Online Appendix
Employment Fluctuations, Real Estate Prices and Property Taxes

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Contents

1 Empirical Analysis: Additional Details

1.1 About Municipal Level Covariates

This appendix provides additional details on the data sources for the variables included in the covariate-balance analysis in section 3.

Income. The Italian Finance Department, dependent on the Ministry of Economy and Finance, provides data on gross income (*reddito complessivo*) for each municipality. The income measure we use is an aggregate of income declarations from the resident population in each municipality.

Local Credit Market. The Aggregated Data - Statistical Database of The Italian Central Bank (*Banca D'Italia*) is the main source for loans and deposits at the municipal level. Loans and deposits present the stock at the end of the year, reported by all bank branches in each municipality.

Local government Financial Statements. Data from the Ministry of Interior is the source for the yearly financial statements of municipal governments. For each municipality, financial statements of local governments contain detailed information on financial accounts for revenues, expenditures and debt flows, and stocks.

1.2 About Other Local Policy Tax Changes

The variables controlling for other policy changes included in (2) are described as follows:

1. *2008 Exemption for Main Residence*: Interaction between a dummy for 2008 and the implied reduction in the residential property tax rate relevant for the main residence of households.

2. *2011 Income Tax Reform*: Interaction between a dummy for 2011 and the log value for per-capita revenues from income surcharge tax (IRPEF).

3. *2014 Property Tax Changes*: Interaction between a dummy for 2014 and the log value for per-capita revenues from new the new property service tax (TASI).

2 Tradable and Non-Tradables Industries

Table 1: Tradable NACE Industries (PART 1)

Division	Name	Section	$Trade^E$	$Trade^Y$	HHI
19	Manuf. coke & petroleum	C	595,208	0.31	0.03
20	Manuf. chemicals	C	487,905	0.79	0.013
29	Manuf. vehicles	C	336,130	0.79	0.03
24	Manuf. basic metals	C	285,574	0.6	0.017
26	Manuf. computer/elect/opt	C	239,425	0.44	0.027
21	Manuf. Pharma	C	218,005	0.9	0.013
30	Manuf. other transport equip.	C	156,098	0.17	0.013
10	Manuf. food products	C	138,202	0.2	0.002
28	Manuf. machinery and equip.	C	135,429	0.27	0.003
17	Manuf. paper/products	C	131,726	0.29	0.004
27	Manuf. electrical equip.	C	116,954	0.24	0.003
15	Manuf. leather/products	C	108,611	0.67	0.009
32	Other manuf.	C	89,349	0.13	0.008
22	Manuf. rubber/plastic	C	82,638	0.23	0.002
13	Manuf. textiles	C	75,699	0.44	0.009
14	Manuf. wearing apparel	C	73500	0.59	0.003
23	Manuf. other non-metalic	C	49033	0.25	0.003
31	Manuf. furniture	C	28915	0.22	0.005
61	Telecom.	H			0.03
53	Postal/courier serv.	J			0.03

Notes: The table shows industries classified as tradable using the geographic concentration and global trade criteria as in Mian and Sufi (2014). The first and second column shows the 2-digit NACE code and the name of the industry, respectively. The fourth and fifth columns show the trade (exports+imports) to employment and trade to gross output ratio, respectively computed using aggregate industry data for 2007. Finally, the last column reports the Herfindahl index computed with municipal-level employment shares for 2007.

Table 2: Tradable NACE Industries (PART 2)

Division	Name	Section	$Trade^E$	$Trade^Y$	HHI
63	Information serv.	J			0.035
62	Computer programming serv.	J			0.036
93	Sport/Recreation activ.	R			0.06
50	Water transport	H			0.115
65	Insurance/pension funding	K			0.132
60	Broadcast. activ.	J			0.17
51	Air transport	H			0.305
12	Manuf. tobacco	C			0.338

Notes: See Table 1 for more information.

Table 3: Non-Tradable NACE Industries

Division	Division Name	Section	HHI
49	Land transport and transport via pipelines	H	0.0092
55	Accommodation	I	0.0075
46	Wholesale trade	G	0.0078
56	Food and beverage service activities	I	0.0074
47	Retail trade	G	0.0056
33	Repair & inst. of machinery & equip.	C	0.0051
45	Wholesale and retail trade vehicles & motorcycles	G	0.0043
43	Specialised construction activities	F	0.0032
42	Civil Engineering	F	0.0034
41	Construction of buildings	F	0.0035

Notes: The table shows industries classified as non-tradables using the geographic concentration criteria as in Mian and Sufi (2014). First and second column shows the 2-digit NACE code and the name of the industry. The fourth column reports the Herfindahl-index computed with municipal level employment shares for 2007. The last three rows marked with red are industries excluded from the non-tradable classification because are related to construction.

3 Covariate Balance across Italian Municipalities

Quasi-experimental research designs often examine the similarities between treatment and control groups in pre-treatment observable characteristics to reassure that both groups were comparable prior to treatment exposure (Imbens and Rubin, 2015). This issue is also relevant in any diff-in-diff design. For our particular case, we need to check for potential unbalances in observable characteristics across municipalities with different property tax rate increases. Moreover, examining covariate balance across municipalities shows how property tax change choices during the 2012 tax reform are correlated with other observable municipality-level features.

However, a simple covariate balance table is not sufficiently informative for our research design. What matters for our empirical strategy is that differences across treatment intensity groups are constant over time and that changes in treatment intensity exposure across municipalities are not associated with changes in the distribution of other observable characteristics at the municipality level. We follow the covariate-balance regression approach described in Wing et al. (2018) to examine this.

3.1 Covariate-Balance Regressions: Implementation

Let $x_{m,t}$ be a variable we want to test for covariate balance. Then, using $x_{m,t}$ as a left-hand side variable, we estimate the model in (1).

$$x_{m,t} = \text{FE}_m + \text{FE}_t + \theta_{x,h}\, \Delta\tau^{h}_{m,2012} + \theta_{x,f}\, \Delta\tau^{f}_{m,2012} + \mu_{m,t} \tag{1}$$

Where $\theta_{x,h}$ and $\theta_{x,f}$ capture compositional changes in x due to different choices in property tax rate changes during the 2012 tax reform. We test for the composite null $Ho : \theta_{x,h} = \theta_{x,f} = 0$ of no compositional changes across municipalities with different treatment intensities. Rejecting the null will be interpreted as evidence of imbalances in x across municipalities during the 2012 tax reform.

The variables in our covariate-balance analysis are categorized into three groups. The first group, representing local economic and financial conditions, includes the log of income per capita, the growth rate of income per capita, and the log of loans and deposits. The second group, capturing migration patterns and industry labor shares, includes in-migration, out-migration rates, and labor shares for manufacturing, retail, and construction. Finally, the third group, related to the financial conditions of local governments, includes the per capita growth of revenues and expenditures, capital investment rate, deficit-to-revenues, and debt-to-revenues.

3.2 Covariate Balance Regressions: Results

The results for the covariate balance analysis are reported in Table 4, Table 5, and Table 6. In each table, the first rows present the estimates for $\theta_{x,h}$ and $\theta_{x,f}$, while the third row reports the *p-value*s for the null of no compositional changes.

Regarding local economic conditions, migration patterns, and industry shares, Table 4 and Table 5 show no significant correlation between the property tax increase and the variables in these groups. As a result, we do not reject the null of no compositional changes across municipalities during the 2012 tax reform for these covariates. Therefore, our results show that municipalities with different property tax rate increases are similar in terms of economic and financial local conditions, migration patterns, and industry employment shares.

We obtain mixed results for variables capturing the financial situation of local governments. On the one hand, Table 6 shows that current revenues per capita grew more in municipalities with higher property tax changes. Moreover, a higher increase in residential taxes is associated with a decline in the local government's expenditures. As a result, we observe a reduction in the deficit and debt ratios in municipalities with a larger increase in property taxes.

Overall, the evidence suggests that local governments choosing a higher property tax increase experienced a rise in their current revenues, which was not used to expand current expenditure or investment. The latter could be explained by the fact that municipalities needed to reimburse back part of the extra revenues to the central government. The evidence also suggests that local governments channeled the additional income from property taxes into reducing the deficit and repaying their debts.

The evidence of compositional changes for the debt-to-revenues ratio can be concerning if loans to the local government *crowd-out* private loans at the local level. However, the latter does not seem to be the case, as we do not observe compositional changes in loans and deposits associated with the 2012 property tax increase.

4 Other Potential Threats and Robustness Checks

In this section, we discuss additional identification threats. First, we introduce municipal-level covariates to the baseline model. Then, we alter our baseline specification by including interactions between the treatment intensities and variables meant to capture alternative channels that could explain our baseline results. Finally, we talk about spillovers, their implications for our identification strategy, and the evidence of their importance in the baseline results.

4.1 Controlling for Municipal Level Covariates

To test the robustness of our baseline results, we change our baseline specification by controlling explicitly for additional municipal-level covariates. Let $X_{m,t}$ be the vector of all relevant covariates for municipality m at year t. We show our new specification in (2).

$$y_{m,t} = \text{FE}_m + \text{FE}_t + \boldsymbol{X}_{m,t-1}\boldsymbol{\Gamma} + \beta_{y,h}\, \Delta\tau^h_{m,t} \times \mathbb{1}\{t = 2012\} + \beta_{y,f}\, \Delta\tau^f_{m,t} \times \mathbb{1}\{t = 2012\} + \epsilon_{m,t} \tag{2}$$

Where $\boldsymbol{X}_{m,t-1}$ is the vector of municipal level covariates lagged one year to avoid endogeneity issues. The choice of the variables included in $\boldsymbol{X}_m$ is motivated by the covariate-balance analysis in section 3. Specifically, we control for the share of employment in the construction sector, the growth of per capita revenues, the deficit-to-revenues ratio, and the debt-to-revenues ratio. Additionally, $\boldsymbol{X}_m$ includes controls capturing other local policy changes during 2008-2014.[1]

4.2 About Alternative Hypothesis

Our baseline results may be the byproduct of a spurious correlation between the property tax changes across municipalities and unobserved municipality-specific factors. Therefore, we test three relevant hypotheses for the Italian economy during the 2012 tax reform. Specifically, we test if (*i*) a decline in credit supply, (*iii*) an increase in uncertainty, or (*i*) a drop in productivity could change our baseline results. As we argue next, each hypothesis is consistent with a drop in employment, consumption expenditure, and real estate prices observed across municipalities after the increase in property taxes in 2012.

Let us start with the credit supply hypothesis. In this case, a negative shock to the supply of loans can produce a drop in housing goods and non-housing expenditure, employment, and investment in fixed assets. Moreover, Arellano et al. (2019) shows that, during the 2012 Italian debt crisis, a differential exposure of banks to default risk produced a heterogeneous decline in the loan supply across the regional credit market in

[1] See 1.2 for more details.

Italy. Therefore, if municipalities facing a significant decline in credit supply also increased property taxes by more in 2012, our baseline results should be explained by the across-municipality correlation between the unobserved loan supply shock and the increase in property taxes.

On the other hand, according to the uncertainty hypothesis, the perception of higher uncertainty induced by policy changes or severe economic contractions could result in lower economic activity. On the side of firms, Bloom (2009) shows that uncertainty reduces hiring and temporarily pauses investment. On the side of the household, Christelis et al. (2020) finds that changes in risk perception can produce substantial declines in consumption expenditure due to a precautionary saving motive. In the Italian case, the drastic policy measures implemented in 2012 could have heightened uncertainty within the population. Then, our baseline results are due to the effect of higher uncertainty correlated with property tax changes.

Finally, Italy's significant decline in aggregate TFP after the 2008 financial crisis[2] (Sgherri and Morsy, 2010) could have had a municipality-specific component. Therefore, the decline in labor observed in the data should result from a drop in local productivity affecting relatively more municipalities choosing higher property tax rates.

4.3 Alternative Hypothesis: Implementation

To test for the three hypotheses mentioned earlier, we examine the stability of our baseline regression results under the alternative specification that includes a proxy measure for unobserved shocks to credit supply, productivity, and uncertainty shocks and the interaction of this proxy variable with our treatment intensity variables.

In particular, let $\hat{\eta}^j_{m,t}$ be a proxy measure for the j-shock, where j={*credit supply*, *uncertainty*, *productivity*}. Then, (3) will be our new parametric specification.

$$\begin{aligned} y_{m,t} = \quad & \mathrm{FE}_m + \mathrm{FE}_t + \beta_{y,h}\, \Delta\tau^h_{m,2012} + \beta_{y,f}\, \Delta\tau^f_{m,2012} + \delta_{j,0}\, \hat{\eta}^j_{m,t} \\ & + \delta_{j,h}\, \hat{\eta}^j_{m,t} \times \Delta\tau^h_{m,2012} + \delta_{j,f}\, \hat{\eta}^j_{m,t} \times \Delta\tau^f_{m,2012} + \epsilon_{m,t} \end{aligned} \tag{3}$$

[2] Pellegrino and Zingales (2017) argues that stagnation problems with aggregate productivity in Italy can be even as far back as the mid-1990s.

Where $\delta_{j,0}$ is the coefficient for the j-shocks while $\delta_{j,h}$ and $\delta_{j,f}$ are the coefficients associated with the interaction between the proxy measure and the change in residential and commercial real estate tax rates, respectively.

To proxy credit supply shocks ($\hat{\eta}_{m,t}^{\text{credit supply}}$), we compute the loans-to-deposits ratio from data on loans and deposits for bank branches in each municipality. On the other hand ($\hat{\eta}_{m,t}^{\text{productivity}}$), the proxy for productivity supply shocks is based on the growth rate of income per worker computed using data on resident income declarations and employment at the municipality-level. Finally, we take the data on the income growth per worker at each municipality, and for each year, we compute the standard deviation across municipalities within each Italian province. This variable is used to proxy for uncertainty shocks ($\hat{\eta}_{m,t}^{\text{uncertainty}}$). For each proxy, we use a one-year lag to avoid endogeneity issues.

4.4 Spillovers Effects of the 2012 Tax Reform

Finally, we discuss the issue of spillovers and their effect on our estimation results. For the 2012 tax reform in Italy, the choice of the tax increase not only affects the outcomes related to that municipality but could potentially also impact neighboring municipalities through spillover effects. This is especially true for municipalities regarded as metropolitan areas and their relatively smaller neighbors. The specific commuting patterns between large and small municipalities represent the main reason why we expect that any policy change in the former should spillover onto the latter. In addition, leader-follower behavior when setting up local tax instruments implies that spillovers from large municipalities also affect local policy decisions of small municipalities.

Therefore, problems with spillovers in our case mean that the impact of local property tax changes goes beyond the municipality's borders, affecting the outcomes and even the magnitude of the property tax increase of neighboring smaller municipalities. Our approach is meant to partially capture the effect of spillovers and provide some indicative evidence of its importance for our baseline results. Unfortunately, our data restricts the number of strategies available to deal with spillovers.

For our particular case, we use the classification of municipalities in Local Labor Markets (LLM) provided by the Italian National Institute of Statistics. An LLM is a group of neighboring municipalities where the bulk of the labor force lives and works and where establishments find most workers necessary to occupy available positions. Using the classification of municipalities in LLM, we absorb any unobserved LLM-time varying trend by controlling for LLM × year fixed effects—the specification in (4) is based on the latter.

$$y_{m,t} = \text{FE}_m + \text{FE}_t + \delta_{LLM(m),t} + \beta_{y,h}\, \Delta\tau^{h}_{m,t} \times \mathbb{1}\{t = 2012\} + \beta_{y,f}\, \Delta\tau^{f}_{m,t} \times \mathbb{1}\{t = 2012\} + \epsilon_{m,t} \tag{4}$$

Where $\delta_{LLM(m),t}$ represents the LLM × year fixed effects for municipality m. Including $\delta_{LLM(m),t}$ in our diff-in-diff strategy has the additional benefit of capturing any municipality-level trend component correlated with unobserved LLM trends.

4.5 Robustness Checks: Results

The estimation results for specifications (2), (3) and (4) are depicted in Figure 1. In each plot, one for each outcome, the hollowed diamonds, and dashed vertical lines represent the point estimates and the 95% confidence intervals of $\beta_{y,h}$ and $\beta_{y,f}$, respectively. The light gray line dividing the x-axis into two halves separates the results on the right corresponding to the increase in the tax rate for commercial real estate properties (*i.e.* $\beta_{y,f}$) and on the left for the increase in the residential tax rate (*i.e.* $\beta_{y,h}$). The baseline results reported are depicted in blue. The results for models (2) and (4) are depicted in red and orange, respectively. Finally, the point estimations and confidence intervals in purple, green, and gray represent the estimates of (3) when controlling for productivity, uncertainty, and credit supply shocks, respectively.

Based on Figure 1, we conclude that our baseline results for the response of employment, consumption, and real estate prices to the 2012 property tax increase are robust in magnitude and significance. Our point estimations usually remain negative and relatively close to the baseline results. However, in some cases, we observe some loss in precision, especially for the response of residential and commercial real estate prices when controlling for credit supply and uncertainty shocks. The loss in efficiency is explained by the additional interactions included in these specifications. Lastly, regarding sign stability, our baseline results only show significant changes in the response of consumption expenditure to commercial real estate taxes when controlling for credit supply shocks. More details about the estimation results on each outcome of interest under the different specifications discussed in the empirical can be found in 5.

Table 4: Covariate Balance: Local Economic and Financial Conditions

	Income Growth	Income	Loans	Deposits
$\Delta\tau^{h}_{m,2012}$	-0.001	-0.002	-0.009	0.028
	(0.007)	(0.004)	(0.025)	(0.022)
$\Delta\tau^{f}_{m,2012}$	-0.008	-0.002	-0.001	0.004
	(0.005)	(0.004)	(0.016)	(0.017)
$Ho : \theta_{x,h} = \theta_{x,f} = 0$ (p-val)	0.25	0.77	0.93	0.42
N_{obs}	43,540	43,540	14,185	14,185
$\bar{R}^2$	0.10	0.99	0.99	0.99

Notes: The table shows the covariate balance test for observables related to local economic and financial conditions. Income per capita is the total taxable income divided by the end of the year population expressed in 2010 prices. Loans and deposits measure the stock of loans and deposits in bank branches within the municipality. Standard errors in parentheses are clustered at the local labor market level, *, **, *** indicate significance at the 10% 5% and 1%, respectively.

Table 5: Covariate Balance: Migration Patterns and Supply Side Controls

	Migration Rate		Employment Share		
	In	Out	Manuf.	Const.	Retail
$\Delta\tau^{h}_{m,2012}$	0.002	0.001	0.004	0.010**	0.000
	(0.002)	(0.002)	(0.005)	(0.005)	(0.005)
$\Delta\tau^{f}_{m,2012}$	0.001	-0.001	-0.004	0.002	-0.001
	(0.001)	(0.001)	(0.004)	(0.004)	(0.003)
$Ho : \theta_{x,h} = \theta_{x,f} = 0$ (p-val)	0.39	0.73	0.51	0.10	0.94
N_{obs}	43,540	43,540	43,540	43,540	43,540
$\bar{R}^2$	0.40	0.62	0.96	0.90	0.90

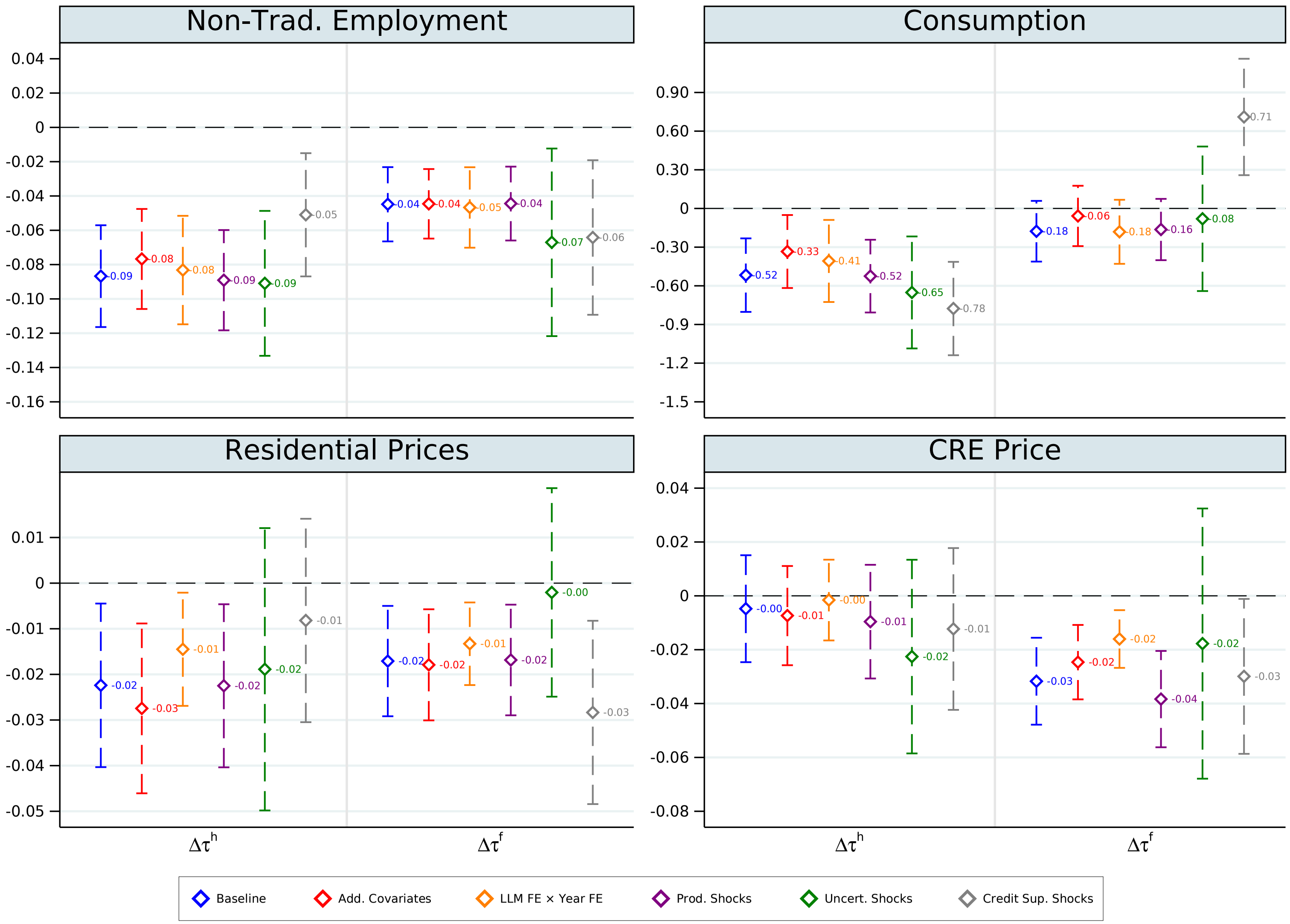
Notes: The table shows the covariate balance test for observables related to migration patterns and sectoral labor shares. The in-migration (out-migration) rate is the share of persons moving into (out of) a municipality relative to the total population living in the municipality at the end of the year. Employment share is the share of two-digit industry employment to total employment. Manufacturing, Construction, and Wholesale and Retail sectors are represented by industries in sections C, F, and G according to the NACE (2.Rev) industry classification. Standard errors in parentheses are clustered at the local labor market level, *, **, *** indicate significance at the 10% 5% and 1%, respectively.

Table 6: Covariate Balance: Financial Situation of Local Governments

	Revenues Growth	Expend. Growth	Investment Rate	Deficit/Rev Ratio	Debt/Rev Ratio
$\Delta\tau^{h}_{m,2012}$	0.072**	-0.065**	-0.025	-0.137***	-0.122*
	(0.032)	(0.029)	(0.057)	(0.024)	(0.069)
$\Delta\tau^{f}_{m,2012}$	0.20***	-0.006	-0.052	-0.175***	-0.143***
	(0.024)	(0.025)	(0.046)	(0.015)	(0.047)
$Ho : \theta_{x,h} = \theta_{x,f} = 0$ (p-val)	0.00	0.10	0.46	0.00	0.01
N_{obs}	43,519	43,519	43,540	43,519	43,519
$\bar{R}^2$	0.92	0.93	0.53	0.27	0.59

Notes: The table shows the covariate balance test for variables related to migration patterns and supply-side conditions. The variable current revenues include income from local taxes and tariffs collected by the municipal government. At the same time, current expenditures represent all municipal government spending for regular operations during the fiscal year. Per capita revenues and expenditures are expressed in 2010 euros. Local government investment rate is the ratio of municipal government capital expenditure to total current expenditure. Deficit is the difference between current expenditures and current revenues. Finally, debt is the book value of the stock of local government debt at the end of the fiscal year. Standard errors in parentheses are clustered at the local labor market level, *, **, *** indicate significance at the 10% 5% and 1%, respectively.

Figure 1: Robustness of Baseline Estimates



Note: The figure depicts the estimation results for specifications (2), (3), and (4) on the outcome variables. The results are obtained with a sample of 6,246 municipalities during 2008-2014. The dashed vertical lines represent the 95% confidence intervals with the point estimates depicted with a hollowed diamond at the center of the interval. The left half x-axis reports the estimated coefficients for $\beta_{y,h}$. The right half x-axis presents the $\beta_{y,f}$ estimates. The y-axis on each graph is expressed in percentage points. Standard errors are clustered at the Local Labor Market level.

5 Robustness Checks: Empirical Estimates

5.1 Non-Tradable Employment

Table 7: Non-Tradable Employment: Robustness Checks

	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta\tau^{h}_{m,t} \times \mathbb{1}\{t = 2012\}$	-0.087***	-0.077***	-0.083***	-0.089***	-0.091***	-0.051***
	(0.015)	(0.015)	(0.016)	(0.015)	(0.022)	(0.018)
$\Delta\tau^{f}_{m,t} \times \mathbb{1}\{t = 2012\}$	-0.045***	-0.045***	-0.047***	-0.044***	-0.067**	-0.064***
	(0.011)	(0.010)	(0.012)	(0.011)	(0.028)	(0.023)
N_{obs}	43,540	43,539	43,519	43,540	43,540	31,486
N_{mun}	6,220	6,220	6,220	6,220	6,220	6,220
R^2	0.13	0.21	0.22	0.13	0.13	0.13
Municipality FE	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓
Region × Year FE		✓	✓			
LLM × Year FE			✓			
Additional Controls		✓				
Productivity × $\Delta\tau^{i}_{m,2012}$				✓		
Uncertainty × $\Delta\tau^{i}_{m,2012}$					✓	
Credit Supply × $\Delta\tau^{i}_{m,2012}$						✓

Notes: The dependent variable is the non-tradable employment growth rate. The sample used covers the period 2008-2014. Column (1) reports the baseline results, column (2) adds municipal level covariates, and column (3) controls for local labor market time trends. Columns (4), (5), and (6) include the interaction between the 2012 residential/commercial real estate tax rate change and proxies for productivity, uncertainty, and credit supply shocks, respectively. We use the annual growth of income per worker to proxy for productivity shocks. The proxy for uncertainty shocks is based on the yearly standard deviation for the income growth rate per worker across municipalities within the same province. Finally, to proxy for credit supply shocks, we use data from bank branches in each municipality to compute the loan to deposits ratio. Standard errors in parentheses are clustered at the local labor market level, *, **, *** indicate significance at the 10% 5% and 1% respectively.

5.2 Consumption

Table 8: Consumption Expenditure: Robustness Checks

	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta\tau^{h}_{m,t} \times \mathbb{1}\{t = 2012\}$	-0.517***	-0.334**	-0.407**	-0.525***	-0.652***	-0.776***
	(0.145)	(0.144)	(0.162)	(0.144)	(0.221)	(0.184)
$\Delta\tau^{f}_{m,t} \times \mathbb{1}\{t = 2012\}$	-0.177	-0.058	-0.181	-0.163	-0.080	0.710***
	(0.120)	(0.119)	(0.126)	(0.121)	(0.285)	(0.230)
N_{obs}	34,517	34,517	34,350	34,517	34,517	28,599
N_{mun}	5,740	5,740	5,740	5,740	5,740	5,740
R^2	0.10	0.10	0.21	0.10	0.10	0.10
Municipality FE	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓
Population deciles × Year		✓				✓
LLM × Year FE			✓			
Additional Controls		✓				
Productivity × $\Delta\tau^{i}_{m,2012}$				✓		
Uncertainty × $\Delta\tau^{i}_{m,2012}$					✓	
Credit Supply × $\Delta\tau^{i}_{m,2012}$						✓

Notes: The dependent variable is the growth rate of consumption expenditure proxied by expenditures on new vehicles. The sample used covers the period 2008-2014. Column (1) reports the baseline results, column (2) adds municipal level covariates, and column (3) controls for local labor market time trends. Columns (4), (5), and (6) include the interaction between the 2012 residential/commercial real estate tax rate change and proxies for productivity, uncertainty, and credit supply shocks, respectively. We use the annual growth of income per worker to proxy for productivity shocks. The proxy for uncertainty shocks is based on the yearly standard deviation for the income growth rate per worker across municipalities within the same province. Finally, to proxy for credit supply shocks, we use data from bank branches in each municipality to compute the loan to deposits ratio. Standard errors in parentheses are clustered at the local labor market level, *, **, *** indicate significance at the 10% 5% and 1% respectively

5.3 Residential Prices

Table 9: Residential Prices: Robustness Checks

	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta\tau^{h}_{m,t} \times \mathbb{1}\{t = 2012\}$	-0.022**	-0.027***	-0.014**	-0.022**	-0.019	-0.008
	(0.009)	(0.009)	(0.006)	(0.009)	(0.016)	(0.011)
$\Delta\tau^{f}_{m,t} \times \mathbb{1}\{t = 2012\}$	-0.017***	-0.018***	-0.013***	-0.017***	-0.002	-0.028***
	(0.006)	(0.006)	(0.005)	(0.006)	(0.012)	(0.010)
N_{obs}	38,731	38,729	38,494	38,731	38,731	27,445
N_{mun}	5,534	5,534	5,534	5,534	5,534	5,534
R^2	0.33	0.34	0.66	0.33	0.63	0.34
Municipality FE	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓
Province $\times$ Year FE					✓	
LLM $\times$ Year FE			✓			
Population deciles $\times$ Year	✓	✓	✓	✓	✓	✓
Productivity $\times$ $\Delta\tau^{i}_{m,2012}$				✓		
Uncertainty $\times$ $\Delta\tau^{i}_{m,2012}$					✓	
Credit Supply $\times$ $\Delta\tau^{i}_{m,2012}$						✓

Notes: The dependent variable is the growth rate of residential property prices. Residential property price is defined as the average value per meter^2 across homogeneous real state markets within each municipality. The sample used covers the period 2008-2014. Column (1) reports the baseline results, column (2) adds municipal level covariates, and column (3) controls for local labor market time trends. Columns (4), (5), and (6) include the interaction between the 2012 residential/commercial real estate tax rate change and proxies for productivity, uncertainty, and credit supply shocks, respectively. We use the annual growth of income per worker to proxy for productivity shocks. The proxy for uncertainty shocks is based on the yearly standard deviation for the income growth rate per worker across municipalities within the same province. Finally, to proxy for credit supply shocks, we use data from bank branches in each municipality to compute the loan to deposits ratio. Standard errors in parentheses are clustered at the local labor market level, *, **, *** indicate significance at the 10% 5% and 1% respectively.

5.4 Commercial Real Estate Prices

Table 10: CRE Prices: Robustness Checks

	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta\tau^{h}_{m,t} \times \mathbb{1}\{t = 2012\}$	-0.005	-0.007	-0.002	-0.010	-0.023	-0.012
	(0.010)	(0.009)	(0.008)	(0.011)	(0.018)	(0.015)
$\Delta\tau^{f}_{m,t} \times \mathbb{1}\{t = 2012\}$	-0.032***	-0.025***	-0.016***	-0.038***	-0.018	-0.030**
	(0.008)	(0.007)	(0.005)	(0.009)	(0.026)	(0.015)
N_{obs}	29,471	25,805	29,000	25,805	25,805	19,332
N_{mun}	3,687	3,687	3,687	3,687	3,687	3,687
R^2	0.31	0.46	0.65	0.21	0.21	0.21
Municipality FE	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓
Population deciles × Year		✓				
Region × Year FE	✓	✓	✓			
LLM × Year FE			✓			
Productivity × $\Delta\tau^{i}_{m,2012}$				✓		
Uncertainty × $\Delta\tau^{i}_{m,2012}$					✓	
Credit Supply × $\Delta\tau^{i}_{m,2012}$						✓

Notes: The dependent variable is the growth rate of commercial property prices. The price of commercial real estate properties is defined as the average value per meter^2 across homogeneous real state markets within each municipality of all properties used in the retail sector. The sample used covers the period 2008-2014. Column (1) reports the baseline results, column (2) adds municipal level covariates, and column (3) controls for local labor market time trends. Columns (4), (5), and (6) include the interaction between the 2012 residential/commercial real estate tax rate change and proxies for productivity, uncertainty, and credit supply shocks, respectively. We use the annual growth of income per worker to proxy for productivity shocks. The proxy for uncertainty shocks is based on the yearly standard deviation for the income growth rate per worker across municipalities within the same province. Finally, to proxy for credit supply shocks, we use data from bank branches in each municipality to compute the loan to deposits ratio. Standard errors in parentheses are clustered at the local labor market level, *, **, *** indicate significance at the 10% 5% and 1% respectively

6 Model Characterization and Additional Results

6.1 Firms problem

We begin with the the profit maximization problem of a firm producing variety c_j. The first order conditions are as follows:

$$\{L_j\}: \quad \alpha \left(\frac{\epsilon-1}{\epsilon}\right) C^{\frac{1}{\epsilon}} L^{\alpha\left(\frac{\epsilon-1}{\epsilon}\right)-1} \left(H^h\right)^{(1-\alpha)\left(\frac{\epsilon-1}{\epsilon}\right)} = W(1+\mu_j^f) \tag{5a}$$

$$\left\{H_j^f\right\}: \quad (1-\alpha) \left(\frac{\epsilon-1}{\epsilon}\right) C^{\frac{1}{\epsilon}} L_j^{\alpha\left(\frac{\epsilon-1}{\epsilon}\right)} \left(H_j^h\right)^{(1-\alpha)\left(\frac{\epsilon-1}{\epsilon}\right)-1} = P^f \left(1+\tau^f - \phi_f\, \mu_j^f\right) \tag{5b}$$

$$\mu_j^f \left[W L_j - \phi_f P^f H_j^f\right] = 0 \tag{5c}$$

where μ_j^f represent the multiplier of the firm collateral constraint. Assuming the collateral constraint is binding, we can use (5a) and (5b) to solve for L_j and H_j^f:

$$L_j = \left[\alpha\, \frac{\epsilon-1}{\epsilon}\right]^{\epsilon} \frac{C}{W^{1+\alpha(\epsilon-1)} \left(\phi_f P^f\right)^{(1-\alpha)(\epsilon-1)} (1+\mu_j^f)^{\epsilon}} \tag{6}$$

$$H_j^f = \left[(1-\alpha)\, \frac{\epsilon-1}{\epsilon}\right]^{\epsilon} \frac{\phi_f^{\alpha(\epsilon-1)} C}{W^{\alpha(\epsilon-1)} \left(P^f\right)^{1+(1-\alpha)(\epsilon-1)} (1+\tau^f - \phi_f \mu_j^f)^{\epsilon}} \tag{7}$$

using the ratio (6) to (7) and solving for μ^f:

$$\mu_j^f = \frac{\alpha\, (1+\tau^f+\phi_f)}{\phi_f} - 1 \tag{8}$$

replacing (8) into (7) and (6) we obtain the demand for commercial real estate properties and labor, respectively.

$$H_j^{f,d} = \left(\frac{\epsilon-1}{\epsilon}\right)^{\epsilon} \frac{\phi_f^{\alpha(\epsilon-1)}\, C}{W^{\alpha(\epsilon-1)} \left(P^f\right)^{1+(1-\alpha)(\epsilon-1)} (1+\tau^f+\phi_f)^{\epsilon}} \tag{9}$$

$$L_j^d = \left(\frac{\epsilon - 1}{\epsilon}\right)^{\epsilon} \frac{\phi_f^{1+\alpha(\epsilon-1)}\ C}{W^{1+\alpha(\epsilon-1)}\ \left(P^f\right)^{(1-\alpha)(\epsilon-1)}\ (1+\tau^f+\phi_f)^{\epsilon}} \tag{10}$$

alternatively, we can use the firm's collateral constraint to find the firm's labor demand.

$$L_j^d = \phi_f \frac{P^f\, H_j^f}{W} \tag{11}$$

replacing (10) and (9) into the firm's profit function:

$$\Pi_j = \frac{(\epsilon-1)^{\epsilon-1}\ \phi_f^{\alpha(\epsilon-1)}\ C}{\epsilon^{\epsilon}\ W^{\alpha(\epsilon-1)}\ \left(P^f\right)^{(1-\alpha)(\epsilon-1)}\ (1+\tau^f+\phi_f)^{\epsilon-1}} = \frac{W\ L_j^d\ (1+\tau^f+\phi_f)}{\phi_f\ (\epsilon-1)} \tag{12}$$

finally, aggregating Π_j, L_j^d, and $H_j^{f,d}$ across all varierties $j \in [0, 1]$:

$$L^d = \left(\frac{\epsilon - 1}{\epsilon}\right)^{\epsilon} \frac{\phi_f^{1+\alpha(\epsilon-1)}\ C}{W^{1+\alpha(\epsilon-1)}\ \left(P^f\right)^{(1-\alpha)(\epsilon-1)}\ (1+\tau^f+\phi_f)^{\epsilon}} \tag{13}$$

$$H^{f,d} = \left(\frac{\epsilon - 1}{\epsilon}\right)^{\epsilon} \frac{\phi_f^{\alpha(\epsilon-1)}\ C}{W^{\alpha(\epsilon-1)}\ \left(P^f\right)^{1+(1-\alpha)(\epsilon-1)}\ (1+\tau^f+\phi_f)^{\epsilon}} \tag{14}$$

$$\Pi = \frac{W\ L^d\ (1+\tau^f+\phi_f)}{\phi_f\ (\epsilon-1)} \tag{15}$$

where $L^d = \int_0^1\ L_j^d\ dj$, $H^{f,d} = \int_0^1\ H_j^{f,d}\ dj$, and $\Pi = \int_0^1\ \Pi_j\ dj$. Alternatively we can use (11) to express the aggregate demand for labor as follows:

$$L^d = \phi_f \frac{P^f\, H^f}{W} \tag{16}$$

6.2 Household problem

With the first stage problem for households we get the following first-order conditions:

$$\{C\}: \quad \beta\, C^{\beta-1} \left(H^h\right)^{1-\beta} = \lambda + \mu^h \tag{17a}$$

$$\{L\}: \quad \chi\, L^{\frac{1}{\nu}} = \lambda\, W \tag{17b}$$

$$\left\{H^h\right\}: \quad (1-\beta)\, C^{\beta} \left(H^h\right)^{-\beta} = \lambda\, P^h(1+\tau^h) - \mu^h\, \phi_h\, P^h \tag{17c}$$

$$\lambda \left[WL + \Pi - C - P^h H^h (1+\tau^h)\right] = 0 \tag{17d}$$

$$\mu^h \left[C - \phi_h P^h H^h\right] = 0 \tag{17e}$$

where μ^h and λ are the multipliers for the household's borrowing and budget constraint, respectively. Assuming the household borrowing constraint is binding, we can use (17e) and (17d) to find a solution for C and H^h:

$$C = \frac{\phi_h}{1+\tau^h+\phi_h} \left(WL + \Pi\right) \tag{18}$$

$$H^h = \frac{1}{P^h \left(1+\tau^h+\phi_h\right)} \left(WL + \Pi\right) \tag{19}$$

alternatively, the solution for C is determined using (17e):

$$C = \phi_h P^h H^h \tag{20}$$

now, using (17a), (17c), and (17e), we can solve for μ^h and λ:

$$\mu^h = \frac{1}{\left(\phi_h P^h\right)^{1-\beta}} \left[\beta - \frac{\phi_h}{1+\tau^h+\phi_h}\right] \tag{21}$$

$$\lambda = \frac{\phi_h^{\beta}}{\left(P^h\right)^{1-\beta}\left(1+\tau^h+\phi_h\right)} \tag{22}$$

we can solve for the optimal labor supply by replacing (22) into (17b)

$$L^s = \left[\frac{W\phi_h^{\beta}}{\chi\left(P^h\right)^{1-\beta}\left(1+\tau^h+\phi_h\right)}\right]^{\nu} \tag{23}$$

finally, replacing for Π and WL^s in (18) and (19) with the aggregate profits in (15), the labor market equilibrium $L^d = L^s$, and the optimal labor supply in (23)

$$C = \frac{\phi_h^{1+\beta\nu}W^{1+\nu}(1+\tau^f+\epsilon\phi_f)}{\chi^{\nu}\phi_f(\epsilon-1)\left(P^h\right)^{(1-\beta)\nu}(1+\tau^h+\phi_h)^{1+\nu}} \tag{24}$$

$$H^{h,d} = \frac{\phi_h^{\beta\nu}W^{1+\nu}(1+\tau^f+\epsilon\phi_f)}{\chi^{\nu}\phi_f(\epsilon-1)\left(P^h\right)^{1+(1-\beta)\nu}(1+\tau^h+\phi_h)^{1+\nu}} \tag{25}$$

6.3 Constrained competitive equilibrium

Let $\mu^h > 0$ and $\mu^f > 0$. Using (16) and (23) we can solve for the equilibrium wage

$$W = \left[\frac{\phi_f\,\chi^{\nu}}{\phi_h^{\beta\nu}}\left(P^f\right)^{1+\sigma_f}\left(P^h\right)^{(1-\beta)\nu}(1+\tau^h+\phi_h)^{\nu}\right]^{\frac{1}{1+\nu}} \tag{26}$$

replacing the equilibrium wage into (16) to find the equilibrium employment

$$L = \left[\frac{\phi_f\phi_h^{\beta}(P^f)^{1+\sigma_f}}{\chi(P^h)^{1-\beta}(1+\tau^h+\phi_f)}\right]^{\frac{\nu}{1+\nu}} \tag{27}$$

alternatively, using (13) and(23). solving for the equilibrium wage and employment.

$$W = \left[\left(\frac{\epsilon-1}{\epsilon}\right)^{\epsilon}\left(\frac{\phi_h^{\beta}}{\chi(P^h)^{1-\beta}(1+\tau^h+\phi_h)}\right)^{\nu}\frac{\phi_f^{1+\alpha(\epsilon-1)}C}{(P^f)^{(1-\alpha)(\epsilon-1)}(1+\tau^f+\phi_f)^{\epsilon}}\right]^{\frac{1}{1+\nu+\alpha(\epsilon-1)}} \tag{28}$$

$$L = \left[\phi_f^{1+\alpha(\epsilon-1)} \left(\frac{\epsilon-1}{\epsilon}\right)^{\epsilon} \left(\frac{\phi_h^{\beta}}{\chi}\right)^{\nu+\alpha(\epsilon-1)} \frac{C}{(P^f)^{(1-\alpha)(\epsilon-1)}(1+\tau^f+\phi_f)^{\epsilon}((P^h)^{1-\beta}(1+\tau^h+\phi_h))^{\nu+\alpha(\epsilon-1)}} \right]^{\frac{\nu}{1+\nu+\alpha(\epsilon-1)}} \tag{29}$$

now, we obtain the equilibrium price of commercial properties using equation (14) and the supply function for commercial estate properties and replacing the equilibrium wage (26).

$$P^f = \left[\left(\frac{\epsilon-1}{\epsilon}\right)^{\epsilon(1+\nu)} \frac{\left(\phi_f \phi_h^{\beta}\right)^{\alpha(\epsilon-1)\nu} C^{1+\nu}}{\chi^{\alpha(\epsilon-1)\nu}(1+\tau^f+\phi_f)^{\epsilon(1+\nu)}(1+\tau^h+\phi_h)^{\alpha(\epsilon-1)\nu}(P^h)^{\alpha(\epsilon-1)(1-\beta)\nu}} \right]^{\frac{1}{A_f}} \tag{30}$$

where, $A_f = (1+\sigma_f)(1+\nu+\alpha(\epsilon-1)) + (1+\nu)(1-\alpha)(\epsilon-1)$. Next, with (25) and the housing supply and replacing the equilibrium wage (26) to solve for the price of residential properties.

$$P^h = \left[\frac{(P^f)^{1+\sigma_f}(1+\tau^f+\epsilon\phi_f)}{(\epsilon-1)(1+\tau^h+\phi_h)} \right]^{\frac{1}{1+\sigma_h}} \tag{31}$$

alternatively we can also express residential prices by replacing the equilibrium wage (28)

$$P^h = \left[\left(\frac{\phi_h^{1+\nu(\alpha(\epsilon-1)\beta)+1}}{\epsilon^{\epsilon(1+\nu)}} \right)^{\frac{1}{\alpha(\epsilon-1)}} \left(\frac{(1+\tau_f+\epsilon\phi_f)^{1+\nu+\alpha(\epsilon-1)}}{(1+\tau^f+\phi_f)^{\epsilon(1+\nu)}(1+\tau^h+\phi_h)^{(1+\nu)(1+\alpha(\epsilon-1))}} \right)^{\frac{1}{\alpha(\epsilon-1)}} \frac{(\epsilon-1)^{\frac{1-\alpha+\nu}{\alpha}} \phi_f^{\nu}}{(P^f)^{\frac{(1-\alpha)(1+\nu)}{\alpha}}} \right]^{\frac{1}{1+\sigma_h+(1-\beta)\nu}} \tag{32}$$

finally, replacing the housing supply into (20) to find for the equilibrium consumption expenditure

$$C = \phi_h (P^h)^{1+\sigma_h} \tag{33}$$

6.4 About Binding Borrowing Constraints

Proposition 1 *Let $\{W, P^h, P^f,\}$ and $\{L, H^h, H^f, C\}$ be the vectors of equilibrium prices and allocations, respectively. Then, the household's borrowing constraint binds (i.e. μ^h>0) if and only if:*

$$\frac{C}{WL+\Pi} < \beta, \tag{34}$$

Furthermore, the firm's collateral constraint binds (i.e. $\mu_j^f > 0$) if and only if:

$$\frac{WL_j}{WL_j + P^f H^f (1+\tau^f)} < \alpha \tag{35}$$

Proof. Given that the expenditure share in consumption goods in a frictionless economy is β, while for the financially constrained economy will be $\frac{C}{WL+\Pi} = \frac{\phi_h}{1+\tau^h+\phi_h}$. Therefore, using equation (21) we can see that $\mu^h > 0$ if

$$\beta - \frac{\phi_h}{1+\tau^h+\phi_h} > 0 \iff \frac{C}{WL+\Pi} < \beta$$

On the other hand, the labor cost-to-total costs ratio in a friction in a frictionless economy and financially constrained economy is α and $\frac{\phi_f}{1+\tau^f+\phi_f}$. Then, with equation (8), $\mu^f > 0$ if and only if:

$$\frac{\alpha\,(1+\tau^f+\phi_f)}{\phi_f} - 1 > 0 \iff \frac{WL_j}{WL_j + (1+\tau^f)P^f H_j^f} < \alpha$$

QED.

For households, the intuition behind equation (34) is explained next. The parameter β captures the expenditure share on non-housing goods in an economy with no borrowing constraints for households. If β is high enough, households prefer to allocate most of their expenditure towards non-housing goods, which can be done only by reducing housing expenditures. However, spending on non-housing goods requires a loan amount that surpasses the household's collateral value. Therefore, the only option is to get the maximum loan consistent with their housing wealth, which implies a drop in the share of expenditure on non-housing goods relative to a case with no financial frictions.

For firms, the intuition for equation (35) is similar. In this case, α captures the ratio of labor costs to total costs in an economy with no financial constraints for firms. If α is high enough, the high labor's marginal productivity induces firms to hire more workers. However, this decision is inconsistent with the value of collateral firms own. In the end, firms' maximum loan available reduces the ratio of labor costs to total costs compared to the one in a frictionless economy.

6.5 The Housing Wealth and Firm Collateral Channel on Employment

Proposition 2 *Applying **Definition 2** (main text) to the optimal labor demand we obtain equations (36) and (37)*

$$\delta^{wealth}(\Theta) = -\left[\frac{1}{1+\phi_h}\right]\left[\frac{(1+\sigma_h)(1+\alpha(\epsilon-1))(1+\nu)\nu}{(1+\sigma_h+\nu(1-\beta))(1+\nu+\alpha(\epsilon-1))\alpha(\epsilon-1)}\right] \tag{36}$$

$$\delta^{coll}(\Theta) = -\left[\frac{1}{1+\phi_f}\right]\left[\frac{(1+\sigma_f)\nu\epsilon}{(1+\sigma_f)(1+\nu+\alpha(\epsilon-1))+(1+\nu)(1-\alpha)(\epsilon-1)}\right] \tag{37}$$

Proof. Recall that:

$$\delta^{\text{wealth}} = \frac{\partial l}{\partial \Delta\tau^h} = \frac{\partial l^d}{\partial c}\frac{\partial c}{\partial p^h}\frac{\partial p^h}{\partial \Delta\tau^h} \tag{38}$$

for $\Delta\tau^h > 0$ and $\Delta\tau^f = p^f = 0$.

Then, to obtain $\delta^{\text{wealth}}(\Theta)$, first we use the equilibrium employment in (13) to compute $l^d = \ln L^{d,\text{HIGH}} - \ln L^{d,\text{low}}$

$$l^d = \frac{\nu}{1+\nu+\alpha(\epsilon-1)}\left[c - \Big(\nu+\alpha(\epsilon-1)\Big)\left((1-\beta)p^h + \frac{\Delta\tau^h}{1+\phi_h}\right)\right] \tag{39}$$

now, with equation (32) to obtain $p^h = \ln P^{h,\text{HIGH}} - \ln P^{h,\text{low}}$

$$p^h = -\frac{\Delta\tau^h}{1+\sigma_h+(1-\beta)\nu}\left(\frac{(1+\nu)(1+\alpha(\epsilon-1))}{1+\phi_h}\right)] \tag{40}$$

finally, with expression (33) to obtain $c = \ln C^{\text{HIGH}} - \ln C^{\text{low}}$

$$c = (1 + \sigma_h) p^h \tag{41}$$

using (39), (40), and (41) we obtain

$$\frac{\partial l^d}{\partial c} = \frac{\nu}{1 + \nu + \alpha(\epsilon - 1)} \tag{42a}$$

$$\frac{\partial c}{\partial p^h} = (1 + \sigma_h) \tag{42b}$$

$$\frac{\partial p^h}{\partial \Delta\tau^h} = -\frac{(1+\nu)(1+\alpha(\epsilon-1))}{(1+\sigma_h+(1-\beta)\nu)(1+\phi_h)} \tag{42c}$$

replacing (42a), (42b), and (42c) into equation (38), we get the expression for the housing wealth channel in (36).

On the other hand, we know that:

$$\delta^{\text{coll}} = \frac{\partial l}{\partial \Delta\tau^f} = \frac{\partial l^d}{\partial p^f}\frac{\partial p^f}{\partial \Delta\tau^f} \tag{43}$$

for $\Delta\tau^f > 0$ and $\Delta\tau^h = p^h = 0$. Following procedure as before to compute $\delta^{\text{coll}}(\Theta)$. Initially, we use (27) to obtain an expression for $l^d = \ln L^{d,\text{HIGH}} - \ln L^{d,\text{low}}$

$$l^d = \frac{\nu(1+\sigma_f)}{1+\nu} p^f \tag{44}$$

and using (30) to compute $p^f = \ln P^{f,\text{HIGH}} - \ln P^{f,\text{low}}$

$$p^f = -\frac{\epsilon(1+\nu)}{\Big((1+\sigma_f)(1+\nu+\alpha(\epsilon-1)+(1+\nu)(1-\alpha)(\epsilon-1))\Big)\Big(1+\phi_f\Big)}\Delta\tau^f \tag{45}$$

therefore

$$\frac{\partial l^d}{\partial p^f} = \frac{\nu(1+\sigma_f)}{1+\nu} \tag{46a}$$

$$\frac{\partial p^f}{\partial \Delta \tau^f} = -\frac{\epsilon(1+\nu)}{\Big((1+\sigma_f)(1+\nu+\alpha(\epsilon-1)+(1+\nu)(1-\alpha)(\epsilon-1))\Big)\Big(1+\phi_f\Big)} \tag{46b}$$

replacing (46a) and (46b) into (43) we obtain the parametric function for the firm collateral channel in (37) **QED**.

6.6 Reduced form Coefficients and Calibrated Parameters

Proposition 3 *For a given value of parameters in Θ_{out}, the model-implied reduced-form effects $\Big\{\beta_{p^h,h}(\Theta), \beta_{p^f,f}(\Theta)\ \beta_{C,h}(\Theta), \beta_{p^h,f}(\Theta)\Big\}$ pin-down the structural parameters in Θ_{in} as follows:*

$$\beta_{p^h,h} = \beta_{p^h,h}(\sigma_h, \phi_h, \Theta_{out}) \tag{47a}$$

$$\beta_{c,h} = \beta_{c,h}(\sigma_h, \phi_h, \Theta_{out}) \tag{47b}$$

$$\beta_{p^f,f} = \beta_{p^f,f}(\sigma_f, \phi_f, \Theta_{out}) \tag{47c}$$

$$\beta_{p^h,f} = \beta_{p^h,f}(\sigma_f, \phi_f, \Theta_{out}), \tag{47d}$$

Proof. First, fix the value of $\Theta_{\text{out}} = [\alpha, \beta, \nu, \epsilon]$. We know that:

$$\beta_{p^h,h}(\Theta) = -\frac{1}{1+\sigma_h}\left[\frac{1}{1+\phi_h} - (1+\sigma_f)\beta_{p^f,h}(\Theta)\right] \tag{48a}$$

$$\beta_{c,h}(\Theta) = (1+\sigma_h)\beta_{p^h,h}(\Theta) \tag{48b}$$

Moreover, we also know that:

$$\beta_{p^h,f}(\Theta) = \frac{1}{1+\sigma_h}\left[(1+\sigma_f)\beta_{p^f,f}(\Theta) + \frac{1}{1+\epsilon\phi_f}\right] \tag{49a}$$

$$\beta_{p^f,f}(\Theta) = \frac{1}{A_f}\left[\Big((1+\nu)(1+\sigma_h) - \alpha(\epsilon-1)(1-\beta)\nu\Big)\beta_{p^h,f}(\Theta) - \frac{\epsilon(1+\nu)}{1+\phi_f}\right] \tag{49b}$$

Then can use (48a) and (48b) to solve for $\{\sigma_h, \phi_h\}$. At the same time, We can obtain $\{\sigma_f, \phi_f\}$ from (49a) and (49b) **QED**.

6.7 Checking the Robustness of Model Predictions on Employment

We check for changes in the employment predictions in the model by changing the value of the Frisch elasticity (ν) and the elasticity for varieties (ϵ). The Frisch elasticity determines the size of the wealth effect on labor supply. We choose the values of $\nu = 0.5, 2$ as these are consistent with the bounds found in the literature. In particular, the surveys of Ashenfelter et al. (2010) and Alan (2011) report short-run estimates between 0.1 and 2.

The elasticity of demand for varieties defines the shape of the production function of intermediate goods and affects the labor demand response of these firms. Based on estimates for the elasticity of substitution across varieties reported by Gaulier et al. (2006), Mohler (2009), and Broda et al. (2017), we choose to change the values of this parameter to $\epsilon = 2, 10$.

Table 11: Robustness of Model Predictions: Employment

	Model $\beta_{l,i}(\Theta)$					Data	
	$\epsilon = 5$		$\nu = 1$		Baseline	$\hat{\beta}_{l,i}$	95 % CI
	$\nu = 0.5$	$\nu = 2$	$\epsilon = 2$	$\epsilon = 10$	$\nu = 1, \epsilon = 5$		
$\Delta\tau^h$	0.063	0.069	0.060	0.083	0.071	0.087	[0.06, 0.12]
$\Delta\tau^f$	0.041	0.081	0.065	0.060	0.061	0.045	[0.02, 0.07]

Table 11 show how robust the model's predictions for employment are under different values of ν and ϵ. The first and second columns show the employment predictions under different values of ν. At the same time, the third and the fourth columns report the labor predictions under different values for ϵ. Finally, the last three columns reproduce the baseline predictions and the empirical estimates reported in the paper.

The main takeaway from Table 11 is that the model's predictions regarding the labor response to changes in property taxes seem robust enough to extreme values of ν and ϵ. Moreover, compared to the empirical estimates, the model predictions remain reasonably close to the point estimates and well within the 95% confidence interval, with the only exception being for $\beta_{l,f}$ when the Frisch elasticity is too high (*i.e.* $\nu = 2$).

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