

Replication Package for: “Green Capital Requirements”

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Overview

This paper is theoretical and uses **no data**. All quantitative exhibits in the paper are model-generated illustrations. This replication package therefore consists of a single MATLAB program, `main.m`, which reproduces **all computer-generated figures of the paper (Figures 1–7) in one execution**, writing each figure in two formats, EPS and PDF, to the subfolder `output/` (`Figure1.eps` and `Figure1.pdf`, ..., `Figure7.eps` and `Figure7.pdf`).

The only exhibit not produced by code is the schematic drawing in the Appendix (“Consumer Theory Illustration”, Figure 8), which was drawn in Microsoft PowerPoint; its source and the exact file included in the manuscript are provided in `manual_figure/` (see “List of Figures and Programs” below).

Approximate total replication time: **5–15 minutes** on a standard desktop or laptop computer.

Data Availability and Provenance Statement

- This paper does not involve analysis of external data. **No data of any kind (proprietary, licensed, confidential, or public) are used.** All figures are generated from model equations and parameter values that are stated in the paper (in the caption of each figure) and hard-coded in `main.m`.
- The random numbers used in the simulation for Figure 7 are generated inside `main.m` from MATLAB’s default random number generator with a fixed seed (see “Randomness” below); no random draws are imported from outside the program.

Statement about Rights

- We certify that the authors of the manuscript have legitimate access to and permission to use all material contained in this package.
- The code was written by the authors and their research assistant and is provided for the purpose of replicating the results of the paper.

Computational Requirements

Software

- **MATLAB R2020a or later.** The published figures were produced with MATLAB **R2023b** (Update 4/7) on Windows 10 and macOS. (The figure files are written with `print`; the renderer options `-vector/-image` of R2021b are used when available, with a fallback for earlier releases.)
- Required toolboxes:
 - **Statistics and Machine Learning Toolbox** (function `normcdf`)
 - **Optimization Toolbox** (function `fsolve`)
- No third-party (user-contributed) packages are required. No internet access is required.

Hardware and Runtime

- Any standard computer (no special memory or CPU requirements; peak memory use is well below 1 GB).
- Runtime of a full run of `main.m`: approximately **5–15 minutes**. Most of the time is spent in the parameter loop of Figure 4 (a few thousand calls to `fsolve`).

Randomness

- Figure 7 is the only exhibit involving random numbers (a simulation with 10,000 clean and 10,000 dirty firm types). `main.m` sets the random number generator immediately before the draws via `rng("default")` (Mersenne twister, seed 0), so the figure is **exactly reproducible** across runs and machines using MATLAB.
- Figures 1–6 are fully deterministic.

Description of Programs

The package contains a single program:

- **`main.m`** — self-contained MATLAB program (all model routines are included as local functions; no other code files are needed). Running it once produces all seven computer-generated figures, each in EPS and PDF format. It is organized in four parts, each with the parameterization reported in the corresponding figure captions of the paper:
 - **Part A (Figures 1–2)**: baseline banking-sector equilibrium model and the effect of a brown penalizing factor (BPF). Local function `make_figures_1_2`; model routines `equilibrium_BS`, `FOC_slms2`, `equalize_pr`.
 - **Part B (Figures 3–4)**: optimal prudential capital regulation and the effect of transition risk ($\mu_C = 2.5\%$, $\mu_D = 3\%$, $\sigma = 20\%$, $\lambda = 1$). Local function `make_figures_3_4`; model routine `PrudentialPPI`.
 - **Part C (Figures 5–6)**: the planner’s problem, one vs. two policy tools (as Part B but $\mu_D = 6\%$ and $\phi_D = 0.1$). Local function `make_figures_5_6`; model routines `PrudentialPPI`, `func_IC`, `func_all`. (With $\mu_D = 6\%$ the prudential first-order condition for dirty loans has no interior solution; the code implements the corner by setting the dirty requirement to numerically zero, as in the original code.)
 - **Part D (Figure 7)**: many-types extension with costly equity issuance. Local function `make_figure_7` (with plotting helper `plot_demand_curve`, which draws each aggregate demand curve — a step function with one segment per firm type, green for clean and red for dirty types — as one connected polyline whose segments merge 80 consecutive types (about 1 pt long) and are colored by the share of clean types among them; at any output resolution this is indistinguishable from drawing the 20,000 one-type segments, whose colors blend optically); model routine `func_equilibrium`.
- Expected console output includes the solved prudential capital requirements for Figure 3, $e_D^{\text{PPI}} = 8.8\%$ and $e_C^{\text{PPI}} = 12.6\%$, which match the values reported in the caption of Figure 3 of the paper.

Figure layout and text sizes

All figure files have a fixed physical size and identical text sizes, so that they can be included in the manuscript without any rescaling:

- Single-panel figures (Figures 1, 6, 7): 5.5×3.5 in, with the same plot box in every figure — narrower than the 6.25-in text width of the manuscript, so a centered figure leaves white space left and right.
- Two-panel figures (Figures 2–5): 6.25×3.0 in, with two square panels (2.1 in) — exactly the text width of the manuscript. (Figure 2’s left panel starts further left than in Figures 3–5, which need the margin for their y-axis labels; the wider gap between Figure 2’s panels holds the legend.)
- Text: tick labels and axis labels 12 pt, legends 10 pt (Computer Modern, via MATLAB’s LaTeX interpreter); data lines 1.5 pt. Figure 2 keeps its panel titles (“Small BPF”, “Large BPF”, 12 pt bold); Figures 3–5 have no panel titles (the y-axis labels already name each panel).

The layout (margins, panel positions, legend placement) is computed by the code — local functions `fig_layout` (all constants), `place_axes`, `layout_single`, `layout_two_panel` and `export_figure` at the end of `main.m`. Each plot box is given a fixed inner position (in normalized units derived from the inch constants, with `PositionConstraint = 'innerposition'`), so the tick labels, axis labels and titles extend into the surrounding margins without changing the plot box, and the layout does not depend on the size of the figure window on screen. The figure windows therefore never need to be resized by hand, and the files are written at the figure size at scale 1:1 (the PDF page equals the figure size; the EPS bounding box is MATLAB’s tight box around the content, i.e. the same drawing without the surrounding white margin). Include the files at their natural size (a centered `\includegraphics` without a width option) to reproduce the text sizes above in the manuscript. The widths can be changed in `fig_layout`.

Instructions to Replicators

1. Unzip/copy the package to any folder.
2. Open MATLAB (R2020a or later, with the two toolboxes listed above).
3. Set MATLAB’s current folder to the package folder (the folder containing `main.m`).
4. Type `main` in the command window (or open `main.m` and press **Run**).
5. All figure files (`Figure1.eps`, `Figure1.pdf`, ..., `Figure7.eps`, `Figure7.pdf`) are written to the subfolder `output/` (created automatically). No manual intervention is required at any point.

To compare the results with the published figures, reference copies of the published figure files (EPS and PDF version of every figure) are provided in `expected_output/`.

Notes for comparison:

- EPS/PDF files embed creation metadata (e.g., time stamps), so replicated files will not be byte-identical to the reference files; the figure *content* is what should (and does) coincide.
- Each figure is provided in both formats with identical content at the same scale (the page size of the PDF file equals the figure size given above; the bounding box of the EPS file is cropped to the content, so it omits the white margin). All figures are vector graphics.
- Exact line-for-line coincidence of Figure 7 requires MATLAB’s random number generator (see “Randomness”); under other numerical environments the 20,000 simulated draws differ and the two demand curves will differ imperceptibly (the equilibrium objects agree to about 3 decimal places by the law of large numbers).
- Figure windows are created at the physical size of the figure files (6.5 in wide). The exported files do not depend on the window size, so the windows may be moved or resized while the

program runs.

List of Figures and Programs

All computer-generated figures are produced by `main.m` in a single run (“Part” refers to the four parts of `main.m` described above). Each figure is written in two formats with identical content, `FigureN.eps` and `FigureN.pdf`, where N is the figure number in the paper.

Exhibit	Output files (in output/)	Part	Note
Figure 1: Banking Sector Equilibrium	<code>Figure1.eps</code> , <code>Figure1.pdf</code>	A	
Figure 2: Brown Penalizing Factor	<code>Figure2.eps</code> , <code>Figure2.pdf</code>	A	
Figure 3: Optimal prudential capital regulation	<code>Figure3.eps</code> , <code>Figure3.pdf</code>	B	Console reports the caption values 8.8% and 12.6%
Figure 4: Effects of transition risks	<code>Figure4.eps</code> , <code>Figure4.pdf</code>	B	
Figure 5: Planner capital requirements	<code>Figure5.eps</code> , <code>Figure5.pdf</code>	C	
Figure 6: Welfare effects of tools and mandates	<code>Figure6.eps</code> , <code>Figure6.pdf</code>	C	
Figure 7: BPF with multiple types, equity raising	<code>Figure7.eps</code> , <code>Figure7.pdf</code>	D	Seeded simulation, <code>rng("default")</code>
Figure 8 (Appendix): Consumer Theory Illustration	see Note	none	Not code-generated: schematic drawn in PowerPoint. Included as <code>manual_figure/Consumer.pdf</code> , source <code>manual_figure/Consumer Theory Illustration.pptx</code>

The paper contains no tables with computational content.

Package Contents

<code>README.md</code> / <code>README.pdf</code>	this file
<code>main.m</code>	produces Figures 1–7 in one run, each as EPS and PDF (output to <code>./output/</code>)
<code>expected_output/</code>	reference copies of the published figure files (<code>Figure1.eps</code> , <code>Figure1.pdf</code> , ..., <code>Figure7.eps</code> , <code>Figure7.pdf</code>)
<code>manual_figure/</code>	Figure 8 (Appendix): PowerPoint source and the PDF included in the manuscript
<code>output/</code>	created by <code>main.m</code> at run time

References

Oehmke, Martin, and Marcus Opp. “Green Capital Requirements.” *The Journal of Finance*, forthcoming.