Online Appendix

Declining search frictions, unemployment and self-employment

Piotr Denderski[1,2,*] and Florian Sniekers[3,†]

August 24, 2023

C Additional Data, Estimation and Calibration Appendix

In this section of the Online Appendix we present the definitions of the variables used in estimation, the results of the first-stage regression, descriptive statistics of our sample, and background information on our calibration.

C.1 Data Sources and Definitions

Labour market variables. For those countries and years for which we have data on broadband, we source our labour market variables from ILOSTAT (International Labour Organization, n.d.). We rely on the ILO modelled estimates because these series provide the most internationally comparable labour statistics. We focus on workers above 25 years old, because the age group of workers between 15 and 25 does not face the same risks as older workers. We select unemployment rates u, the pool of payroll employees PE, self-employed workers SE and own account workers OA. Using the standard formula for the unemployment rate in (2), we recover the pool of unemployed workers U and construct the self-employment rate and own-account work rate in (3) and (4).

The categorization of employment follows the International Classification of Status in Employment (ICSE) of 1993. The ISCE-93 distinguishes payroll and self-employment based on the economic risks faced by workers and the type of authority that workers have or are subject to in their employment relationship (Hoffmann, 2003). According to the ICSE-93, self-employment can be further decomposed in employers,

[*]**Correspondence address:** piotr.denderski@le.ac.uk
[†]f.j.t.sniekers@tilburguniversity.edu

own-account workers, members of producers' cooperatives, and contributing family workers. As explained in the main text, employers of large firms may not face the same risks as smaller employers or own-account workers. However, own-account workers exclude small employers that face similar risks as own-account workers. For that reason, we report results on both self-employment in general, and own-account workers specifically. The definitions for each of these categories of status in employment can be found in Hoffmann (2003, p. 126-127).

Other variables.

- *Broadband:* We measure broadband penetration as the number of fixed-broadband subscriptions per 100 inhabitants, which we take from the World Telecommunication/ICT Indicators Database (International Telecommunication Union, 2019). Fixed-broadband subscriptions refer to fixed subscriptions to high-speed access to the public Internet (a TCP/IP connection) at downstream speeds equal to, or greater than, 256 kbit/s. This includes cable modem, DSL, fibre-to-the-home/building, other fixed (wired)-broadband subscriptions, satellite broadband, and terrestrial fixed wireless broadband. This total is measured irrespective of the method of payment. It excludes subscriptions that have access to data communications (including the Internet) via mobile-cellular networks. It should include fixed WiMAX and any other fixed wireless technologies. It includes both residential subscriptions and subscriptions for organizations.

- *Tax Burden:* We take the tax wedge expressed in percentage points of total labour cost as an average over the tax rate for a single person without children earning the average wage, and a one-earner married couple at average earnings with two children, from the OECD (OECD, n.d.).

- *Replacement Rate:* We take the average of net replacement rates calculated for a six different types of households including singles and couples, either with two children or without them; for households with two earners we allow the second earner to either earn the average wage or be without work. The replacement rate is taken for an unemployment spell of a person lasting 12 months, excluding housing benefits, from the OECD (OECD, n.d.).

- *Public Sector:* We take data on Government Employment (all levels) and divide it by Total Employment, both from ILOSTAT (International Labour Organization, n.d.).
- *GDP:* We measure GDP using the expenditure approach as GDP per capita in 2010 US Dollars, constant PPPs, which we take from the OECD (OECD, n.d.). Our variable precedes the change in the methodology introduced in 2019.
- *Prices:* We take price levels from the Penn World Tables (PWT), Version 10.0 (Feenstra *et al.*, 2021) as described in Feenstra *et al.* (2015).

C.2 First-Stage Regression

This nonlinear regression relies on the fact that rollout of broadband predominantly relied on the copper wire of the voice telephony network or the coaxial cable of the cable TV network, so that these pre-existing infrastructures provide information on the maximum attainable broadband penetration rate (Czernich *et al.*, 2011). Since 1998 is the first year broadband appeared in our data, we take the voice telephony and cable TV penetration rates in 1997 as instruments for the maximum reach of broadband.[1] We take the values of these instruments from the OECD (1999) Communications Outlook and present them for each country in Table C1.

To arrive at a predicted broadband penetration rate, we first assume that the maximum broadband penetration rate for each country i is described by:

$$\gamma_i = \gamma_0 + \alpha_1 \text{tel\_net}_{i,1997} + \alpha_2 \text{cable\_net}_{i,1997}, \tag{C.1}$$

where $\text{tel\_net}_{i,1997}$ and $\text{cable\_net}_{i,1997}$ are the voice telephony and cable TV penetration rates in 1997. These γ_i enter the logistic diffusion curves that we assume to predict the broadband penetration rates B for each country i in year t, according to:

$$B_{it} = \frac{\gamma_i}{1 + e^{-\beta(t-\tau)}} + \varepsilon_{it}. \tag{C.2}$$

In this equation, β and τ are the coefficients for the speed and inflection point of the diffusion process, and ε_{it} is an error term. Substituting (C.1) into (C.2), we can estimate a nonlinear first-stage regression. The

[1] Broadband was introduced in Canada in 1997, but we do not have access to cable TV penetration rates for 1996.

Table C1: *Infrastructure penetration rates (in %).*

	Cable TV, 1997	Voice Telephony, 1997	Pred. broadband, 2017
Australia	3.1	51.2	31.0
Austria	29.8	45.7	30.3
Belgium	88.7	48.5	35.1
Canada	68.4	61.6	39.2
Czech Republic	16.2	32.0	23.8
Denmark	49.5	63.6	38.9
Finland	37.6	55.6	34.9
France	9.6	57.6	34.0
Germany	50.5	55.0	35.4
Greece	0.6	51.6	31.0
Hungary	44.6	31.9	25.5
Ireland	46.9	42.1	29.8
Italy	0.2	44.9	28.2
Japan	11.3	47.9	30.1
Korea	5.9	52.0	31.5
Netherlands	93.1	56.6	38.7
New Zealand	0.3	50.5	30.5
Norway	57.5	62.6	39.0
Portugal	9.2	40.8	27.0
Spain	3.9	39.9	26.3
Sweden	60.5	68.0	41.4
Switzerland	87.5	64.5	41.6
United Kingdom	9.7	54.0	32.5
United States	64.8	66.0	40.9
Average	35.4	51.8	33.2

coefficients of this regression are reported in Table C2. The table shows that all coefficients are significant at the 1% level, and that the fit is very good. Compared to Czernich *et al.* (2011), nine additional years of data result in an even larger R^2, a slightly lower diffusion speed and an inflection point one year later. Cable TV has gained strength in predicting broadband, while the coefficient for voice telephony dropped.

We use the predicted values of this nonlinear first-stage regression in our second stage regressions. To illustrate the fit of the logistic diffusion curve, Figure C1 shows the actual and predicted broadband penetration rates for each country. The predicted broadband penetration rates in the last year of our sample are also reported in the last column of Table C1.

C.3 Descriptive Statistics

We report the averages and average changes of all variables in our sample in Table C3. The three countries that experienced the strongest increase in the self-employment rates vary greatly in terms of the pace of broadband adoption. For the Netherlands, it grew approximately by 2 percentage points per year which is

Table C2: *First-stage estimation results on* Broadband Rate.

	Broadband Rate
γ_0	9.554***
	(1.482)
α_1	0.0613***
	(0.00991)
α_2	0.417***
	(0.0308)
β	0.469***
	(0.0214)
τ	2005.4***
	(0.116)
Observations	480
R^2	0.971

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.010$

Note: The sample is 24 OECD countries in years 1998-2017. Robust standard errors in parentheses.

one of the largest rates in the sample. The UK places in the middle and Czech Republic at the bottom in this regard.

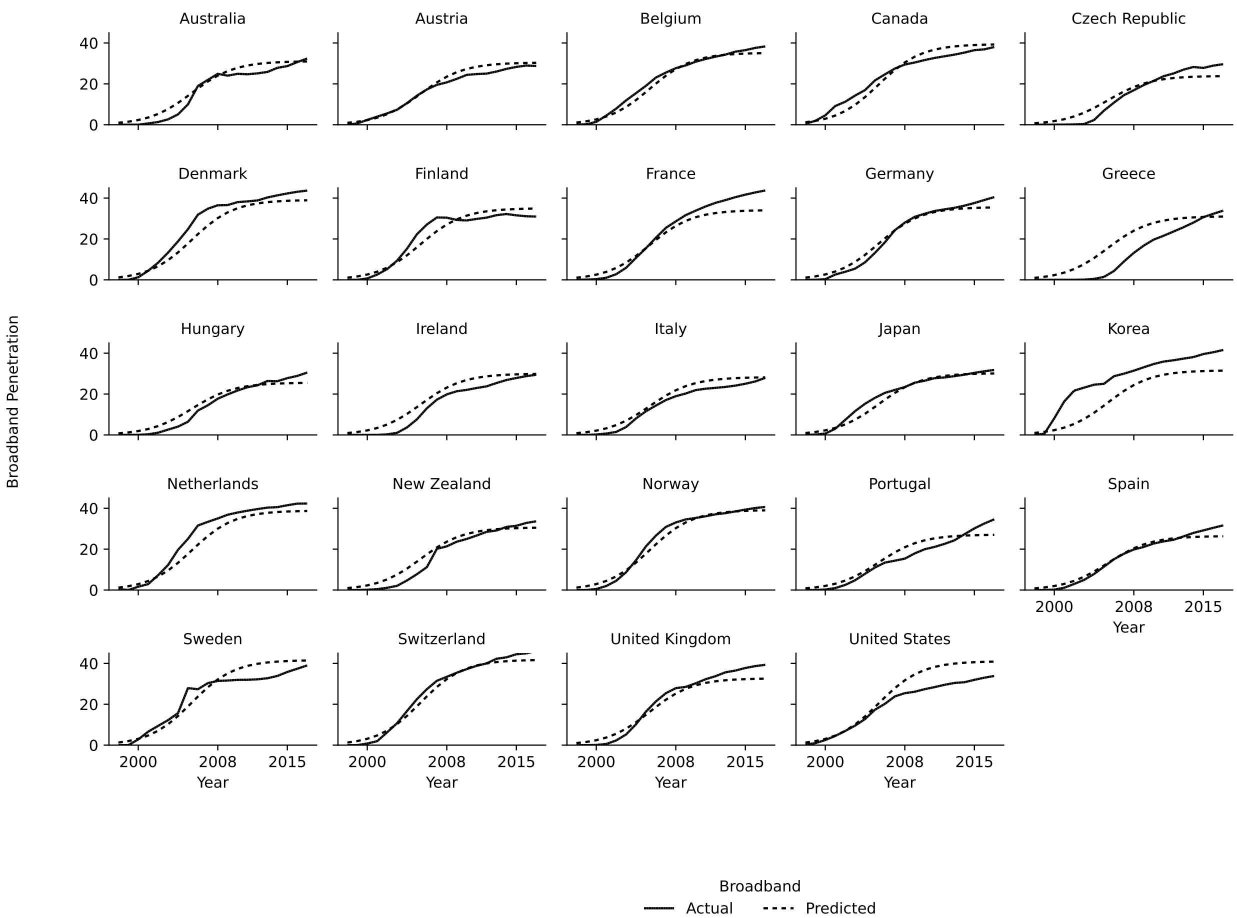


Figure C1: *Actual and predicted broadband penetration rates for 24 countries, 1998–2017.*

Table C3: *Average level and average annual change (first differences) in the self-employment rate, own-account work rate, and regressors.*

	Self-employment		Unemployment		Own-account		Pred. broadband		GDP per capita		Replacement rate		Tax Burden		Public Sector	
	Level	Change	Level	Change	Level	Change	Level	Change	Level	Change	Level	Change	Level	Change	Level	Change
Australia	19.81	-0.1	3.6	-0.07	11.61	0.01	18.76	1.58	41.57	0.59	47.43	-0.28	22.68	-0.15	16.43	-0.09
Austria	14.23	-0.1	3.9	-0.01	6.97	0.01	18.36	1.55	40.84	0.46	56.5	-0.08	42.57	0.06	19.72	-0.12
Belgium	14.95	-0.15	6.1	-0.09	9.24	-0.06	21.25	1.79	38.89	0.41	64.61	0.19	48.27	-0.22	-	-
Canada	16.77	-0.08	5.14	-0.06	11.04	0.0	23.79	2.0	39.77	0.49	46.86	0.07	24.82	-0.43	18.9	0.01
Czech Republic	16.44	0.18	5.23	-0.1	12.03	0.25	14.41	1.21	25.82	0.65	42.62	-1.57	33.85	0.14	23.8	-0.21
Denmark	9.83	-0.1	4.01	0.01	5.06	0.02	23.59	1.99	43.15	0.38	74.86	-0.12	32.0	-0.25	33.27	-0.14
Finland	13.51	-0.04	6.39	-0.15	8.92	-0.06	21.14	1.78	37.39	0.47	66.46	-0.16	41.1	-0.21	-	-
France	11.39	-0.03	7.24	-0.12	6.18	0.05	20.61	1.74	35.55	0.32	73.4	-0.15	45.59	-0.14	26.74	-0.12
Germany	11.64	-0.02	6.46	-0.3	5.85	0.04	21.47	1.81	39.1	0.52	73.36	-0.08	42.73	-0.12	16.07	-0.21
Greece	33.51	-0.73	12.31	0.65	21.31	-0.34	18.77	1.58	26.32	0.06	43.19	0.27	40.94	0.01	21.47	0.11
Hungary	12.78	-0.3	6.18	-0.18	7.34	-0.38	15.44	1.3	21.15	0.52	39.44	-0.72	44.87	-0.62	26.39	-0.46
Ireland	18.99	-0.43	5.98	0.0	12.31	-0.25	18.09	1.52	46.25	1.74	49.1	0.09	23.32	-0.19	18.19	-0.02
Italy	24.95	-0.3	7.4	0.05	16.43	-0.14	17.07	1.44	34.87	0.03	25.71	2.81	42.33	-0.0	16.1	-0.18
Japan	13.58	-0.36	3.59	-0.04	7.54	-0.13	18.23	1.53	34.93	0.3	46.51	0.01	27.58	0.1	8.89	0.03
Korea	31.15	-0.64	2.97	-0.11	18.2	-0.3	19.07	1.6	27.61	0.98	35.49	-0.1	18.5	0.32	8.87	0.04
Netherlands	15.25	0.29	3.33	0.03	10.31	0.32	23.45	1.97	43.75	0.51	74.01	-0.01	34.43	-0.02	16.82	-0.0
New Zealand	18.75	-0.04	3.31	-0.12	11.6	0.06	18.48	1.56	30.65	0.5	47.17	-0.33	12.36	-0.25	12.47	-0.15
Norway	8.04	-0.12	2.22	0.05	5.84	-0.08	23.64	1.99	57.47	0.44	73.26	0.01	34.03	0.01	36.17	-0.06
Portugal	23.73	-0.72	7.15	0.21	17.08	-0.53	16.37	1.38	26.55	0.19	81.28	-0.57	33.28	0.08	15.38	-0.37
Spain	16.6	-0.33	13.35	0.05	10.68	-0.22	15.95	1.34	31.33	0.35	67.73	-0.46	36.36	0.06	15.83	-0.03
Sweden	10.98	-0.06	4.75	-0.13	6.74	-0.04	25.11	2.11	40.18	0.66	61.38	-0.68	42.53	-0.39	29.64	-0.05
Switzerland	17.31	-0.17	3.01	0.05	8.22	-0.06	25.23	2.12	51.21	0.49	82.94	0.02	16.39	-0.08	16.58	-0.14
United Kingdom	14.57	0.15	3.75	-0.08	11.14	0.19	19.71	1.66	35.99	0.45	36.25	0.03	29.66	-0.09	19.66	-0.22
United States	7.6	-0.09	4.14	0.01	4.3	-0.02	24.77	2.08	48.13	0.6	40.31	-0.16	25.03	0.02	16.63	-0.13

Note: GDP per capita in $1000 (level and change). All other variables are reported in percentages (for levels) and in percentage points (for changes).

C.4 AR(1) Residuals

In this section we present the results of estimating the main estimation equation under the more general specification that allows for an AR(1) process in the residuals. Allowing for an autoregressive process in the residuals does not matter much for the results for the *Self-Employment* and *Own-Account Work* rates. Indeed, the estimation results reported in Tables C4 and C6 are very similar to those reported in Tables 2 and A1. However, we find much stronger effects of *Predicted Broadband* on the *Unemployment* rate than in our baseline estimation, as can be seen in Table C5. In case of this variable, allowing for an autoregressive process in the residuals is quantitatively important as the estimated AR(1) coefficient is substantial and positive.

Table C4: *Effects of Broadband Internet on the Self-Employment Rate, AR(1) residuals.*

	(1) ΔSE rate	(2) ΔSE rate	(3) ΔSE rate	(4) ΔSE rate	(5) ΔSE rate	(6) ΔSE rate
Lagged SE rate	-0.094***	-0.096***	-0.138***	-0.239***	-0.122***	-0.279***
	(0.021)	(0.021)	(0.027)	(0.039)	(0.025)	(0.048)
ΔPredicted B-band	0.025***	0.026***	0.025*	0.047***	0.019	0.077***
	(0.009)	(0.009)	(0.014)	(0.011)	(0.012)	(0.020)
Lagged Predicted B-band	0.003***	0.003***	0.004*	0.008***	0.002	0.014***
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.003)
ΔGDP		0.003	-0.016	0.003	0.003	-0.020
		(0.083)	(0.088)	(0.081)	(0.085)	(0.086)
Lagged GDP		0.026	0.033	-0.021	0.033	-0.003
		(0.030)	(0.038)	(0.038)	(0.034)	(0.047)
ΔReplacement Rate			0.004			0.040
			(0.017)			(0.032)
Lagged Replacement Rate			-0.013			0.006
			(0.013)			(0.027)
ΔPublic Sector				-0.036		-0.055
				(0.044)		(0.046)
Lagged Public Sector				-0.134***		-0.179***
				(0.031)		(0.040)
ΔTax Burden					0.051	0.062
					(0.039)	(0.042)
Lagged Tax Burden					-0.003	-0.014
					(0.023)	(0.029)
Observations	432	432	360	227	384	189
No. countries	24	24	24	22	24	22
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
RMSE	0.027	0.027	0.027	0.021	0.026	0.021
AR(1) coefficient ρ	0.118	0.118	0.124	0.113	0.133	0.227
Durbin-Watson	1.795	1.795	1.795	1.814	1.776	1.668

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: The dependent variable is the change in the logarithm of the *Self-Employment* rate. The sample is 24 OECD countries in years 1998-2017. Cluster-robust standard errors in parentheses.

Table C5: *Effects of Broadband Internet on the Unemployment Rate, AR(1) residuals.*

	(1)	(2)	(3)	(4)	(5)	(6)
	ΔU rate	ΔU rate	ΔU rate	ΔU rate	ΔU rate	ΔU rate
Lagged U rate	-0.332***	-0.421***	-0.319***	-0.321***	-0.335***	-0.253***
	(0.037)	(0.040)	(0.038)	(0.049)	(0.036)	(0.044)
ΔPredicted B-band	-0.096	-0.094	-0.205***	-0.085	-0.187***	-0.267***
	(0.067)	(0.065)	(0.077)	(0.080)	(0.066)	(0.096)
Lagged Predicted B-band	-0.020**	-0.023**	-0.040***	-0.019	-0.035***	-0.048***
	(0.010)	(0.010)	(0.014)	(0.012)	(0.011)	(0.016)
ΔGDP		-1.493***	-1.598***	-1.266***	-1.678***	-1.298***
		(0.289)	(0.283)	(0.342)	(0.283)	(0.317)
Lagged GDP		-1.375***	-1.057***	-1.140***	-1.106***	-0.913***
		(0.235)	(0.194)	(0.265)	(0.196)	(0.225)
ΔReplacement Rate			0.061			0.006
			(0.052)			(0.116)
Lagged Replacement Rate			0.166***			0.017
			(0.056)			(0.122)
ΔPublic Sector				0.272		0.496***
				(0.170)		(0.159)
Lagged Public Sector				0.163		0.557***
				(0.154)		(0.141)
ΔTax Burden					-0.062	-0.166
					(0.125)	(0.150)
Lagged Tax Burden					0.043	-0.019
					(0.116)	(0.127)
Observations	432	432	360	227	384	189
No. countries	24	24	24	22	24	22
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
RMSE	0.095	0.090	0.083	0.087	0.084	0.076
AR(1) coefficient ρ	0.652	0.662	0.471	0.592	0.518	0.413
Durbin-Watson	1.019	1.306	1.355	1.319	1.304	1.412

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: The dependent variable is the change in the logarithm of the *Unemployment* rate. The sample is 24 OECD countries in years 1998-2017. Cluster-robust standard errors in parentheses.

Table C6: *Effects of Broadband Internet on the Own-Account Work Rate, AR(1) residuals.*

	(1) ΔOA rate	(2) ΔOA rate	(3) ΔOA rate	(4) ΔOA rate	(5) ΔOA rate	(6) ΔOA rate
Lagged OA rate	-0.133***	-0.131***	-0.141***	-0.284***	-0.122***	-0.307***
	(0.021)	(0.021)	(0.026)	(0.044)	(0.024)	(0.054)
ΔPredicted B-band	0.014	0.016	0.024	0.064***	0.019	0.079***
	(0.011)	(0.011)	(0.017)	(0.015)	(0.014)	(0.026)
Lagged Predicted B-band	0.002*	0.003**	0.004	0.011***	0.003	0.013***
	(0.001)	(0.001)	(0.003)	(0.002)	(0.002)	(0.004)
ΔGDP		-0.151	-0.210*	-0.104	-0.183*	-0.159
		(0.109)	(0.110)	(0.104)	(0.109)	(0.113)
Lagged GDP		0.020	0.005	-0.056	0.005	-0.056
		(0.038)	(0.045)	(0.050)	(0.041)	(0.060)
ΔReplacement Rate			-0.001			0.032
			(0.022)			(0.043)
Lagged Replacement Rate			-0.011			-0.005
			(0.016)			(0.035)
ΔPublic Sector				-0.046		-0.075
				(0.056)		(0.062)
Lagged Public Sector				-0.155***		-0.194***
				(0.040)		(0.052)
ΔTax Burden					0.009	-0.010
					(0.051)	(0.056)
Lagged Tax Burden					0.007	-0.010
					(0.028)	(0.037)
Observations	432	432	360	227	384	189
No. countries	24	24	24	22	24	22
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
RMSE	0.035	0.035	0.034	0.027	0.034	0.028
AR(1) coefficient ρ	0.072	0.071	0.058	0.127	0.059	0.193
Durbin-Watson	1.874	1.876	1.905	1.777	1.902	1.710

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: The dependent variable is the change in the logarithm of the *Own-Account Work* rate. The sample is 24 OECD countries in years 1998-2017. Cluster-robust standard errors in parentheses.

C.5 Calibration

C.5.1 Unemployment insurance b

Regulations concerning unemployment insurance (UI) vary substantially across countries. The two crucial dimensions of these regulations are the generosity of the UI, measured by the rate of replacement of lost earnings by benefits, and the eligibility for receiving them. In the empirical section, we proxy for the former, averaging replacement rates one year into unemployment across various types of households, obtaining the *Replacement Rate* variable. This variable, however, abstracts from the length of eligibility for UI.

In our theoretical model, UI is paid out indefinitely while in reality it is not. Fully accounting for the intricacies of unemployment insurance systems and their differences between countries would yield our model analytically intractable. This is why we developed a procedure to capture these differences in just one parameter, b, using an auxiliary model. To map the expiry of benefits into our framework, we first calculate country-specific averages of the *Replacement Rate* variables. Let us label this average as rr_i with i as the country index. Then, at each instant of the numerical solution for the steady-state of our model, given total employee compensation in country i at time t, $w_{it}l_{it}$, the job destruction rate δ and the job-finding rate $\mu(\theta)_{it}$, we solve the following functional equations of the auxiliary model:

$$V^{LM} = \mu(\theta)_{it} V^{PE} + (1 - \mu(\theta)_{it}) \beta V^{LM}, \tag{C.3}$$

$$V^{PE} = u(w_{it} l_{it}) - l_{it} + \beta \left(\delta V^{U} + (1 - \delta) V^{PE} \right), \tag{C.4}$$

$$V^{U} = \mu(\theta)_{it} V^{PE} + (1 - \mu(\theta)_{it}) \left(u\left(rr_i w_{it} l_{it}\right) + \beta (\chi_{it} V^{LM} + (1 - \chi_{it}) V^{U}) \right). \tag{C.5}$$

These equations define the value of looking for a job at a firm by workers ineligible for UI, V^{LM}, the value of payroll employment, V^{PE}, and the value of looking for a job at a firm while being eligible for UI, V^{U}. Benefits expire at a country-and-time-specific rate χ_{it} that we calculate based on Asenjo and Pignatti (2019). They report that the median unemployment benefit duration in advanced economies is equivalent to seven months of full wages. We divide this eligibility period length by rr_i, getting a country-specific proxy of average eligibility for UI, elt_i. If $elt_i < 1$, we set $\chi_{it} = 1$, which implies that benefits fully expire after a year.

For $elt_i > 1$, we find χ_{it} as the solution to

$$elt_i = \sum_{t=1}^{\infty} (1-\chi_{it})^{t-1} (1-\mu(\theta)_{it})^{t-1} t,$$

the discrete-time counterpart to the average time of being eligible for UI, taking into account the outflow from unemployment to employment over time. Then, we calculate the values of entering the labour market and payroll employment as in our model:

$$V^{LM} = \mu(\theta)_{it} V^{PE} + (1-\mu(\theta)) \left(u(b_{it}) + \beta V^{LM} \right), \tag{C.6}$$

$$V^{PE} = u(w_{it} l_{it}) - l_{it} + \beta \left(\delta V^{LM} + (1-\delta) V^{PE} \right). \tag{C.7}$$

We vary the indefinitely-paid value of UI b_{it} to ensure the V^{LM} given by equations (C.3) and (C.6) are identical, ensuring we capture the impact of UI generosity and eligibility on the career choice incentives.[2] Finally, the ratio $rr_{it}^{\text{adj}} = b_{it}/w_{it} l_{it}$ constitutes the model-adjusted replacement rate in an economy with UI paid out indefinitely. Note that we can remove $u(w_{it} l_{it}) - l_{it}$ from the two models, because, given the job-finding and job-destruction rates, they enter all value functions identically in the two models and drop out from the comparison of the two value functions. In other words, workers spend the same amount of time in payroll employment, in expectations, in the two economies, and the differences in the values of entering the labour market are solely due to differences in unemployment insurance.

C.5.2 Job destruction δ

We use the Labour Force Survey data from Donovan *et al.* (2023a), provided at Donovan *et al.* (2023b), to construct δ. In these data, we observe all yearly transition probabilities between non-participation N, unemployment U, self-employment S, and payroll employment E for fourteen of our OECD countries for on average 8.8 years within the time span of 1998-2017. Let us denote the transition probability from payroll employment to unemployment by EU, and analogously for the other fifteen probabilities (including the flows within the same employment status).

[2] We truncate the infinite sum at 10 future periods in numerical work.

Because our model takes a stand on the order of events within a period and does not feature non-participation, we cannot simply set δ equal to EU. Instead, we need to make some transformations. We assume that at the beginning of the period, workers may enter and leave the labour force, after which job destruction takes place. Consistent with our model, workers outside of payroll employment can then choose whether to enter self-employment or the labour market, after which those who enter the labour market may or may not find a job.

Denote the probability that a worker outside of payroll employment chooses to enter self-employment by $\mathrm{P}(SE)$, so that the probability that the worker chooses to become an applicant is $1 - \mathrm{P}(SE)$. Then the probability with which workers in payroll employment end up in unemployment is the complementary probability of the worker leaving the labour force, times the probability with which they lose their job δ, times the probability that the worker chooses to become an applicant (does not enter self-employment), times the probability that the worker does not find a job:

$$EU = (1 - EN)\delta(1 - \mathrm{P}(SE))(1 - \mu(\theta)).$$

Similarly, the probability with which unemployed workers remain unemployed UU is the complementary probability of the worker leaving the labour force, times the probability that the worker chooses to become an applicant , times the probability that the worker does not find a job:

$$UU = (1 - UN)(1 - \mathrm{P}(SE))(1 - \mu(\theta)).$$

So without taking a stance on $(1 - \mathrm{P}(SE))(1 - \mu(\theta))$, we can calibrate δ using the observed flows from payroll employment to unemployment and non-participation, and from unemployment to unemployment and non-participation, according to

$$\delta = EU(1 - UN)/UU(1 - EN).$$

Because we lack observations for δ for 10 out of 24 countries and for three-quarters of our country-years, in our calibration we simply take the average δ across the sample.

C.6 Time series of price indices and model-implied matching efficiency parameters

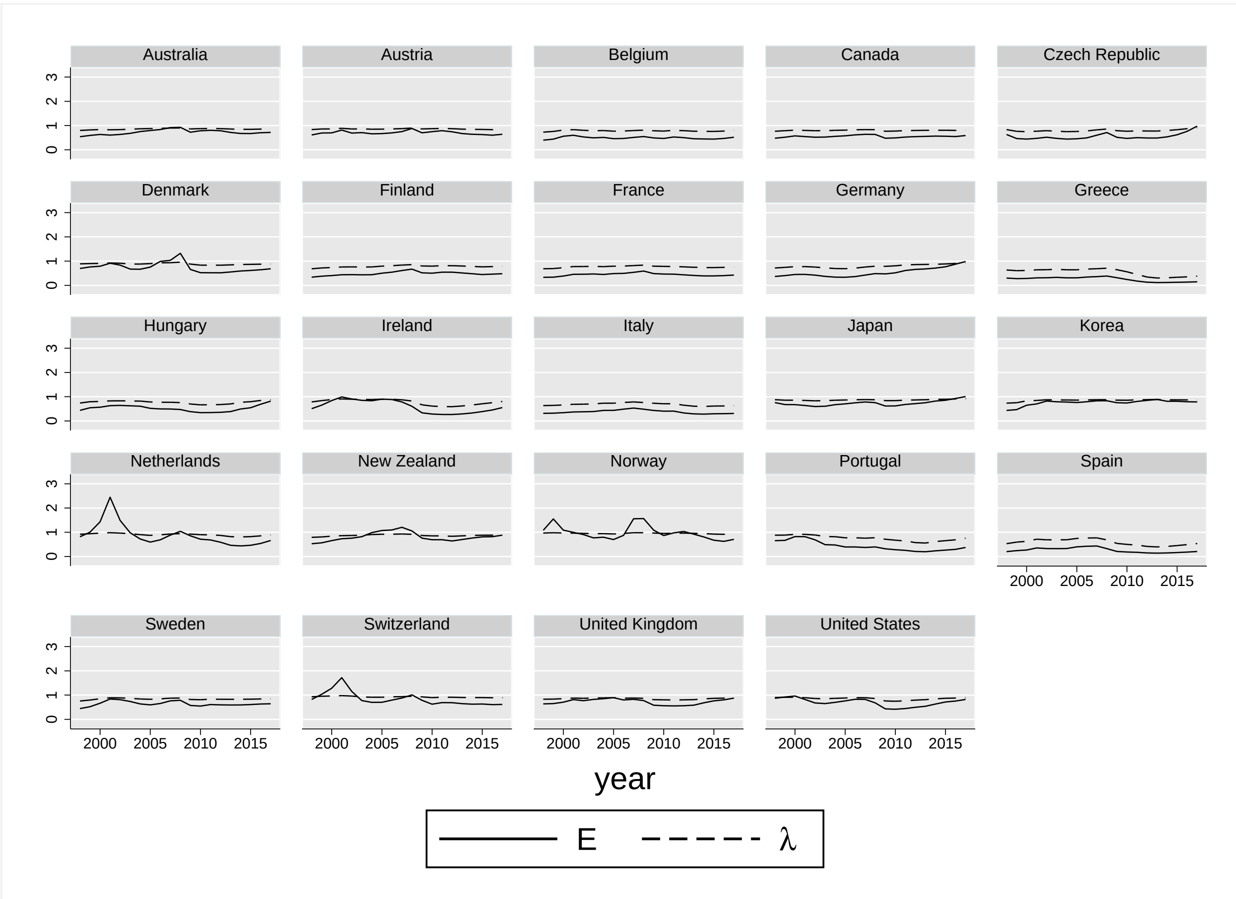


Figure C2: *Model-implied labour market efficiency parameter E and goods market efficiency parameter λ for 24 countries, 1998–2017.*

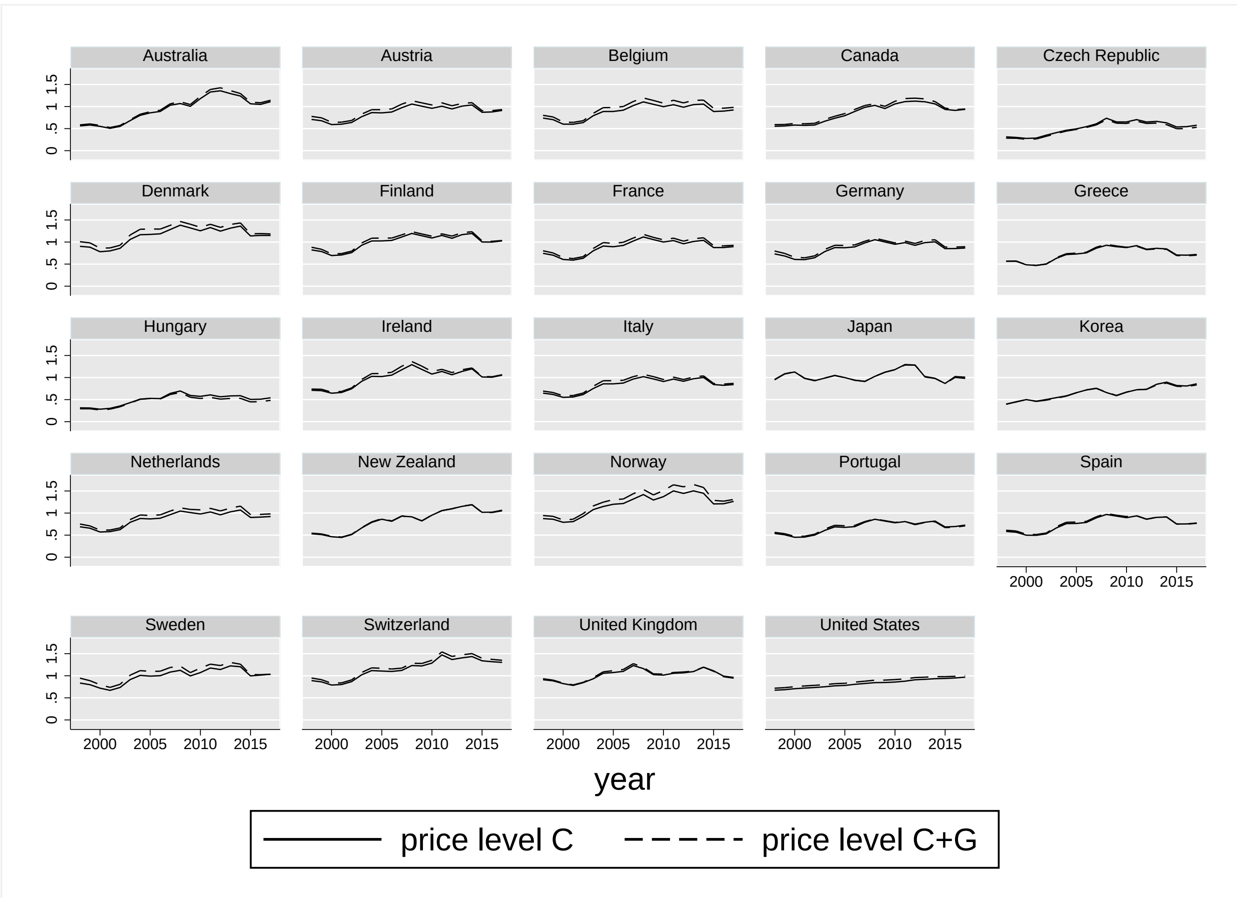


Figure C3: *Price levels of household consumption (C) and of household and government consumption (C + G) for 24 countries, 1998–2017.*

C.7 Alternative calibrations

Here we report quantitative results for alternative values of σ. The baseline choice was $\sigma = 0.3$, here we consider $\sigma = 0.2$ and $\sigma = 0.4$.

Table C7: *Effects of λ and E on the price level for $\sigma = 0.2$.*

	(1) Price C	(2) Price C	(3) Price C	(4) Price C+G	(5) Price C+G	(6) Price C+G
λ	0.197***		0.306***	0.240***		0.383***
	(0.061)		(0.078)	(0.067)		(0.084)
E		0.005	-0.062**		0.003	-0.080***
		(0.022)	(0.027)		(0.024)	(0.029)
Observations	480	480	480	480	480	480
No. countries	24	24	24	24	24	24
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
F-test p-value	0.000	0.000	0.000	0.000	0.000	0.000
RMSE	0.073	0.074	0.073	0.080	0.081	0.079
R-squared	0.828	0.824	0.830	0.808	0.802	0.811

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: The dependent variable is the price level of either household consumption (C), or household and government consumption ($C + G$). The sample is 24 OECD countries in years 1998-2017. Conventional standard errors in parentheses.

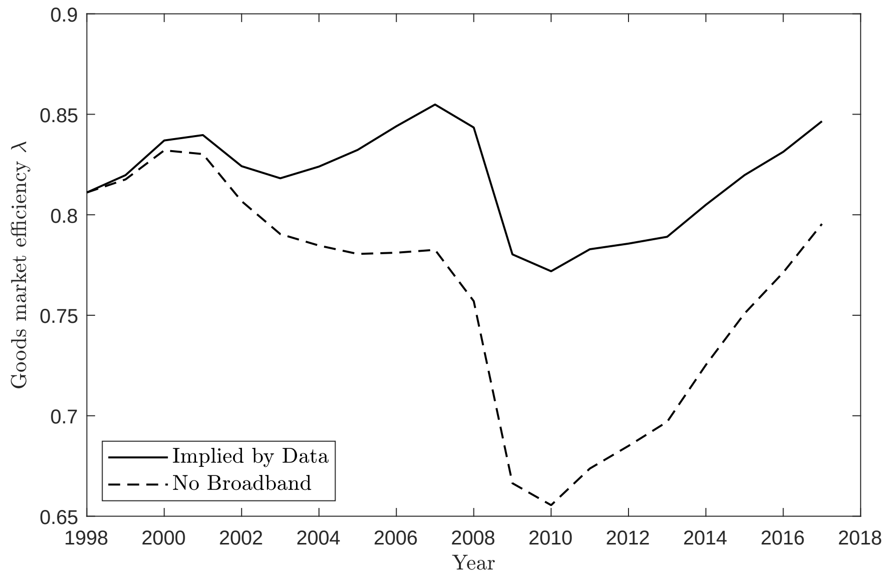
Table C8: *Effects of λ and E on the price level for $\sigma = 0.4$.*

	(1) Price C	(2) Price C	(3) Price C	(4) Price C+G	(5) Price C+G	(6) Price C+G
λ	0.204***		0.363***	0.248***		0.456***
	(0.064)		(0.103)	(0.069)		(0.112)
E		0.044	-0.103*		0.049	-0.135**
		(0.033)	(0.053)		(0.036)	(0.057)
Observations	480	480	480	480	480	480
No. countries	24	24	24	24	24	24
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
F-test p-value	0.000	0.000	0.000	0.000	0.000	0.000
RMSE	0.073	0.074	0.073	0.080	0.081	0.079
R-squared	0.828	0.824	0.829	0.808	0.803	0.810

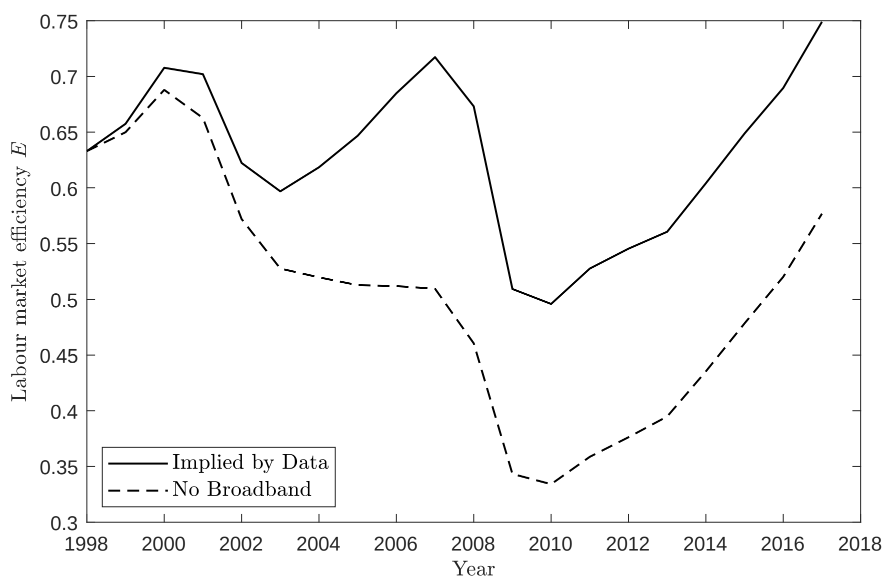
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: The dependent variable is the price level of either household consumption (C), or household and government consumption ($C + G$). The sample is 24 OECD countries in years 1998-2017. Conventional standard errors in parentheses.

Figure C4: *Matching efficiency parameters in the goods and labour market for* $\sigma = 0.2$.



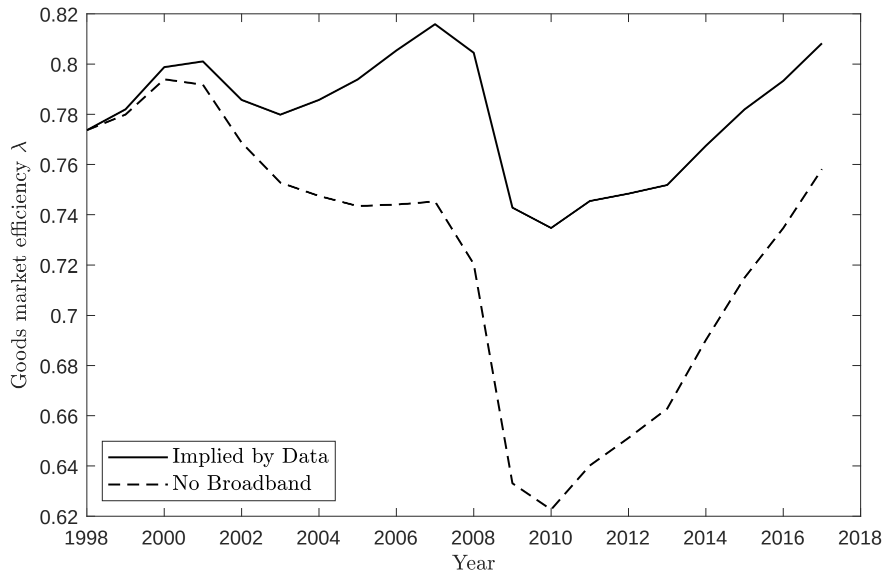
(a) Goods market



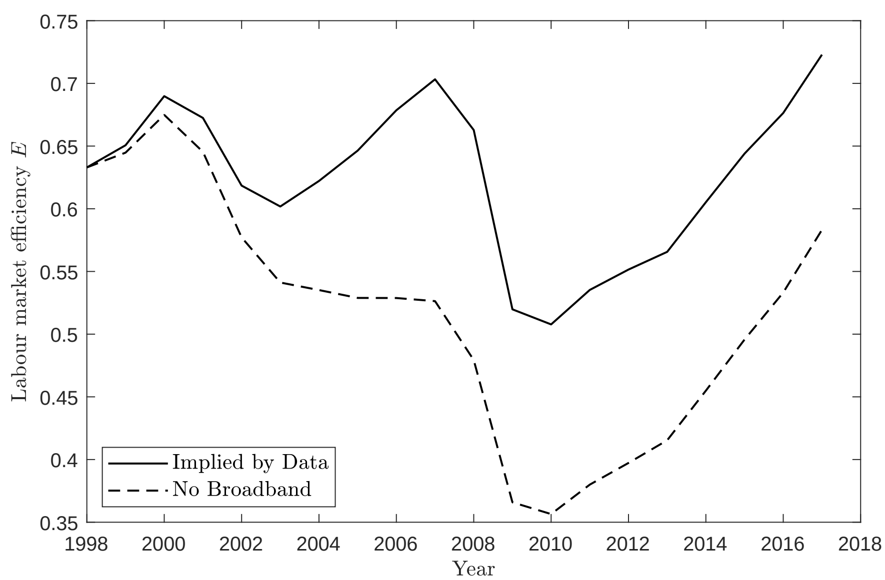
(b) Labour market

Note: These figures plot the labour-force-weighted averages of λ and E implied by the model imposed on time series of self-employment and unemployment rates as in the data and in the no-broadband counterfactual experiment.

Figure C5: *Matching efficiency parameters in the goods and labour market for $\sigma = 0.4$.*



(a) Goods market



(b) Labour market

Note: These figures plot the labour-force-weighted averages of λ and E implied by the model imposed on time series of self-employment and unemployment rates as in the data and in the no-broadband counterfactual experiment.

D Additional Analytical Results

D.1 ODE-representation of an MSCC-equilibrium when $u(b) > 0$.

When $u(b) > 0$, it is no longer possible to separate p and θ as easily as before. However, substituting the workers' indifference condition (21) into the free-entry condition (22), one can solve for θ as a function of p:

$$\theta = \frac{(1-\phi)\, p\, (\lambda\psi(p) - u(b))}{\phi k}.$$

Substitute this equation back into the indifference condition to arrive at the equilibrium price p as an implicit function of b:

$$\lambda\psi(p) = u(b) + \omega\left(\frac{(1-\phi)\, p\, (\lambda\psi(p) - u(b))}{\phi k}\right)(\psi(p) - u(b))\,.$$

By differentiating this equation with respect to $u(b)$, we arrive at a non-autonomous ordinary differential equation of p in $u(b)$ with the initial condition given by p^* implied by equations (25) and (26). Standard existence theorems for ODEs and the smoothness of the equilibrium conditions guarantee existence of the solution to this ODE in the right-neighbourhood of $u(b) = 0$. How far the solution $p(u(b))$ can be extended with respect to $u(b)$, yielding equilibrium $SE \in (0, 1)$, depends on the initial condition and the utility function $u(c)$ that implies a particular $\psi(p)$. We set $u_b = u(b)$ and differentiate the equilibrium conditions with respect to u_b:

$$\lambda\psi'(p)\frac{dp}{du_b} = 1 + \omega'(\theta)\frac{d\theta}{du_b}(\psi(p) - u_b) + \omega(\theta)\left(\psi'(p)\frac{dp}{du_b} - 1\right), \tag{D.8}$$

$$0 = \zeta'(\theta)\frac{d\theta}{du_b}p\,(\psi(p) - u_b) + \zeta(\theta)\left[\frac{dp}{du_b}(\psi(p) - u_b)) + p\left(\psi'(p)\frac{dp}{du_b} - 1\right)\right]. \tag{D.9}$$

These ODEs pin down the MSCC-equilibria, as long as the solution to this set of equations features $SE \in (0, 1)$.

D.2 Analytical solution of the model for particular matching and utility functions

We can fully solve for the equilibrium if we make some further assumptions. Let $u(c) = 2\sqrt{c}$, $g(q) = Bq^2/2$, $M(A, V) = E\sqrt{AV}$, $\delta = 1$, and $\phi = 1/2$. The FOC of buyers, equation (6), then becomes

$$q_c = \frac{1}{Bp^2},$$

while condition (10) is

$$q_s = p.$$

The function $\psi(p) = u(pq_s) - q_s$ is simply a linear function of the price, $\psi(p) = p$. The identity $wl = pq_s$ implies $wl = p^2$. The matching function yields $\mu(\theta) = E\sqrt{\theta}$ and $\zeta(\theta) = E/\sqrt{\theta}$. The equation that pins down the level of effort is

$$\lambda l = (1-\phi)\left(u(wl) - u(b)\right) + \phi\frac{wl}{p} = \frac{3}{2}p - \sqrt{b} \implies l = \frac{1}{\lambda}\left(\frac{3}{2}p - \sqrt{b}\right).$$

We are left with three equations (workers' indifference, goods market clearing, vacancy free entry condition) in p, θ, SE. Workers' indifference implies

$$\lambda p = 2\sqrt{b} + E\sqrt{\theta}\phi\left(p - 2\sqrt{b}\right) \implies \frac{2\left(\lambda p - 2\sqrt{b}\right)}{E\left(p - 2\sqrt{b}\right)} = \sqrt{\theta},$$

while the free-entry condition becomes

$$k = \frac{E}{\sqrt{\theta}}\frac{p}{2}\left(p - 2\sqrt{b}\right) \implies \sqrt{\theta} = \frac{Ep}{2k}\left(p - 2\sqrt{b}\right).$$

Finally, the goods market clearing condition is

$$SE\lambda p + (1 - SE)\frac{2\left(\lambda p - 2\sqrt{b}\right)}{E\left(p - 2\sqrt{b}\right)}\left(\frac{3}{2}p - \sqrt{b}\right) = \frac{1}{p^2}.$$

When $b = 0$, these conditions simplify even more:

$$\lambda = E\sqrt{\theta}\phi \implies \frac{2\lambda}{E} = \sqrt{\theta},$$
$$k = \frac{E}{\sqrt{\theta}}\frac{p^2}{2} \implies p = 2\frac{\sqrt{\lambda k}}{E},$$
$$SE = \frac{\frac{q_c}{\lambda} - \mu(\theta)l}{q_s - \mu(\theta)l} = \frac{3 - \frac{B}{p^3}}{2} = \frac{3}{2} - \frac{BE^3}{16\sqrt{\lambda^3 k^3}}.$$

D.3 Congestion in the goods market

To highlight the main mechanisms, we assume in the baseline model that the probability to enter the perfectly competitive goods market is exogenous. In this section, we relax this assumption and make the probability to enter the goods market a function of the mass of prospective sellers in the goods market (the self-employed and one-worker production units) as in Rocheteau and Wright (2005). To this end, we must adjust the notation slightly. We denote E_L and θ_L as matching efficiency and tightness in the labour market, and E_G and θ_G will be their counterparts in the goods market. The two tightnesses are:

$$\theta_L = \frac{V}{A} = \frac{V}{1-SE}\frac{\mu(\theta_L) + \delta(1-\mu(\theta_L))}{\delta}, \tag{D.10}$$
$$\theta_G = SE + (1-SE)\frac{\mu\left(\theta_L\right)}{\mu\left(\theta_L\right) + \delta\left(1-\mu\left(\theta_L\right)\right)}, \tag{D.11}$$

because the mass of buyers is normalised to 1. Just as we have $\zeta(\theta_L) = E_L\hat{\zeta}(\theta_L)$ with $\hat{\zeta}'(\theta_L) < 0$ and $\hat{\zeta}''(\theta_L) > 0$, and $\mu(\theta_L) = E_L\hat{\mu}(\theta_L)$ with $\hat{\mu}'(\theta_L) > 0$ and $\hat{\mu}''(\theta_L) < 0$, we denote $\lambda(\theta_G) = E_G\hat{\lambda}(\theta_G)$ and assume $\hat{\lambda}'(\theta_G) < 0$, $\hat{\lambda}''(\theta_G) > 0$ and $\hat{\lambda}(0) = 1$.

The decision problem of buyers is unaffected by this extension and the aggregate demand equation is still given by (6). The value of self-employment is:

$$V^{SE}(q^s; p, \theta_G) = \lambda(\theta_G)\left[u(pq^s) - q^s\right],$$

but the optimal production decision is independent of $\lambda(\theta_G)$ and is again given by (10). When firms and workers bargain about the employment contract, they take $\lambda(\theta_G)$ as given, hence the condition (14) is unaffected while (15) and (17) are, respectively:

$$\phi\frac{(\lambda(\theta_G)p-w)lu'(wl)}{1-\beta(1-\delta)}=(1-\phi)\frac{u\left(wl\right)-\lambda(\theta_G)l-u(b)}{1-\left(1-\mu(\theta_L)\right)\beta(1-\delta)}, \tag{D.12}$$

$$k=\zeta\left(\theta_L\right)\frac{\left(\lambda(\theta_G)p-w\right)l}{1-\beta(1-\delta)}. \tag{D.13}$$

Therefore, we are in the position to define the MSCC equilibrium with congestion in the goods market.

DEFINITION 1 (MSCC equilibrium with congestion in the goods market). *A steady state mixed-strategy career-choice equilibrium (MSCC-equilibrium) with congestion in the goods market is a tuple* $(SE, p, q^s, q^c, w, l, \theta_L, \theta_G)$ *such that:*

- $0 < SE < 1$, $0 < \theta_L$, *both types of employment are chosen in equilibrium and active in the goods market,*
- *given SE and* θ_L, *tightness in the goods market* θ_G *is given by* (D.11),
- *given* p, *each consumer demands* q^c *as prescribed by equation* (6), *each visible self-employed sells* q^s *given by equation* (10),
- *given* p *and* θ_G, θ_L, w, l *satisfy equations* (14), (D.12) *and* (D.13),
- *given* $\theta_L, \theta_G, w, l, q^c$ *and* q^s, p *and SE simultaneously clear the goods market,*

$$\lambda(\theta_G)\left(SEq^s+(1-SE)\frac{\mu\left(\theta_L\right)}{\mu\left(\theta_L\right)+\delta\left(1-\mu(\theta_L)\right)}l\right)=q^c, \tag{D.14}$$

and make workers indifferent between self-employment and searching for a job at a firm:

$$(1-\beta)V^{SE}=(1-\beta)V^{LM}$$

$$\lambda(\theta_G)\left[u(pq^s)-q^s\right]=\frac{\mu\left(\theta_L\right)\left[u\left(wl\right)-\lambda(\theta_G)l\right]+\left(1-\mu(\theta_L)\right)\left(1-\beta(1-\delta)\right)u(b)}{1-\left(1-\mu(\theta_L)\right)\beta(1-\delta)}. \tag{D.15}$$

Observe that the sole adjustment in the derivations leading to Lemma 1, and the results provided in this Lemma, is to replace the exogenous λ with an endogenous $\lambda(\theta_G)$. Hence, it is still the case that earnings are equalised, $wl = pq^s$ and that workers staffing visible production units produce more than the self-employed,

$l > q^s$. Furthermore, for $u(b) = 0$ we have that $\lambda(\theta_G) < \mu(\theta_L) / [\mu(\theta_L) + \delta(1 - \mu(\theta_L))]$, securing income is more likely for applicants than for the self-employed, and that $q^s < l\mu(\theta_L) / [\mu(\theta_L) + \delta(1 - \mu(\theta_L))]$, the expected production per capita of applicants exceeds that of the self-employed. The function $\psi(p)$ is not affected by the endogeneity of $\lambda(\theta_G)$ either. Similarly, the dimensionality of the equilibrium proposed in Definition 1 can be reduced to $(\theta_G, \theta_L, SE, p)$ that satisfy the counterparts of (25) and (26):

$$\lambda(\theta_G) = \omega(\theta_L),$$
$$k = \frac{\zeta(\theta_L)(1-\phi)p\psi(p)}{1-(1-\mu(\theta_L)\phi)\,\beta(1-\delta)},$$

the goods-market clearing condition (D.14), and the definition of goods-market tightness (D.11).

The equilibria for the baseline model can be regarded as equilibria of the model with congestion in the goods market. Let (SE^*, p^*, θ_L^*) be the solution to the baseline model for given λ, k, ϕ, β and δ. Then, SE^* and θ_L^* pin down θ_G^* in the equilibrium of the model with congestion for the same k, ϕ, β and δ. The only necessary adjustment is then to pick E_G such that $\lambda = \lambda(\theta_G^*)$.

Imposing Assumption 1 guarantees uniqueness of the equilibrium again. To see this, consider the thought experiment summarised in Figure 4 and in Equation (27). Suppose we start with an MSCC-equilibrium with congestion in the goods market and investigate the effects of an off-equilibrium increase in self-employment. A shift towards self-employment generates the price and labour-market tightness effects, exactly as in the baseline model, and also *increases congestion* in the goods market:

$$0 > \frac{d}{dSE}\left(V^{SE} - V^{LM}\right) = \underbrace{\lambda'(\theta_G)\frac{d\theta_G}{dSE}}_{<0} + \underbrace{[\lambda(\theta_G) - \omega(\theta_L)]\,\psi'(p)\frac{dp}{dSE}}_{=0} - \underbrace{\omega'(\theta_L)\frac{d\theta_L}{dSE}\psi(p)}_{>0}.$$

Relocating a worker from the labour market to self-employment removes a fraction of $\mu(\theta_L)$ of a production unit and increases the pool of the self-employed by one worker. The resulting increase in goods-market tightness makes the self-employed worse off, while large firms and applicants are not directly affected by congestion in the goods market because the equilibrium employment contract features income insurance.

Regarding the comparative statics in Theorem 2, let us differentiate workers' indifference, free entry of vacancies and the clearing of the goods market with respect to E_G:

$$\underbrace{\hat{\lambda}\left(\theta_G\right)+\lambda'\left(\theta_G\right)\frac{d\theta_G}{dE_G}}_{\frac{d\lambda(\theta_G)}{dE_G}}=\underbrace{\omega'\left(\theta_L\right)\frac{d\theta_L}{dE_G}}_{\frac{d\omega(\theta_L)}{dE_G}} \tag{D.16}$$

$$\left[k\mu'\left(\theta_L\right)\phi\beta(1-\delta)-\zeta'\left(\theta_L\right)(1-\phi)\gamma(p)\right]\frac{d\theta_L}{dE_G}=\zeta\left(\theta_L\right)(1-\phi)\gamma'(p)\frac{dp}{dE_G} \tag{D.17}$$

$$\begin{aligned}\frac{dq^c}{dp}\frac{dp}{dE_G}&=\lambda\left(\theta_G\right)\left(q^s-\frac{\mu\left(\theta_L\right)}{\mu\left(\theta_L\right)\frac{dSE}{dE_G}+\delta\left(1-\mu(\theta_L)\right)}l\right)+\lambda\left(\theta_G\right)SE\frac{dq^s}{dp}\frac{dp}{dE_G}\\&+\lambda\left(\theta_G\right)(1-SE)\left(\frac{\delta l}{\left[\mu(\theta_L)+\delta\left(1-\mu(\theta_L)\right)\right]^2}\frac{d\mu(\theta_L)}{dE_G}+\frac{\mu\left(\theta_L\right)}{\mu\left(\theta_L\right)+\delta\left(1-\mu(\theta_L)\right)}\frac{dl}{dp}\frac{dp}{dE_G}\right)\\&+\left[SEq^s+(1-SE)\frac{\mu\left(\theta_L\right)}{\mu\left(\theta_L\right)+\delta\left(1-\mu(\theta_L)\right)}l\right]\frac{d\lambda(\theta_G)}{dE_G}\end{aligned} \tag{D.18}$$

From (D.16) we get that the effect of an increase in the ease of entry to the goods market must have the same sign for $\lambda(\theta_G)$ and $\omega(\theta_L)$. So, both either decrease or increase. From (D.17) we again obtain that price p and θ_L move in the same direction. So, higher tightness θ_L must be compensated with a higher price p. The major complication is that in the model with exogenous λ, we knew right away that $d\theta_L/d\lambda > 0$ and so $dp/d\lambda > 0$. Therefore, we have to consider all possible combinations of the effects of E_G on SE and θ_L:

1. $dSE/dE_G > 0, d\theta_L/dE_G < 0$: The latter implies that $d\lambda(\theta_G)/dE_G < 0$ because of (D.16). Thus, fewer workers make it to the goods market, and among those that do, per capita production decreases, because self-employment increases. Aggregate supply increases because $q^s < l\mu\left(\theta_L\right)/\left[\mu\left(\theta_L\right)+\delta\left(1-\mu(\theta_L)\right)\right]$ so that prices must rise, while the free-entry condition requires the opposite to happen. Consequently, this case can be discarded.

2. $dSE/dE_G > 0, d\theta_L/dE_G > 0$: This combination we find in the baseline model. Higher E_G prompts more self-employment which increases labour market tightness. The only additional feature of the model is that the increase in SE is such that the increase in θ_G does not overcome the direct effect of E_G on $\lambda(\theta_G)$.

3. $dSE/dE_G < 0, d\theta_L/dE_G < 0$: Again, (D.16) requires that $d\lambda(\theta_G)/dE_G < 0$. However, a decrease in $\lambda(\theta_G)$ leads to a contradiction. The decrease in self-employment and drop in the job-finding probability unambiguously lead to an increase in $\lambda(\theta_G)$, on top of the direct effect of higher E_G. Consequently, this case can also be discarded.

4. $dSE/dE_G < 0, d\theta_L/dE_G > 0$: By the virtue of (D.16), we now must have $d\lambda(\theta_G)/dE_G > 0$ for workers' indifference. Hence, we have more workers visible in the goods market, and per worker production increases. Aggregate supply increases because $q^s < l\mu(\theta_L) / [\mu(\theta_L) + \delta(1 - \mu(\theta_L))]$ so that prices should decrease, but the free-entry condition in (D.17) requires price to rise. Consequently, this case can be discarded as well.

Having eliminated three possible effects of an increase in E_G, we still need to consider the lack of an effect on either SE or θ_L:

1. $d\theta_L/dE_G = 0$: Now the free-entry condition yields that $dp/dE_G = 0$, the indifference condition implies that $d\lambda(\theta_G)/dE_G = 0$, and the goods market clearing condition then leads to $dSE/dE_G = 0$. However, this leads to a contradiction since $d\lambda(\theta_G)/dE_G = 0$ requires $d\theta_G/dE_G > 0$, while the mass of self-employed and one-worker productive units is fixed.

2. $dSE/dE_G = 0, d\theta_L/dE_G > 0$: The indifference condition now implies that the probability to enter the goods market increases (the direct effect dominates the indirect effect). As more employees find jobs while self-employment remains constant, aggregate supply unambiguously increases, and prices fall. However, falling prices and an increase in labour market tightness violate the free-entry condition.

3. $dSE/dE_G = 0, d\theta_L/dE_G < 0$: Workers' indifference requires the probability to enter the goods market to drop. However, there are fewer one-worker production units and the same number of self-employed, resulting in a clear contradiction again.

Thus, we have arrived at $dSE/dE_G > 0$ and $d\mu(\theta_L)/dE_G > 0$ as well, exactly as in Theorem 2. For the effects of E_L, analogously to (D.16), we have that the sign of the effect of an increase in labour market efficiency E_L is identical for $\omega(\theta_L)$ and $\lambda(\theta_G)$:

$$\underbrace{\lambda'(\theta_G)\frac{d\theta_G}{dE_L}}_{\frac{d\lambda(\theta_G)}{dE_L}} = \underbrace{\left(\omega(\theta_L) + \omega'(\theta_L)\frac{d\theta_L}{dE_G}\right)}_{\frac{d\omega(\theta_L)}{dE_L}}. \tag{D.19}$$

Now, unlike in the baseline model with $u(b) = 0$, we can rule out $d\omega(\theta_L)/dE_L = 0$, because condition (D.19) would then require that $d\lambda(\theta_G)/dE_L = 0$ as well. However, the only way to cancel the direct effect of E_L on $\omega(\theta_L)$ is via a lower self-employment rate, but as long as $\mu(\theta_L) < 1$, a lower self-employment rate unambiguously increases $\lambda(\theta_G)$. In fact, this argument also rules out $d\omega(\theta_L)/dE_L < 0$. Thus, the only remaining possibility is that improvements in matching efficiency in the labour market decrease the self-employment rate, $dSE/dE_L < 0$ and *increase* the job-finding probability, $d\mu(\theta_L)/dE_L > 0$ and thus $d\omega(\theta_L)/dE_L > 0$. However, the inflow from self-employment dampens the effect of an increase in the matching efficiency in the labour market on the job-finding probability, relative to a model with a fixed self-employment rate, as in the FCC-equilibrium that we consider in the main text.

Affiliations

[1]University of Leicester School of Business, Department of Economics, Finance and Accounting, University Road, Leicester LE17RH , UK

[2]Institute of Economics, Polish Academy of Sciences, Nowy Swiat 72, 00-330, Warsaw, Poland

[3]Tilburg University, Department of Economics; Warandelaan 2, 5037 AB Tilburg, the Netherlands

References

Asenjo, A. and Pignatti, C. (2019). 'Unemployment insurance schemes around the world: Evidence and policy options', Research Department Working Paper 49, International Labour Organization.

Czernich, N., Falck, O., Kretschmer, T. and Woessmann, L. (2011). 'Broadband infrastructure and economic growth', *The Economic Journal*, vol. 121(552), pp. 505–532.

Donovan, K., Lu, W.J. and Schoellman, T. (2023a). 'Labor market dynamics and development', *The Quarterly Journal of Economics*, doi:10.1093/qje/qjad019, qjad019.

Donovan, K., Lu, W.J. and Schoellman, T. (2023b). 'Labor market dynamics and development - Data files', *The Quarterly Journal of Economics*, data deposited at `lfsdata.com` (last accessed: 6 April 2022).

Feenstra, R.C., Inklaar, R. and Timmer, M.P. (2015). 'The next generation of the Penn World Table', *American Economic Review*, vol. 105(10), pp. 3150–82.

Feenstra, R.C., Inklaar, R. and Timmer, M.P. (2021). 'Penn World Tables (PWT) version 10.0', Groningen Growth and Development Centre, doi:10.15141/S5Q94M (last accessed: 5 October 2021).

Hoffmann, E. (2003). 'International classification of status in employment, ICSE-93', in (J. H. Hoffmeyer-Zlotnik and C. Wolf, eds.), *Advances in Cross-National Comparison*, pp. 125–136, New York, NY: Kluwer.

International Labour Organization (n.d.). 'Labour Force Statistics (LFS)', ILOSTAT, `https://ilostat.ilo.org/data/` (last accessed: 23 March 2020).

International Telecommunication Union (2019). 'World Telecommunication/ICT Indicators Database 2018', `https://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx`.

OECD (1999). *OECD Communications Outlook 1999*, doi:10.1787/comms_outlook-1999-en.

OECD (n.d.). 'Data warehouse', doi:10.1787/data-00900-en (last accessed: 23 March 2020).

Rocheteau, G. and Wright, R. (2005). 'Money in search equilibrium, in competitive equilibrium, and in competitive search equilibrium', *Econometrica*, vol. 73(1), pp. 175–202.