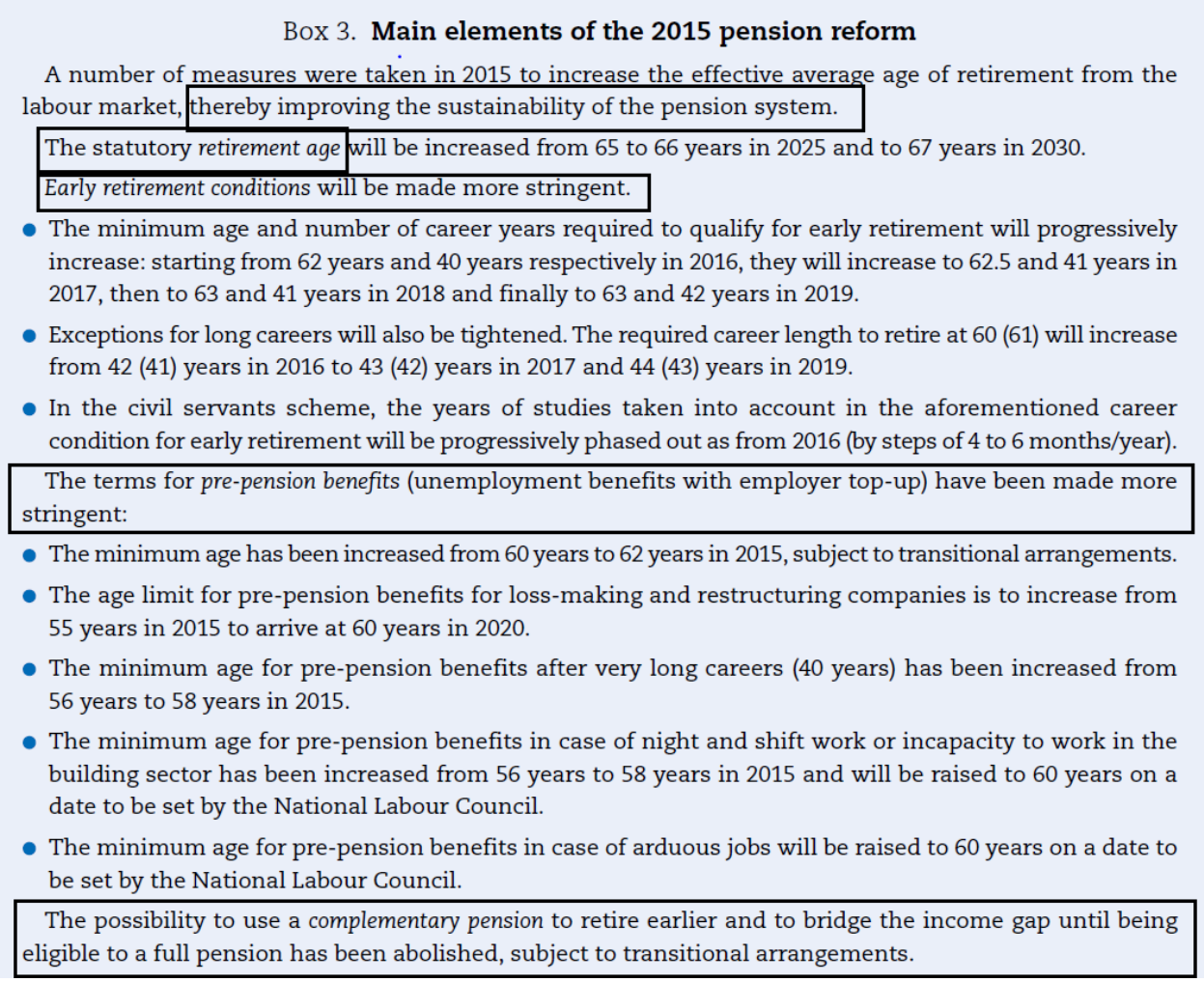
December

An interprofessional agreement (*accord interprofessionel*) is concluded for the period 1995-96. Social charges are reduced for enterprises which create additional jobs by reducing working hours and for the recruitment of long-term unemployed or receivers of minimum benefit. The age limit for early retirement is lowered to 55, subject to special conditions, for two years.

transitional arrangements. As the measure phased out a complementary pension plan, we classify it as a change on pension coverage that come with some implementation lags.

We also categorize all the measures in 2015 as structural changes, as they were motivated by long-run concerns. As explained in Section 5.2, we give intensity score to our pension dummy to capture the scope of reforms. The 2015 reform in Belgium has an intensity of "-5". The high intensity is qualitatively consistent with the assessment from the Survey, as it says that "(T)he Working Group on Ageing Populations and Sustainability projects pension spending to increase from 11.8% of GDP in 2013 to 13.1% of GDP in 2060, compared to an increase to 15.1% of GDP in 2060 in a no-reform scenario (EC, 2016b)." [OECD Economic Survey of Belgium (2017, pg 36)]

Figure B.3: The Surveys have been providing in-depth discussions on economic challenges and policy recommendations since 2003. Example: the Survey for Belgium (2017)



Box 3. **Main elements of the 2015 pension reform**

A number of measures were taken in 2015 to increase the effective average age of retirement from the labour market, thereby improving the sustainability of the pension system.

The statutory *retirement age* will be increased from 65 to 66 years in 2025 and to 67 years in 2030.

Early retirement conditions will be made more stringent.

- The minimum age and number of career years required to qualify for early retirement will progressively increase: starting from 62 years and 40 years respectively in 2016, they will increase to 62.5 and 41 years in 2017, then to 63 and 41 years in 2018 and finally to 63 and 42 years in 2019.
- Exceptions for long careers will also be tightened. The required career length to retire at 60 (61) will increase from 42 (41) years in 2016 to 43 (42) years in 2017 and 44 (43) years in 2019.
- In the civil servants scheme, the years of studies taken into account in the aforementioned career condition for early retirement will be progressively phased out as from 2016 (by steps of 4 to 6 months/year).

The terms for *pre-pension benefits* (unemployment benefits with employer top-up) have been made more stringent:

- The minimum age has been increased from 60 years to 62 years in 2015, subject to transitional arrangements.
- The age limit for pre-pension benefits for loss-making and restructuring companies is to increase from 55 years in 2015 to arrive at 60 years in 2020.
- The minimum age for pre-pension benefits after very long careers (40 years) has been increased from 56 years to 58 years in 2015.
- The minimum age for pre-pension benefits in case of night and shift work or incapacity to work in the building sector has been increased from 56 years to 58 years in 2015 and will be raised to 60 years on a date to be set by the National Labour Council.
- The minimum age for pre-pension benefits in case of arduous jobs will be raised to 60 years on a date to be set by the National Labour Council.

The possibility to use a *complementary pension* to retire earlier and to bridge the income gap until being eligible to a full pension has been abolished, subject to transitional arrangements.

C Projected Budgetary Impact of Pension Reforms: Italy Case Study

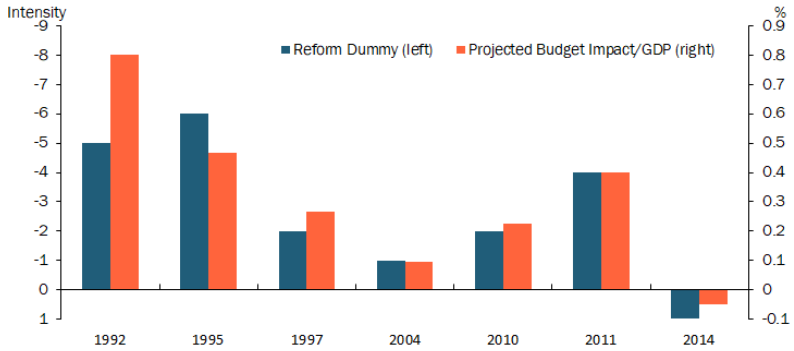
We rely on Alesina, Barbiero, Favero, Giavazzi, and Paradisi (2017) and their corresponding data appendix to construct the projected budgetary impact of major pension reforms in Italy since 1990s. Their study presents the budgetary impact in the year when the legislation was passed and also for up to 5 years out, i.e. $\sum_{j=0}^{5}$ budgetary impact$_{t+j}$ for the reform that was passed at period t. The authors rely on contemporaneous sources including OECD Surveys and country-specific reports.[51] We include reductions in spending and transfers as a result of pension reforms in the relevant years from their database. As a first pass, we do not include savings from increased contributions. The top panel of Figure C.1 compares our major structural reform dummies (blue bars) to their 5-year projected budgetary impact of pension reforms for the corresponding years (orange bars). If we also include savings from increased contributions, the budgetary impact in some years, notably 1995, are increased, see the bottom panel of Figure C.1.

Overall, our reform dummies with intensity line up reasonably well relative to the short-run projected budgetary impact. However, this projected budgetary impact does not account for the projected long-run savings. It is particularly relevant for reforms with very long phase-in periods. For example, the OECD Economic Survey 1997 estimated that the largest expenditure savings associated with the 1995 Dini reform wouldn't materialize until 2025, as shown in Figure C.2. This also illustrates the difficulty in summarizing the projected budgetary impact of pension reforms, because of added uncertainty with such long-run horizons.

[51] They are given in terms of local currency in their Appendix and we convert them in terms of percent of GDP.

Figure C.1: Major structural reform (on the left axis) and the five-year projected budgetary impact as a percentage of GDP from Alesina, Barbiero, Favero, Giavazzi, and Paradisi (2017) (on the right axis) under alternative computations.

(a) Projected 5-year budgetary impact/GDP with expenditure savings.



(b) Projected 5-year budgetary impact/GDP with expenditure and contribution-based savings.

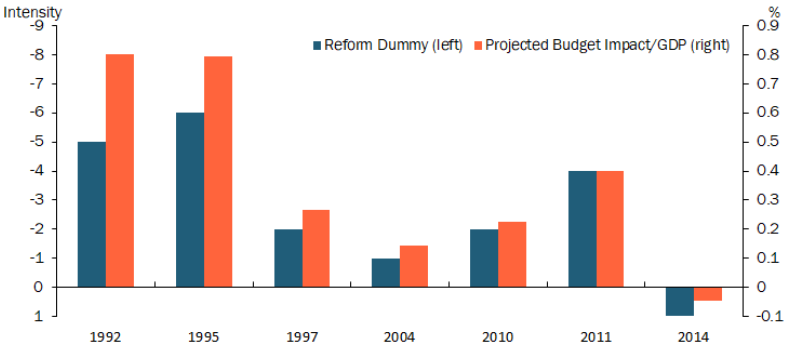
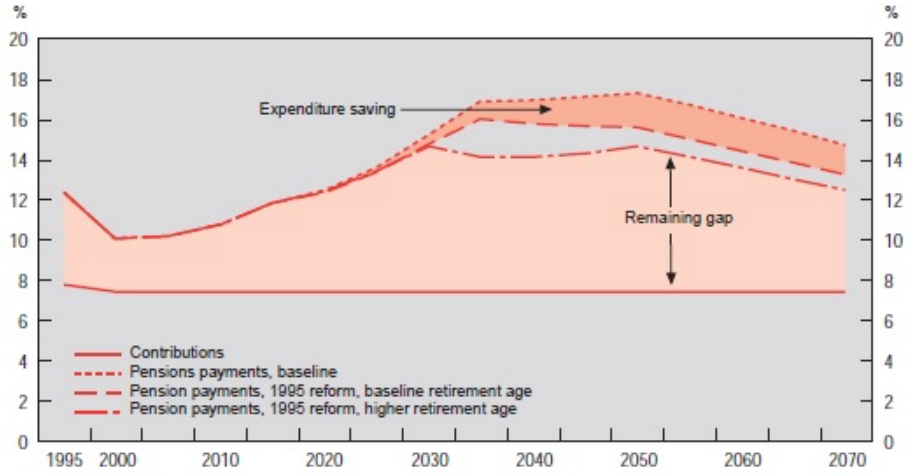


Figure C.2: Projected budgetary impact as a percentage of GDP of the 1995 pension reform in Italy in OECD Economic Survey 1997, pg 84.

Figure 28. **TRENDS IN PENSION PAYMENTS AND CONTRIBUTIONS**

Per cent of GDP



Source: OECD.