## Overview

The code in this replication package constructs the analysis files and generates Tables 1-6 and Figures 1 and 3-6 (figure 2 is a schematic constructed in latex) in “Monetary Policy and Birth Rates: The Effect of Mortgage Rate Pass-through on Fertility” *Review of Economic Studies,* Fergus Cumming and Lisa Dettling.

The replication package directory is organized as follows:

* /data/ folders contain raw/derived and final analysis dataset sets
* /pgm/ folders contains all code and do-files
* /output/ is empty and will populate when files in "pgm" folder are run.

Each of these folders contains four sub-directories:

* /UK/ refers to the analysis in Section 3 and Figure 3, Tables 1-4
* /US/ refers to the analysis in Section 4 and Figures 4-5, Tables 5-6
* /TS/ refers the analysis in Section 5 and Figure 6
* /Figure 1/ refers to Figure 1

Some data used in our analyses are proprietary and the underlying raw cannot be shared. However, we have obtained permission to share derived aggregated and non-disclosive cell-level files created from these raw data sources and those are included in our replication package so that users may replicate the analysis used to produce the figures and tables in our paper. More information on obtaining access to those underlying raw data is included below in “**Data Availability**”. Users who wish to replicate the tables and figures in the paper using only the provided replication archive and without obtaining access the underlying raw data files should begin at Step 3 under “**Instructions for replicators**”.

Code provided in this package runs on Stata Version 16 on a Linux server in 6-10 hours.

## Data Availability

### Statement about Rights

I certify that the author(s) of the manuscript have legitimate access to and permission to use the data used in this manuscript.

### Summary of Availability

Some data **cannot be made** publicly available.

### Details on each Data Source

*Note: This data availability section will describe the contents of the /data/ directory. The description will be delineated by the four main subdirectories (US, UK, TS, and Figure 1). Within each section, we delineate between datasets which are publicly available (raw data is provided in the archive) and datasets which are confidential (only non-disclosive derived data can be provided in the replication archive).*

UK Analysis (Section 3, Figure 3, Tables 1-4)

*Publicly available data (raw data provided in archive):*

* Unemployment rates. Source is ONS (2019). Annual Population Survey/Labour Force; Model Based Estimates of Unemployment.
  + Access at http://www.nomisweb.co.uk. Select *Annual Population Survey* dataset; *local authority* geography; *unemployment rate 16+* variable.
  + Files provided (directory is /data/UK/Input/): lau\_unemp\_0418.csv (downloaded on Apr 2, 2019); urate1624.csv, urate2534.csv, urate3549.csv (downloaded Feb 18, 2021)
* House prices. Source is HM Land Registry (2023) UK House Price Index.
  + Access at <https://www.gov.uk/government/statistical-data-sets/uk-house-price-index-data-downloads-december-2018>
  + Files provided (/data/UK/Input/): UK-HPI-full-file-2018-12.csv (downloaded Jan 4, 2023)
* Home ownership rate/tenure. Source is ONS (2018), 2001 UK Census.
  + Access at <http://www.nomisweb.co.uk>. Select *Census 2001* dataset; *local authority* geography; *household tenure* variable.
  + Files provided (/data/UK/Input/): owner\_age.csv and all\_age.csv (downloaded Oct 30, 2018)
* Educational attainment. Source is ONS (2019), 2001 UK Census.
  + Access at <http://www.nomisweb.co.uk> Select *UV024* dataset; *local authority* geography; *Highest Level of Qualification* variable.
  + Files provided (/data/UK/Input/): lfs\_sex\_age\_qualification: downloaded February 5 2019
* Female Population. Source is ONS (2018), 2001 UK Population estimates
  + Access at <http://www.nomisweb.co.uk> Select *population estimates (2018)* dataset; *local authority* geography*; 16-24, 25-34, 35-44, 45+* variables.
  + Files provided (/data/UK/Input/): Population.xlslx (downloaded Oct 27, 2018)
* Crosswalk files created by authors provided in archive (/data/UK/Input/):
  + LAU\_key.dta A mapping between geographic area codes in the UK created by authors

*Confidential Raw Data (derived data provided in archive):*

* UK Vital Statistics Birth Certificate microdata: Source is UK Office of National Statistics (ONS, 2022), Vital Statistics in the UK: Birth Statistics.
  + The raw data can be accessed through a secure server and accredited researchers are able to apply to the ONS to gain access. To apply to become an accredited researcher and gain access to the data, visit <https://www.ons.gov.uk/aboutus/whatwedo/statistics/requestingstatistics/secureresearchservice>
  + Files **not** provided which must be accessed on ONS servers: UK Vital Statistics birth certificate microdata
  + Files provided (/data/UK/): births\_2005\_2013\_2020.csv. *This is an aggregated, non-disclosive, cell-level file with birth counts which has publication clearance from the ONS, granted Jan 8, 2022*
* Mortgage data. Source UK Financial Conduct Authority (FCA, 2022), Product Sales Database (PSD).
  + The raw data are available on the premises at the Bank of England (BOE) but they cannot leave the building. The Bank is able to grant external researchers access to the underlying data on its premises for replication purposes following an application process. External researchers wishing to obtain such access should contact [misa.tanaka@bankofengland.co.uk](mailto:misa.tanaka@bankofengland.co.uk), the current (as of late 2022) head of research, but also copy in [dsd\_editor@bankofengland.co.uk](mailto:dsd_editor@bankofengland.co.uk) and [enquiries@bankofengland.co.uk](mailto:enquiries@bankofengland.co.uk) in correspondence.
  + Files **not** provided which must be accessed onsite at BOE: PSD mortgage microdata
  + Files provided (/data/UK/): Mortgages.dta, Cashflow.dta, and Missing.dta. *These data are aggregated, non-disclosive cell-level files with mortgage information which have clearance to be shared, granted from BOE in July 2022.*

US Analysis (Section 4, Figures 4-5, Tables 5-6)

*Publicly available data (raw data provided in archive):*

* 2001, 2004 and 2008 Survey of Income and Program Participation, Waves 1-16. Source is US Census Bureau (US Census Bureau 2020).
  + Access data at <https://www.census.gov/programs-surveys/sipp/data/datasets.html>. Download core panel for 2008 waves 1-6, 2004 waves 1-12, 2001 waves 1-9; topical modules for 2008 waves 2,4,7,10; 2004 waves 3,6 and 2001 wave 3.
  + Files provided (/data/US/SIPP/); all downloaded between June 18 and Aug 28, 2020:
    - 2008: core panel for waves 1-6 (called l08[wave#].dat) and mortgage topical module from waves 2,4,7,10 (called p08putm[wave#].dat)
    - 2004: core panel waves 1-12 (called l04puw[wave#].dat) and mortgage Topical Module data from waves 3,6 (called p04putm[wave#].dat)
    - 2001: Core Panel Waves 1-9 (called "l01puw[wave#].dat) and mortgage topical module data from waves 3 (called p01putm3.dat)
  + Dictionary files provided: sipp\_081\_labels, sipp08puw1.dct, sipp04puw1.dct, sipp01puw1.dct, sipp08putm2.dct, sipp08putm4.dct, sipp08putm7.dct, sipp08putm10.dct, sipp04putm3.dct, sipp04putm6.dct, sipp01putm3.dct
    - Note: these were based on or copied from dictionary files obtained from NBER at <https://www.nber.org/research/data/survey-income-and-program-participation-sipp>
* Federal Funds Rate and Selected Interest Rates: Source is BOG (2020), Freddie Mac (2020), IBA (2020), retrieved via St. Louis FRED.
  + Access at <https://fred.stlouisfed.org>; choose series FEDFUNDS, USD12MD156N, USD6MTD156N, DGS1, MORTGAGE30US
  + Files provided (/data/US/Econ variables/): libor\_ffr\_30yr.xls (downloaded Sep 9, 2020) and FEDFUNDS.csv (downloaded Feb 27, 2020)
* House Price Index: Source is Federal Housing Finance Agency (FHFA, 2020)
  + Access at <https://www.fhfa.gov/DataTools/Downloads/Pages/House-Price-Index.aspx>, choose state-level, all transactions index
  + Files provided (/data/US/Econ variables/): HPI\_AT\_State.csv (downloaded March 2, 2020)
* Unemployment rates: Source is Bureau of Labor Statistics, Local Area Unemployment Statistics (BLS, 2020)
  + Access at <https://www.bls.gov/lau/data.htm>, choose files listed below.
  + Files provided (/data/US/Econ variables/): lau9599.txt, lau0004.txt lau0509.txt lau1014.txt, lndata1.txt (downloaded Mar 2, 2020)
* Crosswalks created by authors provided in archive (/data/US/Econ variables/):
  + State codes.dta: a mapping between various geographic area codes in US
  + series2.dta: merges in geographic and series IDs to BLS raw data

*Confidential data (derived data provided in archive): None.*

Times Series Analysis (Section 5, Figure 6)

*Publicly available data (raw data provided in archive):*

* US Birth Certificate Data: Source is National Center for Health Statistics, US Vital Statistics Natality Birth Data (NCHS, 2020), retrieved from NBER.
  + Access at <https://www.nber.org/research/data/vital-statistics-natality-birth-data>
  + Files provided (/data/TS/US/): Births\_1980s.dta, Births\_1990s.dta, Births\_2000s.dta, Births\_2010s.dta
    - Note: the raw vital statistics microdata are *extremely large*. Our programs do not manipulate the data in any way before collapsing to simple monthly birth counts. To save space, we have provided the collapsed counts as well as simple code for processing the raw data from NBER should users prefer to work from the raw data.
* US Economic Variables (federal funds rate, unemployment rate, house prices, 10-year treasury rate, inflation). Source is BLS (2023), BOG (2023), FHFA (2023), retrieved via St Louis FRED.
  + Access at <https://fred.stlouisfed.org/> and choose data from 1980-2019 for the series DFF, UNRATE, USSTHPI, GS10, CPIFESL
  + Files provided (/data/TS/US/): DFF.csv, UNRATE.csv, USSTHPI.csv, GS10.csv, CPILFESL.csv (downloaded Jan 4, 2023)
* UK economic variables (Bank rate (BOE, 2020), unemployment rate (ONS, 2018), house prices (HM Land Registry, 2023), 10-year gilt rate (BOE 2020) and inflation (ONS 2020).
  + Access Bank Rate at at <https://www.bankofengland.co.uk/boeapps/database/Bank-Rate.asp>
  + Access 10-year gilt rate at <https://www.bankofengland.co.uk/statistics/Tables> and pick “MNZC” for ten-year Gilt;
  + Access unemployment rate at [https://www.ons.gov.uk/](https://www.ons.gov.uk/employmentandlabourmarket/peoplenotinwork/unemployment/timeseries/mgsx/lms) and pick “LF24” for unemployment rate.
  + Access RPI at [https://www.ons.gov.uk/](https://www.ons.gov.uk/employmentandlabourmarket/peoplenotinwork/unemployment/timeseries/mgsx/lms) “MM23” for consumer price inflation timeseries.
  + Access HPI at <https://www.gov.uk/government/statistical-data-sets/uk-house-price-index-data-downloads-december-2018> download latest csv and use “Annual change in UK house price index”
  + File provided (data/TS/UK/): TS\_controls.csv (downloaded and compiled Feb-Mar 2020)

*Confidential data (derived data provided in archive):*

* UK Birth Certificate: source is ONS (2022)
  + See above, users must apply to ONS to become an accredited researcher
  + Files **not** provided which must be accessed on ONS servers: Birth certificate microdata
  + Files provided (/data/TS/UK/): TS-data.dta. *This is an aggregated non-disclosive cell-level file with birth counts and economic data which has publication clearance from ONS, Provided on March 2022.*

Figure 1

*Publicly available data (raw data provided in archive):*

* US Birth Certificate Data: Source is National Center for Health Statistics, US Vital Statistics Natality Birth Data (NCHS 2019), retrieved from NBER.
  + Access at <https://www.nber.org/research/data/vital-statistics-natality-birth-data>
  + Files provided (/data/Figure 1/): natl[YEAR].dta (YEAR=2000-2015)
    - The raw vital statistics data is *extremely large*. To save space, we have provided files trimmed of variables not used in our analysis, as well as simple code for processing the full raw data from NBER should users prefer to download the raw data.
* US Female Population Data: US Census Bureau Intercensal population estimates. (US Census, 2019)
  + Access 2000-2010 data at: <https://www.census.gov/data/tables/time-series/demo/popest/intercensal-2000-2010-national.html>; Look for national detailed tables "Annual estimates of resident population by single year of age and sex for US"
  + Access 2010-2019 data at: <https://www.census.gov/data/tables/time-series/demo/popest/2010s-national-detail.html>, Look for national detailed tables "Annual estimates of resident population by single year of age and sex for US"
  + Files provided (/data/Figure 1/): nc-est2018-agesex-res.csv, us-est00int-alldata.csv (downloaded Sep 17, 2019)
* Federal Funds Rate: source is BOG (2020), retrieved via St Louis FRED.
  + Access at <https://fred.stlouisfed.org>; choose series FEDFUNDS,
  + Files provided (/data/Figure 1/): FEDFUNDS.csv (downloaded Feb 27, 2020)
* UK Bank Rate: source is Bank of England
  + Access at <https://www.bankofengland.co.uk/boeapps/database/Bank-Rate.asp> (Bank Rate)
  + Files provided (/data/Figure 1/): bankrate.xlsx, downloaded (downloaded Feb 27, 2020)

*Confidential data (derived data provided in archive):*

* UK Birth Certificate Data and population data: source is ONS
  + See above, users must apply to ONS to become an accredited researcher
  + Files **not** provided which must be accessed on ONS servers: (Births\_[YEAR])
  + Files provided (/data/Figure 1/): national\_trends\_0214.csv. *This is an aggregated non-disclosive cell-level file with birth rates and economic data which has publication clearance from the ONS, granted Jan 8, 2022*

## Dataset list



## Computational requirements

### Software Requirements

* Stata (code was last run with version 16)
* R 3.4.2

### Controlled Randomness

Random seed is set at 1234 in line 6 of /UK/5\_Regressions.do and line 19 of /US/sipp\_analysis\_final.do

### Memory and Runtime Requirements

#### Summary

Approximate time needed to reproduce the analyses on authors machine: 6-10 hours (4-6 hours on BOE and ONS servers + 2-4 hours for replication package).

#### Details

Code was last run on a Linux 2-core intel server with 31G of memory, 2.6Ghz CPU running Ubuntu 18.04.6 LTS.

## Description of programs/code

*Note: This section will describe the contents of the /pgm/ directory. The description will be delineated by the four main subdirectories (US, UK, TS, and Figure 1). We note when programs cannot be run from the replication package because of confidentiality requirements.*

*UK Analysis (/pgm/UK/):*

* 1\_Births\_ONS.do” – collapses the ONS birth certificate data to the LAU-Age group-Quarter level which is exported in births\_2005\_2013\_2020.csv and at the Age-group-quarter level in nationaltrends0214.csv. *Note: this file must be run on ONS secure server.*
* 2a\_Mortgages\_BOE.do” – processes and collapses PSD mortgage data to LAU-age-group-quarter level which is exported in Mortgages.dta *Note: this file must be run on BOE server.*
* 2b\_Rate\_imputation.R” – impute initial interest rates when they are missing, which is an intermediate input for the next file. *Note: this file must be run on BOE server.*
* 2c\_Mortgages\_BOE.do” – processes and collapses information on imputed changes in mortgage payments which is exported to Cashflow.dta and data on estimated mortgages originated before 2005 which is exported to Missing.dta. *Note: this file must be run on BOE server.*
* 3\_Econ\_Variables.do” –processes UK control variables and creates intermediate data sets Education.dta, F\_Pop.dta, Hpi\_Urate.dta, unemp\_age.dta
* 4\_Merging.do” – merges birth, mortgage and econ variables datasets to create analysis data set monpol\_births\_final.dta
* Run “5\_Regressions.do” – produces Figure 3, Tables 1-4 using monpol\_births\_final.dta

*US Analysis (/pgm/US/):*

* sipp\_read\_data.do” – creates main analysis data sets US\_analysis\_final.dta and US\_pretends.dta as well as a number of intermediate data sets which are saved in either “data/US/SIPP” or “data/US/Econ variables”
* sipp\_analysis\_final.do” creates Figure 4-5 and Table 5-6 from US\_analysis\_final.dta and US\_pretends.dta

*Time Series Analysis (/pgm/TS/):*

* /UK/1\_Construct\_TS.do” - constructs the main analysis data sets TS\_data.dta as well as various intermediate data files. *Note: this file must be run on ONS secure server.*
* /US/1\_Construct\_TS\_US.do” - constructs the main analysis data set TS\_data-1.dta as well as various intermediate data files.
* /UK/2\_LPs.do” – constructs Figure 6a
* /US/2\_LPs\_US.do” - constructs figure 6b

*Time Series Analysis (/pgm/Figure 1/):*

* read\_data\_figure1.do” - creates full\_us\_trends\_00\_17.dta and full\_uk\_trends.dta
* figure 1.do” - creates figure 1a and 1b

## Instructions to Replicators

Steps 1 must be conducted on the ONS servers and Step 2 must be conducted on the Bank of England Servers. Once users have been granted access to those servers they will need to request the underlying data files listed in the data availability section and place them in the working directory they are assigned to on those servers. After conducting steps 1-2 they will then need to request publication clearance of the main output files so that those files can be moved off the secure servers to the appropriate location in the replication package (as indicated below).

Steps 3-6 can be run entirely using the provided replication package. Users who wish to replicate the tables and figures in our paper but do not wish to obtain access the ONS and BOE servers should begin from step 3.

### Details

Users should follow these steps in the order listed to replicate the analysis:

1. [*Must be performed on ONS servers – see ‘data availability’ on obtaining access*]
   1. Upload bankrate.xlsx, Population.xlsx, and TS\_controls.csv from the replication archive to the ONS Secure Research Service server.
   2. Run “pgm/UK/1\_Births\_ONS.do”
   3. Run “pgm/TS/UK/1\_Construct\_TS.do”
   4. Request publication clearance from ONS for “births\_2005\_2013\_2020.csv” and “nationaltrends0214.csv“ and “TS-data.dta”
   5. Upon receipt of clearance, save “births\_2005\_2013\_2020.csv” to /data/UK/ and “nationaltrends0214.csv“ to /data/Figure 1/ and “TS-data.dta” to /data/TS/UK/
2. [*Must be performed on Bank of England servers – see ‘data availability’ on obtaining access*]
   1. Run “pgm/UK/2a\_Mortgages\_BOE.do”
   2. Run “pgm/UK/2b\_Rate\_imputation.R”
   3. Run “pgm/UK/2c\_Mortgages\_BOE.do”
   4. Request to move “Mortgages.dta” “Cashflow.dta” and “Missing.dta” offsite
   5. Save those files in /data/UK/

The rest of the code can be run from the provided replication package. Users should begin from here by setting their Stata working directory to location in which they have downloaded the replication package folder (e.g., “cd “[your directory here]/cumming\_dettling\_replication/”).

1. UK Analysis (Section 3), process public data and construct tables and figures:
   1. Run “pgm/UK/3\_Econ\_Variables.do”
   2. Run “pgm/UK/4\_Merging.do”
   3. Run “pgm/UK/5\_Regressions.do”

1. US Analysis (Section 4), process public data and construct tables and figures:
   1. Run “pgm/US/sipp\_read\_data.do”
   2. Run “pgm/US/sipp\_analysis\_final.do”
2. Time Series Analysis (Section 5) process public data and construct figure:
   1. Run “/pgm/TS/US/1\_Construct\_TS\_US.do”
   2. Run “/pgm/TS/UK/2\_LPs.do”
   3. Run “/pgm/TS/US/2\_LPs\_US.do”
3. Figure 1, process public data and construct figure:
   1. Run “/pgm/Figure 1/read\_data\_figure1.do”
   2. Run “/pgm/Figure 1/figure 1.do”

The provided code reproduces all tables and figures in the paper, as summarized in the table below:



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