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Price response to a massive labor cost cut : evidence from French firm-level datap

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Abstract

We use a major labor cost cut of several percents in the form of a tax credit to infer the price response to a drop in labor marginal cost, using firm-level data. We account for common elements determining firm-level prices with a factor model at the sector level. Thus, we model within-sector shocks that affect firms with an individual and permanent loading. By controlling for unobserved heterogeneity and disaggregated prices of input, we argue that we provide a fair short-term counterfactual to assess the impact of the tax credit on prices. Our results suggest that not all sectors are willing to pass the tax benefit on their clients : we find that the sectors for which significant pass-through arise are those having the highest share of labor in total cost, i.e. mostly low-skilled and labor-intensive services. In addition, the pass-through is a lengthy process : significant effects are measured one to two years after the announcement of the policy.

Introduction

In the empirical price setting literature, the labor cost pass-through is scarcely studied essentially due to data limitation. Meanwhile, some policies try to adjust the marginal cost of production likely ignoring prices effects. In France, a major tax credit - the «CICE» (*Crédit d'Impôt Compétitivité Emploi, Competitiveness and Employment Tax Credit*) has been offered to firms based on their payroll to boost both employment and export competitiveness. Employment effects have been shown very limited in the short-term (Carbonnier et al. [2016], Gilles et al. [2016]). If efforts have been made to convince firms that it was a lasting scheme, this policy was also a marked as a political decision. As a consequence, firms may have preferred (reversible) pricing strategies over more compelling employment decisions. In this paper, we propose to estimate the pass-through of the marginal cost decrease triggered by this policy on to the firm-level prices. To this end, we use a novel data set merging PPI product-firm level data to firm balance sheets and perceived tax credit.

Price determinants are notoriously difficult to observe, perhaps at the exception of aggregated input prices. To circumvent this limitation, we use a factor model that capture unobserved common shocks at the sectoral level. These shocks can affect each firm according to an individual factor loading, assumed constant throughout the period. Following the contribution of (3), factor models have been increasingly used in policy evaluation ((16), (15)) as an improvement over difference-in-difference estimates since they relax the common trend assumption ((13)). In the context of prices, a strong commonality is expected (e.g. triggered by oil price over a large set of firms, with varying but plausibly time-invariant impact). This feature is particularly suited to factor models (see for example (5), that show in particular the importance of sectoral shocks relative to macro shocks in the price context). From the correlation between-firms within-sectors, we estimate common shocks that define, in our framework, what would have happened to firm prices in the absence of the policy. Therefore, another difficulty that we intent to tackle by relying on a factor model is the absence of a proper control group, as the policy applies to virtually any firm with employees.

The bulk of research on labor cost pass-through to prices is concerned with the minimum wage and the share of the burden borne by consumers. In a sense, the scope is limited to a few sectors, essentially retail and restaurants. Using micro-data underlying the CPI, a number of authors have found estimates consistent with an output price elasticity to the minimum wage on to prices in proportion to the share of minimum wages workers' wages in total cost (in France in particular, (10), for the US, (1), (2), (19)). Another line of research sheds light on the labor cost pass-through without relying on an external shock. There is survey evidence on the importance of marginal cost in price setting : qualitative results from (17) emphasize the importance of input prices, but also the asymmetry of the pass-through. Note that most past studies on labor-cost pass-through into prices use increases (e.g. minimum wages). Fabiani et al. [2005] report that the majority of surveyed European firms declare to apply a mark-up over their cost, and with explicit and implicit contracts, actors recognize pricing based on cost as the theory the most in accordance with their own practices. On a more quantitative ground, (7) show a quite consequent long-term pass-through of unit labor cost into prices for industrial firms, not statistically different than unity.

Building on this literature, we further investigate two directions. First, our scope is remarkably large as it includes most of the market sector selling to businesses rather than final customers. Second, the policy we consider has more effect on firms' cost than minimum wage increases. The CICE has in common with the minimum wage to be salient. In particular, the take-up rate is particularly high if not complete. It is distinct in that the workers' wages directly eligible are up to 2.5 times the national minimum wages (NMW in what follows). This threshold is particularly high and roughly 90% of workers are paid below, whereas only about 10% of workers are directly concerned by the minimum wage. Aside the base, the magnitude of the decrease in cost is important, starting with 4 % in 2013 before scaling up. Those features make it a sizeable cut in cost : for a firm paying all workers under this threshold, the CICE represents a cut of 4 % in its wage bill the first year, 6 % the two following years. Finally, we are able to merge the firm level data underlying the PPI index with social and fiscal information, on a very large scope, and link the firms quantitative price information with cost structure and exposure to treatment. This features enables us to explore firm level variability in prices and costs rather than relying on aggregate data and to estimate a pass through for each sector.

Our results suggest that the sectors for which the pass-through is statistically significant are characterized by a high share of labor payed under 2.5 times the NMW in total cost. A prominent example is the sector of administrative and support service activities, that comprise temporary employment agencies or services to building (e.g. cleaning activities), where the share of cost targeted by the policy is over 40%. Freight transport and specialized construction (e.g. carpentry, house painters..), for which this share is about 25%, display the same feature. In those three cases, the long-term (two-year) elasticity of prices is comparable with the share of labor paid under 2.5 NMW in total costs. In the market sector, these three sectors rank respectively first, third and forth when classified along this share. On the second rank we find the accommodation and food service activities, that are insignificantly represented in our PPI sample and therefore not studied here. However, other authors have found a significant pass-through of labor cost, at least as the NMW is concerned. Remaining services sectors do not display any significant reaction, in line with a relatively lower share of wages under 2.5 the NMW in costs (under 20%).

In the industry sectors, pass-through is more scattered and estimation procedures are less precise. The shares of cost affected by the policy do not differ much across industrial sectors and are considerably lower than services shares (from 10% to 20%, with a majority close to 15%). Most elasticities are negatives, and we only measure a significant pass-through for a single sector (metallurgy), that overshoots what could be expected from the eligible cost. In contrast, the (instantaneous) elasticity of price to input prices is high and significant for virtually all industrial sectors, while this result is not systematic in the service sectors estimations. All in all, we estimate significant pass-through where the eligible labor cost is the most prominent in total cost.

The remainder of the paper is organized as follows. We present the institutional context and the data in the first section. A second section introduces our empirical framework, briefly reviewing theoretical elements on price setting. In particular, we motivate the use of a factor model in the context of price setting. We discuss our main results in a third section.

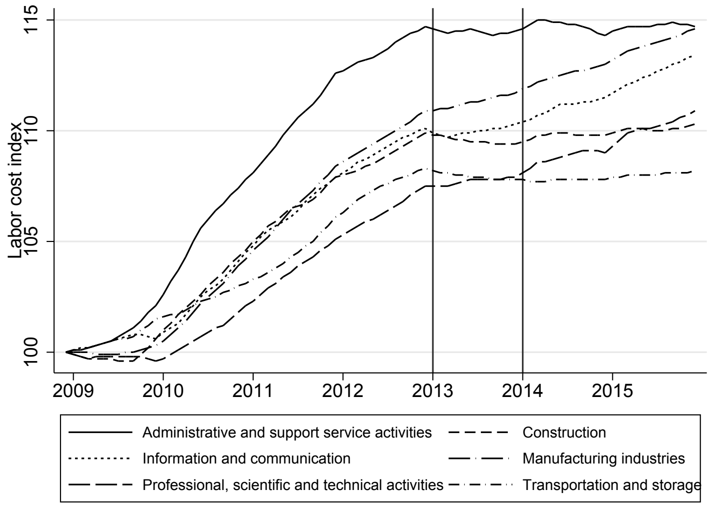
1 Institutional context and data

1.1 The policy

The CICE was intended as a response to tackle two connected but different issues : a high unemployment rate (9.4 % in average in 2012) and a lack of competitiveness. The policy was announced in the last quarter of 2012, only a few months after the presidential election of François Hollande. This policy was not part of his program and was announced following an official report on France lack of competitiveness. The policy consists in a corporate tax credit computed as a share (4% in 2013, then 6 % in 2014, 2015 and 2016 and 7% in 2017) of all wages paid by the firm under 2.5 times the minimum wage. As a comparison, former policies aiming at reducing labor costs with the reduction of employer contribution to social security only includes wages under 1.6 times the minimum wage. Therefore, the CICE decreases labor cost on a large scale, including medium to high wages in order to keep competitive and industrial firms with relatively high wages among beneficiaries. The wedge for public finance was high, about 20 billions a year, 1% GDP. The CICE implementation in 2013 and its scaling up in 2014 constitute a major break in the evolution of firms labor costs, after four years of continuing increases, as depicted in figure 1.

As a corporate tax credit, the CICE is not immediately deductible from wage bill or social security contribution that firms have to pay every month [1]. For instance, the actual benefit outflows generated by wages paid in 2013 became effective in mid 2014, when firms deducted the tax credit due for wages paid in 2013 from the corporate tax on 2013 benefits. Knowing

1. Except for SMEs and some high-technology and young firms that could benefit from an «immediate» restitution, at least before the tax payment.



Source : Insee, base : 100 in december 2008.
Vertical bars are the CICE implementation (January 1st, 2013), and its scaling up (January 1st, 2014)

FIGURE 1 – Sectoral labor cost indexes and CICE implementation

their year wage structure, firms could perfectly anticipate the tax credit due to this policy and rapidly adapt their economic behavior, including price policy. Plus, firms had the possibility to get a CICE "pre-funding" at their bank with a factoring contract including a third party : the French Investment Public Bank (BPIFrance). In practice, firms could borrow the expected CICE amount to their bank, and this loan was guaranteed by BPIFrance, which would then become the holder of the CICE. However, the delay between the operative event and the effective benefit leads us to expect a relatively long-time needed to observe an effective pass-through.

At the firm level, employment responses could interfere with price responses. However, recent research [2] suggest very limited, if not nonexistent, employment effects in the short-run (2013 to 2015). There is some evidence that instead, firms passed part of the benefit to wages. In what follows, we restrict ourselves to the price response. Impact on domestic prices turns out to be an unexpected yet relevant question. First, the 2014 business outlook survey led by INSEE (French statistical public institute) revealed that 32 % of industrial firms and 30 % in services (up to nearly 60% in administrative and support services) intended to use the CICE to lower their selling prices. Second, in June 2013, several complaints were filled regarding a "CICE extortion", consisting for ordering customers to require retroactive rebates to their subcontractors on the ground that subcontractors costs were actually lowered thanks to the CICE. Even though the administration clearly stated that the policy implementation was not a justification to retroactively re-negotiate passed contracts, this "CICE extortion" case is a clear evidence that the CICE had an impact on price negotiations between firms, which were free to take it into account for regular contract re-negotiation. These two facts are qualitative evidence that allow us to inspect closer the firms price response to the CICE.

2. Three research teams were asked to evaluate the policy on a number of channels (employment, wages, margins, exports, investments) : Gilles et al. [2016], Carbonnier et al. [2016], Guillou et al. [2016].

1.2 Data

1.2.1 Scope of the study

We study prices set by a unbalanced panel of French firms over the period 2009-2015. We are interested in two observed labor cost shocks : for wages paid in year 2013, firms were given a tax credit equal to 4% of the wage bill for workers paid under 2.5 times the minimum wage. For wages paid in 2014 and 2015, the rate was increased from 4 % to 6%. Because common shocks may differ dramatically between sectors (e.g. between industrial sectors subject to international competition and specialized construction for private housings, or between technology and skilled intensive services and firm administrative and support services), we divide our sample into 16 sectors. As a rule, we work on the sectors defined by the NAF-A38 [3], which is an intermediate level between the levels 1 and 2 of the NACE. When there were too few firms at this aggregation level, we grouped them to a higher level as specified in table 1. We excluded specific sectors with too few firms and for which no natural higher group arises (excluded sectors are with the corresponding NACE code, B-mining and quarrying, D - electricity, gas, steam and air conditioning supply, E - water supply, sewage, waste management and remediation activities, 20-21 - Manufacture of chemical - pharmaceutical products and L -real estates activities). In average, our sample contains about 250 firms per sector, with a minimum of 78 and a maximum of 461 firms. Note that among the market sectors, we most notably miss wholesale and retail trade and accommodation and food services. These two sectors are not surveyed for Producer Price Index as their clients are primarily households. At the A38 level however, administrative and support service activities (NACE N) comprises rental and leasing activities (NACE 77) which is way less exposed to the policy than the other sub-sectors. Therefore, we also study the sector of administrative and support service activities, excluding rental and leasing activities.

1.2.2 Treatment variables

We call "exposure to CICE" the ratio of the tax benefit due to the firm for the policy on its wage bill. We call "treatment" the labor cost reduction implied by the CICE compared to the preceding year. Since the policy was implemented in 2013 and scaled up in 2014, the treatment variable can take two distinct values for each firm. We use two distinct data sources to compute two distinct treatment variables : one based on the ex-ante exposure (according to past wage bill structure) and the other on contemporaneous exposure (according to the perceived tax credit). The MVC (*Mouvements sur créances*), database is provided by the DGFiP (*Direction Générale des Finances publiques*, the french tax administration). It contains all the effective beneficiaries of the tax credit with the amount due by the state by year and firm. However, and since the tax benefit implied by the policy is computed according to contemporaneous wages, the contemporaneous tax benefit are likely to reflect employment decision of a firm. For instance, a firm may have hired a worker under 2.5 NMW in 2013 thanks to the labor cost reduction policy, which would introduce a simultaneity bias in our estimations. To gauge the extent of this problem, we build a second treatment variable as an intention-to-treat given by the *ex ante* exposure to the CICE. This approach is close to that of Carbonnier et al. [2016]. To that end, we use the DADS (*Déclaration annuelle des données sociales*, Annual Social Data Declaration) files, computed by Insee, which provide wages at the worker-firm-year level. We are therefore able to construct a variable representing the fictive ex-ante (in 2012) decrease in total cost based on the feature of the policy. More precisely, we build an eligible wagebill by adding all wages under 2.5 NMW, and apply the effective rate (4 or 6 %) to compute the amount of tax credit due to the firm. The MVC files allow us to check both the take-up rate and the quality of our reconstruction, since we can compute the expected tax credit with social data and compare it with the fiscal information (see figure 7, in appendix B).

3. Nomenclature des activités française, 38 sectors aggregation

Aggregate sector	N. firms	NACE	Average treatment in 2013	σ
Food, beverage industry	368	10-11-12	2,69	0,83
Textile, apparel	185	13-14-15	2,63	0,72
Wood, paper, printing	241	16-17-18	2,85	0,67
Rubber, plastic and non-metallic mineral prod.	287	22-23	2,60	0,73
Metal products	324	24-25	2,84	0,65
Computer, electronic, electrical prod. and equip.	325	26-27-28	2,27	0,74
Manufacture of transport equipment	78	29-30	2,64	0,80
Other manufacturing	189	31-32-33	2,14	0,91
Specialised construction activities	348	F	3,29	0,73
Transportation and storage	461	H	3,42	0,80
Publishing, programming, broadcast, telecom.	168	58-59-60-61	1,10	0,75
Computer and information services	97	62-63-95-96	1,20	0,85
Professional, scientific and technical acti.	291	M	1,81	1,13
Administrative and support services acti.	310	N	2,23	1,14
- *excluding rental and leasing activities (77)*	187	78-79-80-81-82	2,95	1,05

Note : From sectors originally present in the survey, we group and operate selection so as to obtain per-sector sample with enough firms.
Average treatment and standard deviation (σ) in %.

TABLE 1 – Sample sectors

1.2.3 Product-firm level price data

We use individual data from the french PPI survey OPISE (Price Observation in Industry and Services or *Observation des Prix dans l'Industrie et les SErvice*), conducted by Insee (French public statistical office), aiming at computing and publishing monthly (for industry) and quarterly (for services) producer price indexes at various levels of aggregation. These indexes are especially used as deflators for macroeconomic aggregate values, or as reference for long-term contract indexation. The survey is led over a sample of 6 500 firms (4 200 in manufacturing industry, 1 700 in services and 600 in Specialized construction activities). In practice, when a firm is selected into the survey sample, the statistical office pollsters identify some regular sale transactions that reflect the core business of the company (in average, 6 prices are measured in a firm). These prices can be, for example, the price of a certain reference of bed for a furniture company, the average hourly price of a junior consultant in a consulting firm, or the per-kilometer-per-ton tariff of a road transport company. The surveyed companies then report every month (in industry) or every quarter (in services) the price they charge for these well identified transactions. The statistical office turns these prices into price indexes for each individual response (firm$\times$product), which are used to compute producer price indexes at various levels of the product classification.

We use the firm$\times$product price indexes to compute quarterly price variations, then aggregate prices variations at the firm level, using the survey weights and obtain an unbalanced panel of firm-level price variations. In order to merge this data set with the treatment data set and study its impact, we select firms that are continuously present in 2013 and 2014, year of implementation and year of policy scale-up. We also withdraw a negligible percentage of firms with at least one price increase of more than 100% a given quarter. We thus obtain an unbalanced panel with about 4 000 firms and 28 quarters (2009-2015) for about 80 000 price observations.

1.2.4 Control variables

Besides the treatment, we include intermediate consumption price variation as a control variable. We use production prices and the input-output matrix at a detailed level (129 sectors) to compute intermediate consumption prices for each firm belonging to a sector as the production prices average weighted by the share of sectoral consumption in total intermediate consumption [4].

We also compute and include as control some relevant economic variables prone to have an effect on pricing behaviour. Labor productivity (ratio of value-added over workforce) and profit margin (gross operating surplus over value-added) are two measures of economic efficiency ; capital intensity (fixed assets over value-added) can be seen as a proxy for competition intensity as it may reflect the level of barriers to entry with sunk capital cost ; the value-added ratio (value-added over total sales) is a measure of the vertical integration of the firm in its business line. Finally, the export rate (ratio of export sales to total sales) is regularly cited as a key variable in pricing behavior ((18), (8)). As yearly values, they are introduced in levels in our quaterly specification. However, results remains unchanged if we do not include them. All these variables are computed with the FARE database, provided by the French national statistical institute Insee, on the basis of annual compulsory tax forms filled by the universe of French firms [5]. These rich files contain annuals sales, in France and abroad, detailed expenses (purchase of goods, raw materials, wagebill, social security charges, financial charges, taxes . . .), balance sheet information (tangible and intangible assets, equity, debts. . .), as well with additional information (sector of activity, workforce. . .).

1.3 Summary statistics

1.3.1 Sectoral cost structure of firms in France

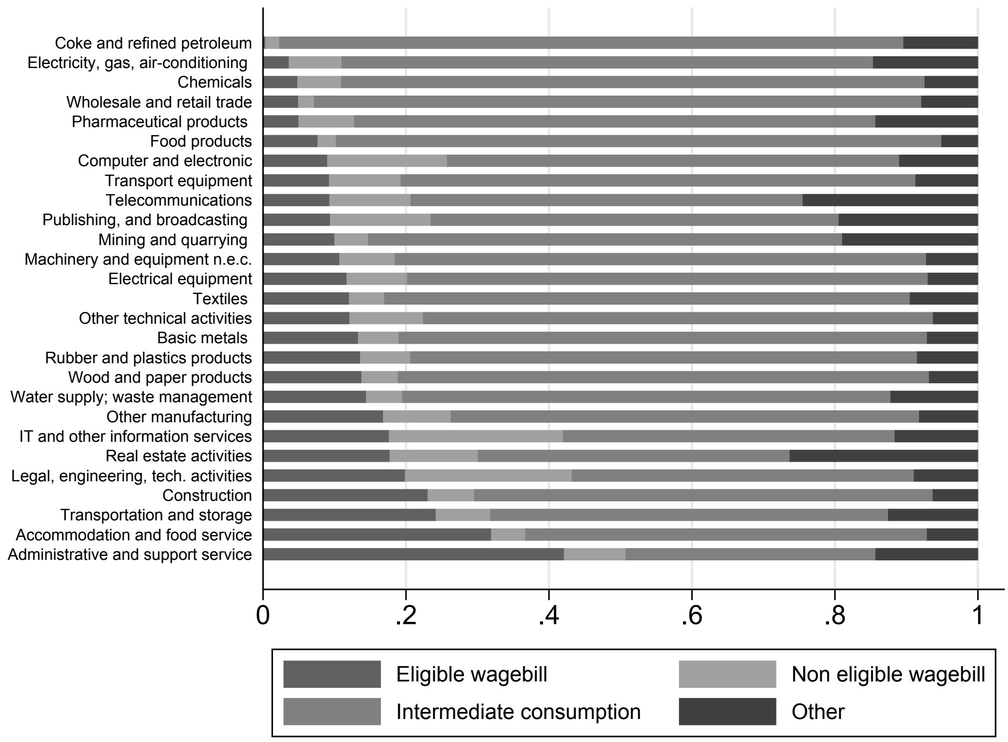
We show in figure 2 the total costs breakdown in the eligible and non eligible wagebill (including employer contributions), intermediate consumption (purchase of primary inputs, merchandises and external charges), and other costs (capital charges and taxes). Sectors are ranked according to the share of eligible wage bill in total costs. Most industrial sectors can be found at the bottom end of the ranking, with an overwhelming share of intermediate consumption. Services sectors use far more labor in proportion, with a heterogeneity in the use of highly remunerated labor. For instance in IT services, labor cost represents 40% of costs, but eligible wages less than 20%. At the top of the ranking are low-wages and labor-intensive services sectors. The precise share for sectors falling in our scope, and measured for our sample, are shown jointly with our results.

1.3.2 Surveyed firms

Our sample comprises firms that represent a disproportional share of the total tax credit, as figure 3 illustrates. But, in average the reduction in cost is lower for them than for the universe of beneficiaries. They are larger firms intended to represent a high share of market transactions to build the PPI index, and they pay higher (non all eligible) wages. The survey is very representative of large firms : from the universe of firms paying corporate tax, 50% of firms over 500 employees

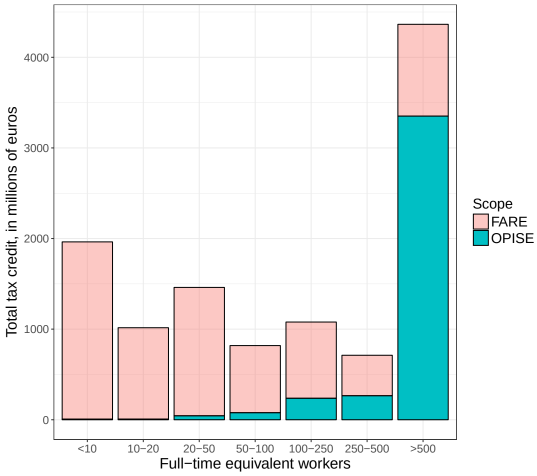
4. We also ran our procedure with intermediate consumption price index interacted with the share of intermediate consumption in total operating costs at the individual level, for similar results

5. Except for the financial and agricultural sectors.

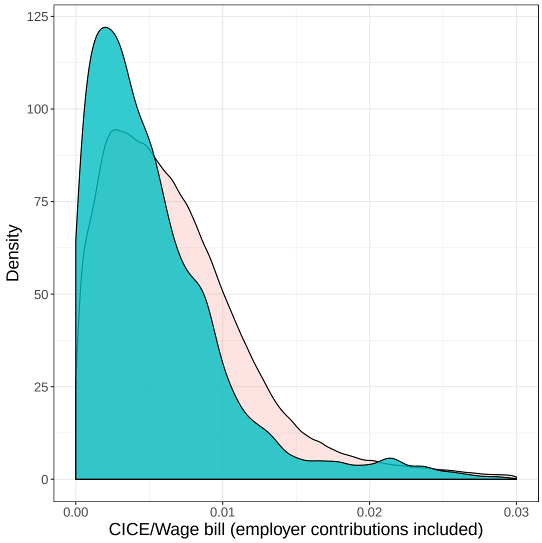


Note : Other costs are capital costs (financial and depreciation charges) and taxes other than value-added tax
Eligible wagebill is the share of labor paid under 2.5 NMW

FIGURE 2 – Cost structure of the universe of French firms, at the exception of agriculture and finance.



(a) Total CICE amount by size and sample



(b) CICE exposure by sample

FIGURE 3 – Surveyed firms (OPISE) compared to other firms (FARE) : a high amount of tax credit in value, a lower share of wage bill eligible to the tax credit

and 34% of firms between 250 and 500 employees are surveyed on their prices. It is still 8% of firms between 50 and 100 employees and falls sharply for smaller firms. Figure 3 also shows that there remains significant heterogeneity in CICE exposure.

1.3.3 Treatment statistics

Contemporaneous treatment (CICE over wagebill in 2013) and ex ante treatment (fictive CICE in 2012/wage bill in 2012) are highly correlated, as depicted in figure 4, because exposure to CICE is primarily a measure of the wage structure of a firm, which is not subject to large short term variations. The average ex ante exposure to CICE in 2012 is not even significantly different from the contemporaneous exposure in 2013.

1.3.4 Prices

We compare basic price summary statistics before and after the policy implementation in table 2. In average on all firms in the sample, quarterly price variations are 0,62% in 2009-2012, and 0,13% in 2013-2015, confirming the global price moderation movement starting in 2013. All industrial sectors and construction have moderate their prices in 2013-2015 compared to 2009-2012. Prices have even decreased in agri-food industry and metallurgy. In service sectors, transports and storage firms have strongly moderated their prices in 2013-2015, leading to a near zero average quarterly price variation, which may be accounted for by the relative oil price evolution on the two periods. Information and communication sector as well with administrative and support service activities also experienced lower price increases. In computer sciences activities as well as in scientific and technical activities, we do not observe price moderation in 2013-2015 compared to 2009-2015. It is worth noticing that price variations exhibit considerable dispersion illustrated with the standard deviation, even within narrowly defined sectors.

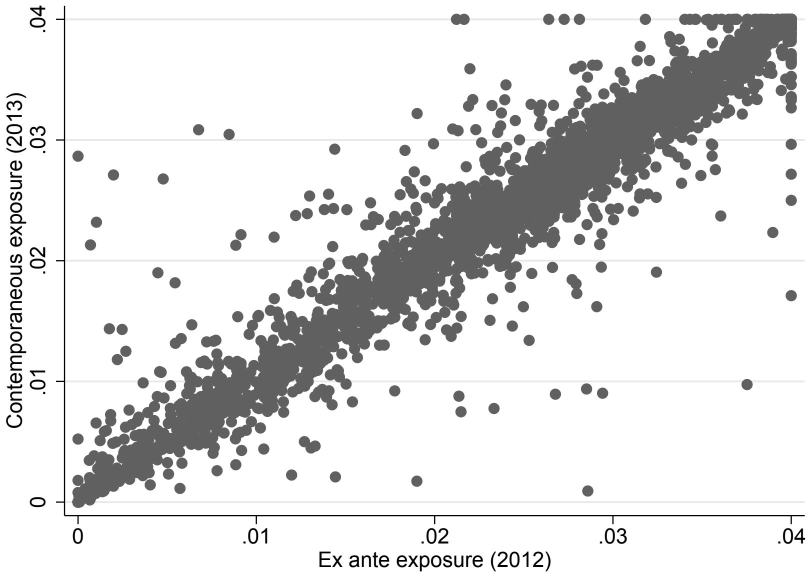


FIGURE 4 – Ex ante and contemporaneous exposure for firms in the survey sample

2 The econometric model

2.1 Some theoretical elements on price setting

As standard in the cost pass-through literature ((8), (7)), we assume that firms are cost minimizing with an objective of production and input prices taken as given. In the simplest model of competitive and price-taker firms that can adjust freely all factors of production, the zero profit condition imply that the decrease in marginal cost is entirely passed on to consumer. Denoting price p, c the unit cost of labor targeted by the policy (paid under 2.5 NMW) and s the share of that type of labor in the firm total costs, output price elasticity with respect to c writes :

$$\frac{d\ln p}{d\ln c} = s$$

Aaronson and French (2008) showed that this result could be extended to monopolistically competitive firms, as long as the elasticity of demand was constant. This highly stylized model gives us guidance on what can be expected at first order, in particular according to different production functions. Hence, we do not expect to observe the same pass-through in sectors where s is over 40% (for instance support and administrative services to firms, including cleaning, call-centers, security activities..) and sectors where this share is of the order of 5 to 15 %, either because of an intensive use of other factors (e.g. industrial activities) or because of a high-skilled composition of labor (e.g. specialized services such as informatics or consultancy). We acknowledge that this share is a source of heterogeneity in potential price response and tackle this issue by running elasticity estimations for each sector defined in table 1.

2.2 A factor model

Our empirical strategy is based on a factor model estimated with the method proposed by (3). It allows to control for difference in quartely-observed behaviour of a set of price-setters, as long as common shocks to prices apply with individual and permanent loadings. It relaxes the common trend assumption : the two-way fixed effects framework is nested into this specification, but

Sector	2009-2012		2013-2015	
	π	σ_π	π	σ_π
Food, beverage industry	1,25	5,38	-0,06	3,71
Textile, apparel	0,93	8,77	0,74	6,96
Wood, paper, printing	0,28	4,43	0,10	2,99
Rubber, plastic and non-metallic prod.	0,61	4,69	0,06	3,75
Metal products	0,83	5,39	-0,02	4,21
Computer, electronic, electrical prod. and equip.	0,41	4,63	0,11	3,91
Manufacture of transport equipment	0,76	5,33	0,05	2,35
Other manufacturing	0,54	5,83	0,24	4,53
Specialised construction activities	0,25	2,85	0,09	1,96
Transportation and storage	0,42	2,56	0,06	1,90
Publishing, programming, broadcast, telecom.	0,77	7,24	0,45	6,22
Computer and information services	0,09	4,62	0,15	3,44
Professional, scientific and technical acti.	0,27	6,92	0,28	5,06
Administrative and support services acti.	0,51	5,27	0,11	3,74
- *excluding rental and leading activities (77)*	0,53	3,87	0,16	3,57
All firms	0,62	5,16	0,13	4,22

Note : Source : OPISE-FARE-MVC. Average quarterly price variation π and standard deviation (σ_π) (in %)

TABLE 2 – Average quarterly price variations

common shocks do not affect necessarily all the units the same way. Importantly, this estimation strategy allows unobserved factors to be correlated with the treatment variable.

The econometric equation can be written as follows, for quarter t, year $\mathrm{y}(t)$, firm $i \in \mathcal{I}$, a group of price setters, and $\pi_{it} = \ln\left(\frac{p_{i,t}}{p_{i,t-1}}\right)$ the price variation between $t-1$ and t,

$$\pi_{i,t} = \sum_{k=0}^{K} \gamma_k C_{i,t-k} + \gamma \pi^{\mathrm{CI}}_{J(i),t} + X_{i\mathrm{y}(t)} b + \lambda_i' F_t + \epsilon_{i,t} \tag{1}$$

where $C_{i,t}$ is the treatment at quarter t, $\pi^{\mathrm{CI}}_{J(i),t}$ is the intermediate consumption price variation of the thin sector to which firm i belongs, which can contemporaneously affect prices. A set of firm annual explanatory variables $X_{iy(t)}$ detailed in section 2 is introduced as a control, but do not influence our results. Then,

$$\lambda_i' F_t = \sum_{k=1}^{R} \lambda_{ik} F_{tk}$$

represents the scalar product of R-sized vectors λ_i and F_t, respectively standing for $|\mathcal{I}|$ individual factor loadings λ_i for each R common shocks F_t specific to $\mathcal{I}$. Both λ_i and F_t are estimated from the data, leveraging correlations between price time-series. Starting with $R = 2$, with $F_t = c(1, \delta_t)$ and $\lambda_i = (\alpha_i, 1)$, $\lambda_i' F_t = \alpha_i + \delta_t$ nest the two-way fixed effects. The set of R time series F_t can be thought of as generating seasonal variations, demand shocks, oil-price shocks... The R-sized vector λ_i represents the specific dependence of firm i to the R common shocks F_t. Finally, $\epsilon_{i,t}$ is an idiosyncratic perturbation.

We specify the treatment variable as

$$C_{it} = 1\{t = 2013 - Q1\}\Delta C_{2013} + 1\{t = 2014 - Q1\}\Delta C_{2014}$$

where ΔC_y is the cost reduction implied by the tax credit for wages paid year y with respect to year $y-1$. For firms with all workers under 2.5 the NMW, the reduction is a permanent reduction of 4% in the first year, of about 2% the second year (when the rate growth from 4 to 6%) of the gross wage. Taking into account employer social contributions as part of the labor cost implies that ΔC is slightly less. For year 2015, the reduction incurred in 2014 still applies, but there is no variation in cost reduction due to the CICE [6]. We tried two treatment variables. The first is a straightforward measure of the reduction of cost, using the contemporaneous tax-credit as recorded by the fiscal administration : $\Delta C_y = \frac{CICE_y - CICE_{y-1}}{\text{Total Wage Bill}_y}$. The second use past wage structure to compute an ex-ante exposure to the tax-credit : by summing wages under 2.5 NMW paid at the firm level over all wages and multiplied by the appropriate rates : $\Delta C_y^{\text{ex-ante}} = (\tau_y - \tau_{y-1}) \times \frac{\text{Eligible Wage bill}_{2012}}{\text{Wage Bill}_{2012}}$. Note that we use in the denominator the gross wage bill, employer social contribution excluded, so as to use the same data than for the denominator (DADS). The lagged specification allows firms to react as soon as wages they pay generate the tax credit and as far as two-year after ($K = 7$), because of the uncertainty on the time when firms integrate into their decisions this amount (e.g. as soon as it can be predicted to when it is cashed in). In particular, we report the two-year pass-through $\beta = \sum_{k=0}^{7} \gamma_k$, as well as the instantaneous pass-through of input prices to prices, γ.

We define homogeneous group of price-setters on a sectoral basis as explained in the data section, so that F_t can be thought of as common shocks at a quite disaggregated level. The choice of the number of factors R is a delicate problem : it is often arbitrarily fixed. To avoid an *ad hoc* choice, we present the number of factors resulting from the test by (4) that balances goodness-of-fit with the number of parameters in a Akaike-like manner. This test is conducted on several balanced panels build from our unbalanced panel, by trading-off firms representation and time-period representation. We check the sensitivity of our results to the number of factors.

As the panel is unbalanced, due most notably to the increased production of price index for services, we adapt the estimation procedure as suggested by (3) with an EM (expectation-maximisation) algorithm, that is described in appendix A.

3 Results

Based on this empirical framework, we analyze the price response of firms to a labor cost shock. We test whether there are between-sector differences price elasticity w.r.t targeted labor cost, in particular in relation to the share of total cost concerned with the cut. We first present the two-year pass-through by sectors, $\beta = \sum_{k=0}^{7} \gamma_k$ in table 3, with the instantaneous elasticity of prices w.r.t input prices.

We find a clear contrast between service sectors highly exposed, for which the labor-cost pass-through is negative and significant and others services for which estimates are sometimes positive but not significant. Estimates are precise in few cases : only sectors for which the share of eligible cost is over 20% of cost have standard errors of the order of 0.1. Second, among highly exposed services sectors, the ranking of the elasticity point estimate as measured by effective

6. At least, not due to a scaling up of the policy. If the firms highers more or less workers paid under 2.5 times the NMW, its exposure varies. We do not take into account this marginal variation.

Services				**Price elasticity**		
				Labor cost (two-year)		Input prices (instant.)
				Effective	Ex-ante	
Sector	Share	Firms	Obs.	(1)	(2)	(3)
Publish., program., broadc.	0.09	168	3559	−0.14	−0.51	0.20
				(0.58)	(0.54)	(0.12)
Professional, scientific, tech.	0.17	291	5689	0.40	0.38	0.38
				(0.33)	(0.23)	(0.08)
Computer, information services	0.18	97	1833	0.76	0.63	0.08
				(0.51)	(0.39)	(0.09)
- Share of eligible cost among total cost over 20%						
Specialised construction	0.23	348	5234	−0.28	−0.10	−0.03
				(0.11)	(0.08)	(0.06)
Transportation and storage	0.24	461	11428	−0.16	−0.15	0.06
				(0.08)	(0.07)	(0.01)
Administrative and support	0.42	310	6880	−0.23	−0.31	0.10
services activities				(0.13)	(0.11)	(0.04)
id. excluding rental, leasing	0.53	187	4277	−0.48	−0.43	0.11
				(0.14)	(0.12)	(0.04)

Industry				**Price elasticity**		
Sector	Share	Firms	Obs.	(1)	(2)	(3)
Food and beverages	0.08	368	8051	0.04	−0.11	0.26
				(0.21)	(0.18)	(0.03)
Manuf. of transport equip.	0.09	78	1695	−0.35	−0.26	0.58
				(0.34)	(0.24)	(0.14)
Computer, electronic, electrical	0.11	325	6186	−0.22	−0.12	0.17
				(0.35)	(0.21)	(0.05)
Textiles, apparel	0.12	185	3324	−0.31	0.61	0.38
				(0.44)	(0.39)	(0.08)
Metal products	0.13	324	6836	−0.73	−0.53	0.75
				(0.22)	(0.18)	(0.04)
Rubber, plastic	0.14	287	6194	−0.22	−0.25	0.06
				(0.22)	(0.18)	(0.02)
Wood, paper, printing	0.14	241	5178	0.45	0.38	0.16
				(0.18)	(0.15)	(0.03)
Other manufacturing	0.17	189	3879	−0.21	−0.25	0.12
				(0.31)	(0.28)	(0.05)

Note : Column (1) and (2) show the two-year pass-through $\beta = \sum_{k=0}^{7} \gamma_k$, depending on whether the exposure variable is defined as effective cost decrease or as an ex-ante, predicted cost decrease. Column (3) shows the input price elasticity as captured by γ in equation 1.

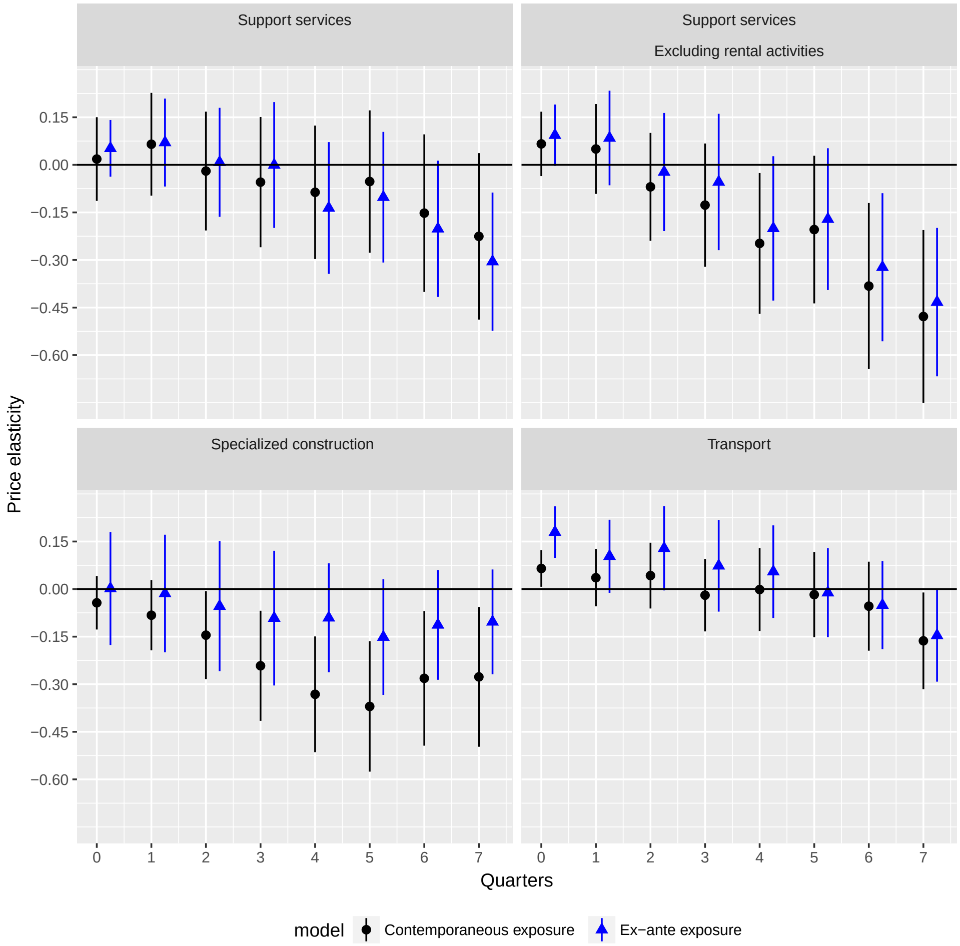
Table 3 – Elasticity estimated from equation 1

exposure match the ranking of the eligible share of cost. In particular, excluding rental activities from administrative and support services let this sector share of eligible cost go up from 42 to 53% (in a sense, this sector sells primarily labor). Concomitantly, the measured two-year pass-through increases to amount to −0.48 (0.14) and −0.43 (0.12) depending on the exposure variable considered. Thus, though imprecisely estimated, these elasticities are coherent with an almost full pass-through. Nonetheless, except for this particular sector, we find a high but incomplete pass-through : transportation and storage, with a share of eligible cost of 24% has a two-year elasticity of −0.16 (0.08). For specialized construction, results are sensitive to the exposure variable considered, with significant elasticity with effective exposure but smaller with ex-ante exposure. This might reflect that those who recruited in this sector and altered their mix of factors in favor of labor remunerated below 2.5 NMW are also those who cut their prices the most. Third, in these sectors, the elasticity with respect to input prices is notably low i.e. under 10%.

Regarding industry, results are more scattered : if most labor-cost elasticity point estimates are negative, few are significant. In particular, metallurgy appears to have a high pass-through of both labor cost and input prices (−0.73 (0.22) and 0.75 (0.04)). In contrast with services, input prices pass-through is pervasive and high, and always significant : ranging from the highest 0.75 (0.04) in metallurgy, it is 0.58 (0.14) in transport equipment, and 0.38 (0.08) in textiles and apparel manufacturing. Four other manufacturing sectors range between 0.12 and 0.26 while the lowest elasticity is found for rubber and plastic manufacturing with 0.06 (0.02).

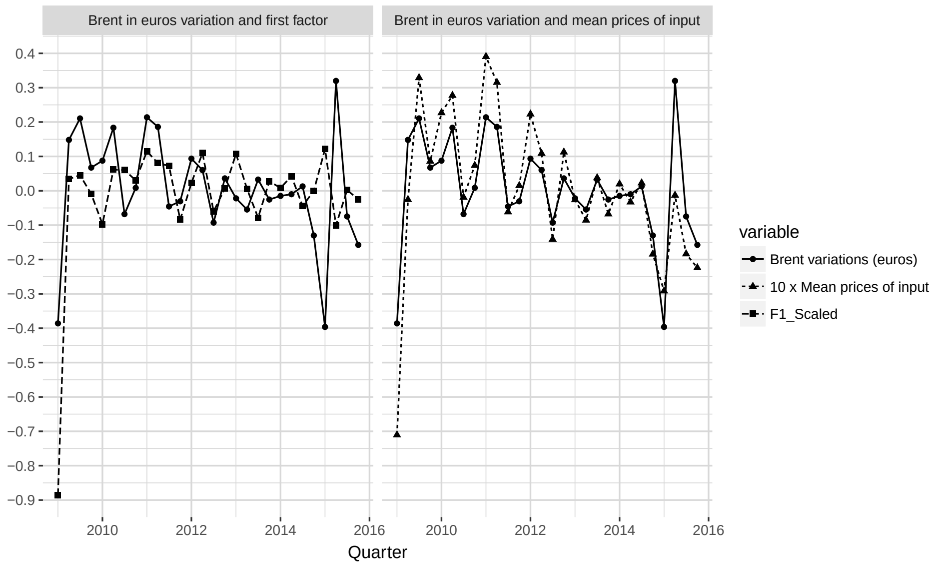
Looking at dynamic responses for services, we find that pass-through takes time. Taking the effective cut in cost leads to higher and quicker responses compared to the predicted one. In the administrative and support services, excluding rentals, the answer materializes after a year. In the transport sector, if the tendency is slowly decreasing, significant pass-through appears at the end of the second year. Specialized construction is particular is the sense that contemporaneous exposure leads to significant effects as soon as the third quarter, while ex-ante exposure leads to non significant effect at 5%.

Our estimation strategy relies on statistical assumptions regarding common shocks faced by firms within a sector. In order to illustrate the power of the method, we show that it is able to find oil variations from firms' prices times series in the transportation and storage sector. Aside supporting our statistical model, it stresses that we carefully take into account the important oil price variations in our studied period (that are already partially taken into account by the input price control, as shown in figure 6). More precisely, when input prices are included in the model, the first factor still mimics the variation of oil price, in an increasingly delayed manner. Therefore, we are not only controlling for the direct effect of the variation of prices input but also for potentially lagged responses, as found in the data. We also allow for differentiated responses : in the figure 6, we represent the first factor scaled with the maximal firms' loading (or sensitivity), but many firms do not show such a sensitivity. Note that if we withdraw input prices from the model and regress oil prices variation over the new set of factors, the R^2 goes from 0.31 to 0.42 : in the absence of an important determinant, factors are found capable to compensate.



Note : 95% confidence intervals for $\sum_{k=0}^{t} \gamma_k$ are represented.

FIGURE 5 – Dynamics of the pass-through of labor cost in the 4 sectors with the highest share of labor under 2.5 times the NMW in their cost



Note : Prices of input directly reflect Brent variations (right panel). On top of this direct control, the first factor of the decomposition (scaled with $\max(\lambda_i^1)$, the maximum sensitivity among firms i) mimics those variations in an increasingly delayed manner (left pannel).

FIGURE 6 – On the role of oil prices in the transportation sector.

Conclusion

We use a large, negative and unanticipated labor cost shock to estimate the output price elasticity with respect to a large share of labor cost, on a novel data set at the individual level. We use a factor model to control for unobserved sectoral common shocks while allowing a high heterogeneity in price setting behavior between firms within a given sector.

Our results indicate that labor cost shocks are passed on to clients when labor represents a significant part of firms costs. Although natural and intuitive, this hypothesis was only tested for few sectors. The scope of our dataset enables us to consistently extend this result to specialized construction, transportation and storage, and administrative and support services. However, we do not find evidence of a significant pass-through in most industry sectors that we link with a larger reliance on intermediate consumption over labor cost in price setting decisions (see for instance Ganapati et al. [2016] in the US industry). In light of our results, if the CICE somehow played a role in the price competitiveness of French firms, we find that it does so mostly for services sectors that are not as exposed to international competition as is industry.

Références

[1] Aaronson, D. Price pass-through and the minimum wage. *Review of Economics and statistics 83*, 1 (2001), 158–169.

[2] Aaronson, D., French, E., and MacDonald, J. The minimum wage, restaurant prices, and labor market structure. *Journal of Human Resources 43*, 3 (2008), 688–720.

[3] Bai, J. Panel data models with interactive fixed effects. *Econometrica 77*, 4 (2009), 1229–1279.

[4] Bai, J., and Ng, S. Determining the number of factors in approximate factor models. *Econometrica 70*, 1 (2002), 191–221.

[5] Boivin, J., Giannoni, M. P., and Mihov, I. Sticky prices and monetary policy : Evidence from disaggregated us data. *The American Economic Review 99*, 1 (2009), 350–384.

[6] Carbonnier, C., Fredon, S., Gautier, B., Malgouyres, C., Mayer, T., Py, L., Rot, G., and Urvoy, C. Evaluation interdisciplinaire des impacts du cice en matière de compétitivité internationale, d'investissement, d'emploi, de résultat net des entreprises et de salaires. *Rapport d'évaluation pour France Stratégie* (2016).

[7] Carlsson, M., and Skans, O. N. Evaluating microfoundations for aggregate price rigidities : evidence from matched firm-level data on product prices and unit labor cost. *The American Economic Review 102*, 4 (2012), 1571–1595.

[8] De Loecker, J., and Warzynski, F. Markups and firm-level export status. *The American Economic Review 102*, 6 (2012), 2437–2471.

[9] Fabiani, S., Druant, M., Hernando, I., Kwapil, C., Landau, B., Loupias, C., Martins, F., Mathä, T., Sabbatini, R., Stahl, H., et al. The pricing behaviour of firms in the euro area : New survey evidence.

[10] Fougère, D., Gautier, E., and Le Bihan, H. Restaurant prices and the minimum wage. *Journal of Money, Credit and Banking 42*, 7 (2010), 1199–1234.

[11] Ganapati, S., Shapiro, J. S., and Walker, R. The incidence of carbon taxes in us manufacturing : Lessons from energy cost pass-through. Tech. rep., National Bureau of Economic Research, 2016.

[12] Gilles, F., Bunel, M., L'Horty, Y., Mihoubi, F., and Yang, X. Les effets du cice sur l'emploi, les salaires et la r&d : une évaluation ex post. *Rapport d'évaluation pour France Stratégie* (2016).

[13] Gobillon, L., and Magnac, T. Regional policy evaluation : Interactive fixed effects and synthetic controls. *Review of Economics and Statistics 98*, 3 (2016), 535–551.

[14] Guillou, S., Sampognaro, R., Treibich, T., and Nesta, L. L'impact du cice sur la marge intensive des exportateurs. *Rapport d'évaluation pour France Stratégie* (2016).

[15] Hagedorn, M., Manovskii, I., and Mitman, K. The impact of unemployment benefit extensions on employment : The 2014 employment miracle ? Tech. rep., National Bureau of Economic Research, 2015.

[16] Kim, D., and Oka, T. Divorce law reforms and divorce rates in the usa : An interactive fixed-effects approach. *Journal of Applied Econometrics 29*, 2 (2014), 231–245.

[17] Loupias, C., and Sevestre, P. Costs, demand, and producer price changes. *Review of Economics and Statistics 95*, 1 (2013), 315–327.

[18] Manova, K., and Zhang, Z. Export prices across firms and destinations. *The Quarterly Journal of Economics 127*, 1 (2012), 379–436.

[19] Montalioux, C., Renkin, T., and Siegenthaler, M. The pass-through of minimum wages into us retail prices : evidence from supermarket scanner data. Tech. rep., 2017.

A EM algorithm

As suggested by (3), we implement the two nested loops :

— External loop : At step h, consider $\hat{F}^{(h)} \in \mathbb{R}^T$ where $T = \max(T_1, \cdots, T_N)$.

— Internal loop : At step m, For non missing observations, set $W_{it}^m = \pi_{it} - C_{it}\beta^{(h)}$, for missing observations, set $W_{it}^m = F_t^{(m-1)}\lambda_i^{(m-1)}$. Produce the factor decomposition of $W^m W^{m\prime}$. Iterate until convergence, then set $F^{(m_{final})} = F^{(h+1)}$. Then compute

$$\hat{\beta}^{(h+1)} = \hat{\beta}(\hat{F}^{(h+1)}) = (\sum_{i=1,t=1}^{N,T_i} X_{it}X_{it}')^{-1} \sum_{i=1,t=1}^{N,T_i} X_{it}(\pi_{it} - \lambda_i^{(h+1)\prime} F_t^{(h+1)})$$

Standard errors are computed in the same way as for a balanced panel since we do have a balanced panel for explanatory variables. Taking into account heteroskedasticity, we compute :

$$\widehat{var}(\hat{\beta}) = \left(\frac{1}{NT}\sum_{i=1,t=1}^{N,T} Z_{it}Z_{it}'\right)^{-1} \sum_{i=1,t=1}^{N,T} \hat{\epsilon}_{it}^2 Z_{it}Z_{it}' \left(\frac{1}{NT}\sum_{i=1,t=1}^{N,T} Z_{it}Z_{it}'\right)^{-1}$$

where Z_i is defined in (3), p. 1241.

B Complements

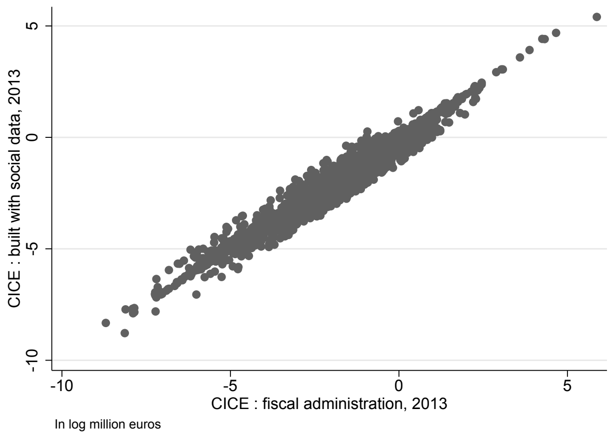


FIGURE 7 – Quality of CICE computation with social data