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E-commerce and the cost of waiting

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Abstract: The paper studies the expenditure switching effect of exchange rate changes in a model where trade takes time and consumer face waiting costs. The trade-off between lengthier delivery times and cheaper goods is tested in the context of internet markets where these costs are particularly important. I use a large database on postal exchanges to estimate the premium that the typical consumer would be willing to pay in exchange for an immediate delivery. For the median shipping time in the sample, the estimated premium is 30% of the value of the good.

Keywords: Online trade, Shipping time, Exchange rates.

E-commerce et coût de l'attente

Abstract : Ce papier étudie des frictions caractéristiques du commerce électronique et normalement absentes en commerce international. Lors des achats en ligne, les consommateurs paient leur courses en amont et attendent ensuite que les biens soient livrés. A l'aide d'uns base de données sur le commerce international de colis, j'estime la prime que les consommateurs seraient prêts à payer pour une livraison immédiate. Pour le temps d'attente médian, elle est estimée à 30% de la valeur de l'achat.

Mots-clefs : commerce en ligne, temps de transport des marchandises, taux de change.

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1. Introduction

Internet markets are increasingly denoted as frictionless. Online transactions exhibit lower search costs than offline ones. Conducting just a few computerized searches, consumers compare prices and access complete listings worldwide undercutting the middlemen (Hortaçsu et al., 2009; Lendle et al., 2015). Just as search costs tend to vanish in online markets, new trade costs also appear. Transactions are all but immediate, especially with cross-border e-commerce. Consumers pay for their purchases in advance but have to wait for the goods to be delivered. This study estimates the importance of these 'waiting costs', and their impact on international e-commerce.

We anchor our theoretical analysis on stylized facts of cross-border e-commerce trade, developing a simple model that examines how the presence of waiting costs affects price elasticities. The model captures short-run currency shocks, typical of the foreign exchange markets, to which producers cannot immediately adjust. Consumers, however, react to exchange rate shocks by shifting their expenditures. Taking advantage of more favorable prices, they substitute by sourcing from exporters in other locations. Goods shipped from different countries have dissimilar delivery times. Arbitrage opportunities for consumers are thus governed by changes in shipping times. Our cornerstone assumption is that e-commerce transactions for physical goods feature both a 'monetary cost' (the world price of the good) and a 'waiting cost' (goods are delivered after purchase). The model predicts that the elasticity of demand with respect to the exchange rate is decreasing in the share of waiting costs. [2]

To test this prediction we use a panel database on international postal exchanges. The database, collected by the Universal Postal Union (UPU), contains information on both the time parcels take to reach the final consumer and the volume of parcels traded by a given country pair. Our coverage is comprehensive, with data on 133 exporters to 126 destinations observed during for 4 years on a weekly basis. In line with the model, we define the cost of

[2] A direct consequence is that in the short-run exchange rate pass-through will be close to one for markets with low waiting costs and zero for those with high ones.

waiting as an increasing function of shipping times. We estimate that on average after 18 days the cost of waiting amounts to 30 % of the net price of the good.

Our findings are important for at least three reasons. First, significant waiting costs are consistent with the practices of internet platforms, such as Google or Amazon, who constantly seek new and faster ways to deliver purchases.[3] In opposition to the traditional international trade framework, where waiting costs are born by intermediates, e-commerce goods are shipped directly to final consumers who internalize delivery times. Our study is the first to test if these costs matter and to attempt to quantify them.

Second, we provide a full picture of the distribution of these costs. The database disentangles the time to ship in three legs: lead time to export (22 %), international transportation (40 %), and domestic delivery in importing countries (38 %). This anatomy of distribution costs can serve as a basis for directing trade facilitation activities.

Third, expenditure switching effects of exchange rate changes for offline purchases have been consistently estimated to be low.[4]. The few studies for online markets have produced mixed results, some estimate high exchange rate pass-through (Gorodnichenko and Talavera, 2014) while others low exchange rate pass-through (Boivin et al., 2012; Anson et al., 2014). In the model, both outcomes are plausible and depend explicitly on the cost of waiting. Thanks to a greater country coverage our results are more representative.

We face several challenges to estimate the importance of waiting costs and their effect on expenditure switching across countries. First, we need a model where exchange rate elasticities interact with delivery times. The challenge lies in identifying the proper transmission

[3]The Economist publication of May 3rd 2014 covers this topic. See for instance: `http://www.economist.com/news/business/21601556-online-firms-are-plunging-same-day-delivery-again-same-day-dreamers`.

[4]This phenomenon is well documented for offline markets (Devereux and Engel, 2002; Obstfeld and Rogoff, 2001), the traditional explanation being firms' market power and their ability to engage in 'Pricing to Market' (PTM) (Campa and Goldberg, 2005; Corsetti and Dedola, 2005; Gopinath et al., 2011).

channels. We postulate a price equation that explicitly depends on the time to ship. The model yields a sharp prediction; price elasticities are significantly related to waiting costs. The simple modeling framework has the advantage of suggesting both a natural econometric specification and a unique correspondence between structural and reduced form parameters.

Second, to estimate the prediction of the model, and because exchange rates move at high frequency, we need both reliable high frequency international trade data and adequate estimates of shipping times. Our identification approach is built around the consumer expenditure switching effect of exchange rate changes. To identify plausibly the arbitrage effect, it is necessary to observe demand changes within short time windows so to overcame aggregation biases. Two databases of the UPU on international parcels allow us to solve this issue. One allows us to compute weekly merchandise trade generated by online markets all over the world. The other provides information on the time parcels take to reach the final consumer.

Third, the estimation of parcel flows on delivery times may be affected by an endogeneity problem as large parcel flows may lead to better postal infrastructures and faster delivery times. To solve for the potential endogeneity of time in transit, we use the time to ship documents/letters. Since both parcels and letters use the same distribution network, their delivery schedules are highly correlated. We exploit this feature to construct a suitable instrumental variable estimator.

For offline markets, the trade reducing effects of time to ship are known thanks to the analysis of cargo shipping data. Hummels and Schaur (2013) use the modal transportation choice of exporters (airborne vs. cargo) to reveal the valuation of time by consumers. They estimate the air premium from a sample of all imports to the United States, differentiating the effect of shipping times for all HS6 categories.[5] Djankov et al. (2010) study the issue

[5] The authors construct shipping times from a master schedule of of shipping vessels (port to port).

with a World Bank survey of freight-forwarding companies operating in 98 countries.[6] In line with Hummels and Schaur (2013), they find trade reducing effects of an additional shipping day to be and of about 1 %.

Even though the literature on trade and time is comprehensive, to the best of our knowledge this is the first paper on e-commerce waiting costs. The paper differs from previous studies in two key aspects. First, we do not use cargo data. Firms exporting online do not use freight-forwarding companies to deliver their goods. Instead, they rely on the postal network or some other sort of courier service. Therefore, postal data is the best available information on e-commerce trade. Second, we have a different data coverage with more exporters and importers observed at a higher frequency. This comes at a price as we do not have detailed HS classifications but data aggregated by country. In spite of this drawback, the study has the advantage of exploiting data from a unifying source, the UPU, allowing for international comparisons. All the data points are the product of tracking number scans and dispatch bags so the accuracy is very high. Furthermore, we can take advantage of the high frequency nature of our data to look for arbitrage movements which would not be possible with traditional trade data.

The remainder of the paper is organized as follows. Section 2 discusses the role of the cost of waiting in a modeling framework. Section 3 discusses our identification strategy based on parcel flows and exchange rate shocks. Section 4 presents the database. Section 5 discusses the results. Section 6 concludes.

2. Model

We consider a world with $j = 1, \dots, J$ symmetric countries populated by a representative consumer. We define preferences of the representative consumer in country j to be quasi-

[6]The survey differentiates between three types of goods: textile yarn and fabrics (SITC 65), articles of apparel and clothing accessories (SITC 84), and coffee, tea, cocoa, spices, and manufactures thereof (SITC 07).

linear over a domestically produced *numéraire* good and a continuum of varieties, $i \in [0, N]$, of a good differentiated by origin in the spirit of Armington (1969). For simplicity we consider that each country produces one and only one variety.

$$U_j = A_j + \int_0^N q_j(i)^{(\sigma-1)/\sigma} di \tag{1}$$

Where A_j is a domestically produced *numéraire* good and $q_j(i)$ is the quantity of variety i coming from country i. It is straightforward to see that demand for variety i in country j takes the form

$$q_j(i) = \left[\frac{\sigma}{\sigma - 1} p_j(i)\right]^{-\sigma} \tag{2}$$

where $p_j(i)$ is the price of variety i in country j. We assume that producers invoice in their own currency which implies full exchange rate pass-through for online purchases (Obstfeld and Rogoff, 1995; Devereux and Engel, 2002).[7]

When sourcing from country i, the consumer in j faces two types of costs. First, the monetary price defined as the world price in the producer's currency, $p^w(i)$ converted by the nominal exchange rate $E_j(i)$ in direct quote. Second, the cost of waiting, $F_j(i)$. Thus the *net consumer price* (cost) of variety i is:

$$p_j(i) = \underbrace{E_j(i)p^w(i)}_{\text{Monetary Cost}} + \underbrace{F_j(i)}_{\text{Cost of waiting}} \tag{3}$$

Equation (3) follows the intuition of Corsetti and Dedola (2005). However, since there are no intermediaries for online purchases, consumers bear no expenditure on domestic distribution

[7] Although we do not have information about the invoicing system on internet markets, Ellison and Ellison (2009) show that only firms with considerable market power can price in the consumer's currency because price elasticities are very high in the presence of price comparing engines.

costs. In contrast, consumers bear the cost of waiting, $F_j(i)$. In (3), the cost of waiting is valued in domestic currency so from (2) and (3) the demand for variety i is:

$$q_j(i) = \left[\frac{\sigma}{\sigma - 1}(E_j(i)p^w(i) + F_j(i))\right]^{-\sigma} \tag{4}$$

If the cost of waiting is important and the willingness to pay for variety i is low, consumers may prefer to source the good from a closer destination. This captures the observation that most consumers tend to shop nationally or from bordering countries unless the price differences are large. Since we are evaluating the response to weekly exchange rate changes, firms do not adjust their output. Moreover, if one assume that firms do not alter prices in response to bilateral currency changes, the effect of a currency depreciation in country j is determined on the demand side and given by equation (5).[8]

$$\frac{\partial \ln q_j(i)}{\partial \ln E_j(i)} = -\sigma \left(1 - \frac{F_j(i)}{E_j(i)p^w(i) + F_j(i)}\right) = -\sigma(1 - s_j(i)) \quad < 0 \tag{5}$$

In (5) $s_j(i)$ is the share of the cost of waiting in the net price of the good. In constrast to Hummels et al. (2009), where $F_j(i)$ is a fee for freight companies endogenous to market structure, shipping prices in the postal network are exonenous as they are negotiated multilaterally, and do not depend on the type of good transported. Equation (5) allows for a direct comparison between a transaction where consumers do not bare the cost of waiting, i.e. $F_j(i) = 0$, and transactions where the cost of waiting is sizable $F_j(i) > 0$. This feature will allow us to retrieve $s_j(i)$ and σ from our empirical analysis.

[8] This assumption is supported by Boivin et al. (2012) for online book markets in Canada and the United States. They find that even if firms react to domestic competition, they do not do so for foreign price changes due to exchange rate movements. Under no price adjustment from firms, the expression for exchange rate pass-through from (3) is:

$$ERPT_j(i) = \frac{\partial \ln p_j(i)}{\partial \ln E_j(i)} = \frac{E_j(i)p^w(i)}{E_j(i)p^w(i) + F_j(i)} = 1 - \frac{F_j(i)}{E_j(i)p^w(i) + F_j(i)}$$

3. Estimation strategy

We estimate the cost of waiting on consumption decisions based on the high-frequency data of the UPU international parcel flows described below. In the absence of price data we cannot estimate the structural model. Therefore, we estimate the model in a reduced form where prices are fixed. From equation (4), quantities adjust bilaterally as a function of the exchange rate and the cost of waiting. We model the relationship as

$$\begin{aligned} \ln q_{ijt} &= \underbrace{\beta}_{<0} \ln E_{ij,t-1} + \underbrace{\gamma}_{>0} \ln E_{ij,t-1} F_{ij} + \underbrace{\alpha_{ij} + \lambda_{jt} + \nu_{it}}_{\text{fixed}} + \underbrace{\epsilon_{ijt}}_{\text{random}} \\ F_{ij} &= f(t_{ij}) = \ln(t_{ij}) \\ i &= 1, \ldots, N \quad j = 1, \ldots, i-1, i+1, \ldots, N \quad t = 1, \ldots, T \end{aligned} \tag{6}$$

where i is the country exporting the parcel, j the destination country and t the week of the year, $\ln q_{ijt}$ is the logarithm of exported parcels and $\ln E_{ij,t-1}$ is the one week lagged logarithm of the weekly average of the bilateral exchange rate. Because packaging and shipping goods takes time (approximately 4 to 6 days), the reaction to an exchange rate change is assumed to happen with a 1 week delay. To control for omitted variable bias, we estimate (6) by fixed effects. We introduce a common intercept per country pair ij taking into account all unobserved time-invariant bilateral factors (e.g. distance, common language, trade agreements and customs unions), and omitted time-varying factors (e.g. multilateral devaluations, aggregate demand shocks) with jt and it fixed effects.[9] We also have correlation within pairs, ij, as well as different variances so we structure the idiosyncratic effect, ϵ_{ijt}, to be independent at the country pair level, a specification consistent with Stock and Watson (2008).

$$\epsilon_{ij} \sim IID(0, \Sigma_{ij}) \tag{7}$$

[9]Model (6) fits the category of three dimensional panels discussed in Balázsi et al. (2014). As the authors point out, the optimal within transformation that is necessary to wipe out the fixed effects yields biased estimates in the absence of self-flows. The bias is decreasing with the number of importers and exporters. Given our large panel dimensions we do not expect to have that problem.

Notice that $f(t_{ij})$ is a function of time (the cost of waiting) and it does not vary with t. We could not make $f(t_{ij})$ time variant because we need to have enough observations to estimate the average time to ship. Finally, the cost of waiting, $f(t_{ij})$, is likely to be a concave function which we a approximate by the logarithm.

Suppose $f(t_{ij})$ to be negligible (low t_{ij}). Then, the expenditure switching effect of a currency depreciation is β. As shipping times ,t_{ij}, increases, the cost of waiting, $f(t_{ij})$, increases and the response to an exchange rate change, $\ln E_{ij,t-1}$, is augmented by the cost of waiting:

$$\frac{\ln q_{ijt}}{\ln E_{ij,t-1}} = \beta \underbrace{+\gamma f(t_{ij})}_{\text{time cost}} \tag{8}$$

Our first implicit identification assumption is that the exchange rate influences is exogenous to parcel flows. Since parcel flows are negligible, both in value and mass, in the the bulk of international trade, imbalances in parcel flows do not affect the exchange rate. Therefore we can safely rule out reverse causality considering that $\ln E_{ij,t-1}$ is predetermined. However, delivery times might depend on parcel flows as larger volumes may trigger improved logistics. Then, the interaction term, $\ln E_{ij,t-1} f(t_{ij})$, is potentially endogenous.

Fortunately, our database provides a possible instrument for tackling this issue. In addition to the time of shipping parcels, we are also able to calculate the time to send letters. Thus, we instrument our interaction term by the time of shipping letters interacted with the exchange rate.[10] We have at least two reasons to think that the time of shipping letters is a good instrument. First, it is uncorrelated with parcel volumes as they are different kinds of flows. Letters weigh up to 2 kg while parcels can weigh up to 30 kg. Second, it is directly linked to the time to ship parcels. For a given dyad they share the same distance and postal

[10] We cannot just instrument by the time of shipping letters because we would end up sacrificing the time variation.

operators.

4. Data Description

Table 1 shows the typical goods sold in shipped through the postal network, see Anson et al. (2014). The database uses information from two postal databases of the UPU: the Electronic Data Interchange (EDI), 2013 to 2014, messaging system and the PREDES standard, 2010 to 2014. Each international parcel sent by a postal operator member of the UPU has a unique code-bar with a *track-and-trace* number. When dispatching parcels to their partners around the world, postal operators scan *track-and-trace* numbers and send customized messages indicating the time and location of the parcel. These messages are called EDI messages and they are collected and treated by the Portal Technological Center under the EMSEVT standard. From postal collection to final delivery there are several messages exchanged between postal operators. The type of messages collected are described in Table 2.

Table 1: Products transported by international postal networks

HS2	Description	Sample Frequency
61	Art. of apparel & clothing access	0.136
49	Printed books, newspapers, pictures	0.123
85	Electrical machinery, equipment and parts therof	0.108
95	Toys, games & sports requisites	0.095
64	Footwear, gaiters and the like	0.054
21	Miscellaneous edible preparations	0.049
70	Glass and glassware	0.038
33	Essential oils & resinoids	0.026
90	Optical, photographic, cinematographic, measuring, etc.	0.026
84	Boilers, machinery & computers	0.026
62	Art. of apparel & clothing access, n.e.s.	0.025
87	Vehicles o/t railway/tramway roll-stock	0.023
71	Natural/cultured pearls, prec. stones	0.023
92	Musical instruments; parts & accessories	0.022
42	Articles of leather; saddlery/harness, hand bags, etc.	0.020

Outward statistics from a customs declaration sample representative of parcel flows.

Source: Anson et al. (2014).

Table 2: Description of the UPU EMSEVT events

Message ID	Event Information
Exporting Events	
EMA	Posting/Collection
EMB	Arrival at outward office of exchange
EMC	Departure from outward office of exchange
Importing Events	
EMD	Arrival at inward office of exchange
EME	Held by import Customs
EMF	Departure from inward office of exchange
EMG	Arrival at Delivery office
EMH	Attempted/Unsuccessful delivery
EMI	Final delivery
Transit Events	
EMJ	Arrival at transit office of exchange
EMK	Departure from transit office of exchange

Source: Universal Postal Union, EMSEVT v1 standard.

The messages provide, among others, information about the date and location of postal items. We use this database to calculate bilateral transport durations for country dyads using a sample of 250 million track-and-trace messages between 2013 and 2014.[11] We proxy the waiting time for consumers in days by taking the difference between event EMA, posting, and event EMH or EMI, attempted delivery or final delivery. For each country pair we observe several items in traffic. We estimate the expected waiting time by the sample mean of all these items at the country pair level.

The PREDES messaging system records, at the exporter level, the quantity and weight of postal items dispatched bilaterally for a given date. This is our proxy of consumption.

[11] 250 million taking into account international parcels, letters and express mail.

The exchange rate is taken the London closing time from the Thomson Reuters Datastream. The exchange rate database contains spot rates in direct rate with respect to the United States Dollar (USD). We compute the bilateral exchange rates by cross currency triangulation.

Postal flows exhibit seasonal patterns by day of the week, see Anson et al. (2014). We solve the problem by aggregating at the weekly level. This aggregation reduces greatly the variability by smoothing out parcel flows and accounts for the number of zeros resulting from holidays. Our panel data structure is summarized in Table 3.

Table 3: Sample overview

Time frame	2010, 40th week - 2014, 39th week
Exporters	133
Importers	126
Country Pairs	8'680

Source: author's calculations.

On average we observe 100 weeks of activity per country pair. The sample is heterogeneous and the country coverage is very large. Table 4 reports summary statistics of our dependent and independent variables.

Table 4: Summary statistics: variables of interest

	mean	25th-p	Median	75th-p	min	max
$\ln q_{ijt}$	2.73	1.39	2.49	3.87	0	12.13
Mean t_{ij}	24.66	11.27	18.06	29.02	0.03	623.67

Source: author's calculations. Statistics based on the estimation sample of columns (2) to (6), Table 5.

When focusing exclusively on international parcels and estimating the model with all sets of fixed effects, we end up with 133 importing countries and 126 exporting ones. Our coverage is higher than in other e-commerce studies (Hortaçsu et al., 2009; Lendle et al., 2015) but at the price of missing the product dimension.

5. Estimation Results

Table 5 uses the weekly sample of all international parcels dispatched from October 2010 to December 2014. The coefficients are very consistent and stable through the specifications. For the exchange rate effect, we have an estimate between -0.5 and -0.6. The interaction term is stable and always close to 0.1. The overall effect of the exchange rate is a function of time. As of the logarithmic specification the maximum effect of a currency depreciation is when $t_{ij} = 1$. This effect gets dampened by the cost of waiting. Increasing the cost of waiting reduces the currency effects. If we take column (6) of Table 5 as the baseline, our estimated effect is

$$\frac{\ln c_{ijt}}{\ln E_{ijt}} = -0.5 + 0.1 \ln(t_{ij}) \tag{9}$$

a function of t_{ij}. From the baseline coefficient of -0.5 it takes 12 days to halve the effect of the exchange rate. Another important fact is that the average time in our sample is of 25 days. The corresponding average effect is even lower at -0.18. The economic interpretation of the result is that consumers are less reactive to arbitrage opportunities if the delivery network is not fast enough. In the e-commerce market, it means that consumers do not take as much advantage as expected from favorable currency swindles.

Table 5: Reduced form estimation

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. variable	$\ln q_{ijt}$	$\ln q_{ijt}$	$\ln q_{ijt}$	$\ln q_{ijt}$	$\ln q_{ijt}$	$\ln q_{ijt}$
$\ln E_{ij,t-1}$	-0.297***	-0.638***	-0.608***	-0.563***	-0.571***	-0.499*
	(0.033)	(0.118)	(0.118)	(0.037)	(0.036)	(0.260)
$\ln E_{ij,t-1} \times \ln t_{ij}$		0.122***	0.110***	0.097***	0.100***	0.091***
		(0.041)	(0.041)	(0.012)	(0.013)	(0.014)
Constant	2.775***	2.773***	2.568***	2.778***	2.777***	2.767***
	(0.008)	(0.015)	(0.018)	(0.004)	(0.005)	(0.068)
Pair FE	YES	YES	YES	YES	YES	YES
Month FE	NO	NO	YES	NO	NO	NO
Year FE	NO	NO	YES	NO	NO	NO
Destination-Time FE	NO	NO	NO	YES	NO	YES
Origin-Time FE	NO	NO	NO	NO	YES	YES
N	690378	659663	659663	659663	659663	659663
R^2	0.002	0.002	0.026	0.909	0.902	0.917

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

Standard errors clustered by country-pair.

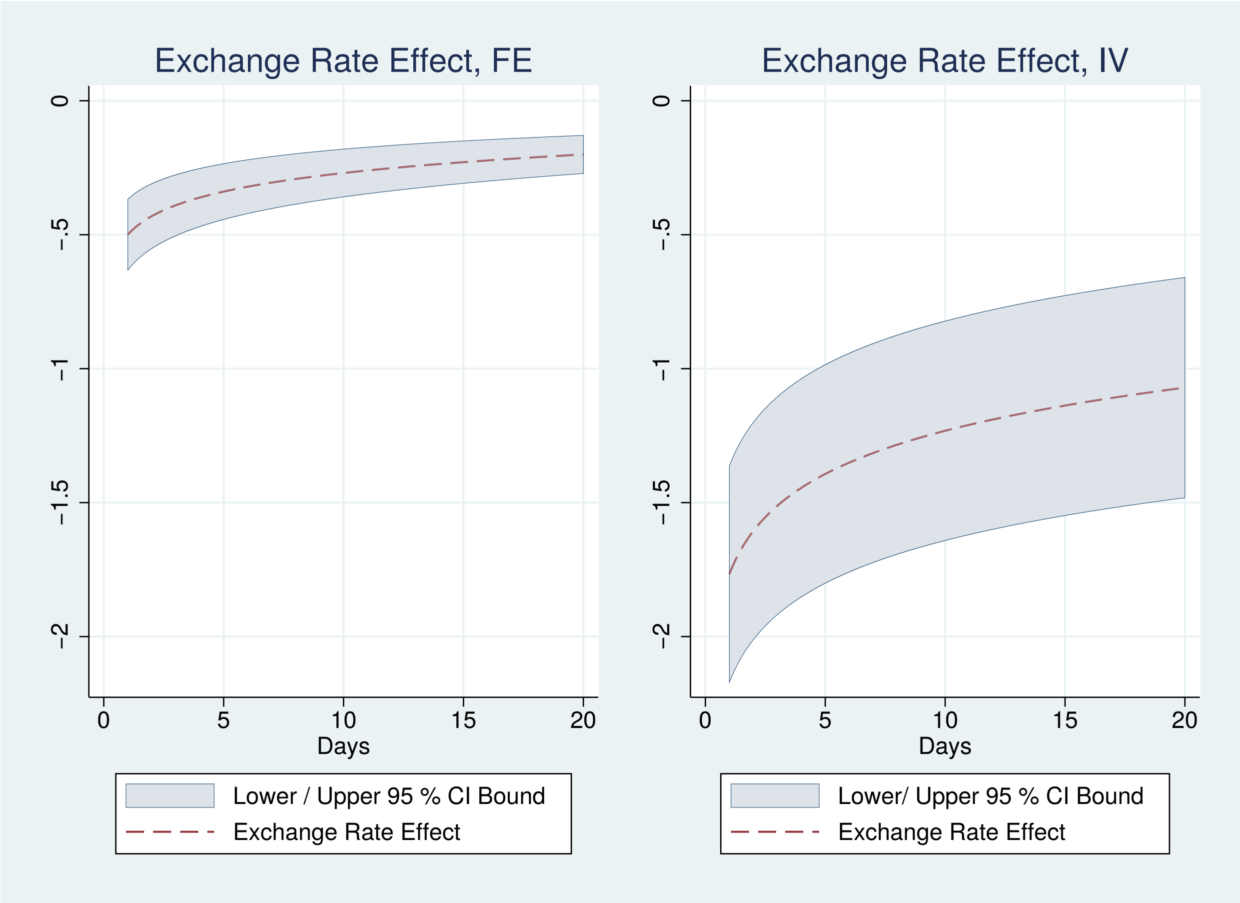
Table 6 provides the results of the instrumental variables estimator. We use as an instrument the time to ship letters. The coefficients are of different but the overall magnitude of the effect is similar and qualitatively corroborates our first findings. Using that specification the overall effect halves when passing from one to 44 days, as the exchange rate effect is a lot higher, and the total effect at the mean is almost half of the previous estimation, -0.1. Comparing this to the previous estimation, we observe that the coefficient on the exchange rate has a much larger variance. Also, we know that fixed effects estimators are downward biased in the presence of endogeneity. These two facts explain the difference in the size of the effect.

Table 6: Instrumental variables estimation

	(1)
Dep. variable	$\ln q_{ijt}$
$\ln E_{ij,t-1}$	-1.767***
	(0.454)
$\ln E_{ij,t-1} \times \ln t_{ij}$	0.233***
	(0.057)
Constant	3.288***
	(0.113)
Pair FE	YES
Destination-Time FE	YES
Origin-Time FE	YES
R^2	0.940
N	267185

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Standard errors clustered by country-pair.
Specification (1) instrumented by the time to ship documents.

Figure 1: Overall Exchange rate effect



Source: Author's calculation, standard errors based on the asymptotic distribution of the joint distribution of $\widehat{\gamma}, \widehat{\beta}$.

We compute the standard error of (9) based on the asymptotic distribution of $\widehat{\beta}$ and $\widehat{\gamma}$. Figure 1 shows the asymptotic confidence intervals for specification (6) in Table 5 and specification (1) in Table 6. As it is often the case the variance of the instrumental variables is a lot bigger than the fixed effects estimator. Both models suggest qualitatively similar results.

To fully grasp our estimation results, we retrieve the structural parameters of our model from our regression equation. Linking our model to our estimated parameters we have

$$\frac{\partial \ln q_j(i)}{\partial \ln E_j(i)} = -\sigma(1 - s_j(i)) \approx \widehat{\beta} + \widehat{\gamma} \ln(t_{ij}) \qquad (10)$$

To find an estimate of the cost of waiting we use the expression we require the identifying assumption that $F_j(i) = lnt_{ij}$. In that case, $F_j(i) = 0$ *iff* $t_{ij} = 1$.[12] So we have

$$-\widehat{\sigma} = \widehat{\beta} \tag{11}$$

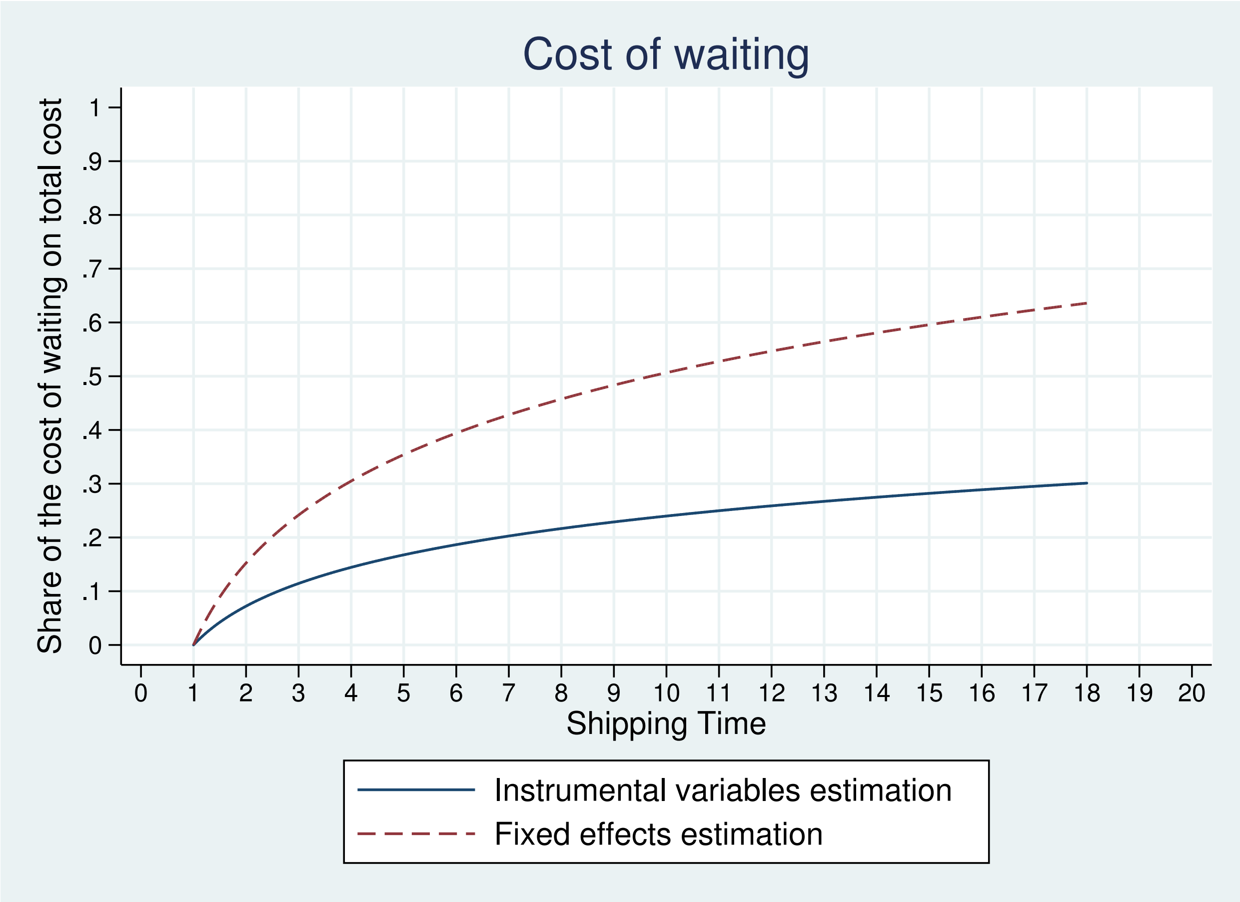
which yields to an estimate for the cost of waiting in the net price of the good

$$\widehat{s}_j(i) = -\frac{\widehat{\gamma}\ln(t_{ij})}{\widehat{\beta}} \tag{12}$$

which is the share of the cost of waiting in the total cost of the good. In Figure 2, we plot (12) as a function of time. We find that the instrumental variables estimates predict a lower cost of waiting. After 4 days, it suggests share less than 15 % over the total cost of the good. After 18 days we reach 30 % of the price of the good. The estimates from the fixed effects are a bit larger. After 4 days it predicts a cost of 30 % and the share reaches 60 % after 18 days. These numbers suggest that the cost of waiting is high and very large for country pairs with long shipping times. Taking the instrumental variables as the reference, consumers would be willing to pay up to 30 % more to get a good instantaneously rather than waiting 18 days for it.

[12] Notice how our estimates for the elasticity of substitution, $\widehat{\sigma}$, are very much in line to the ones identified by exchange rate or price changes summarized by Head and Mayer (2014).

Figure 2: Estimation of the cost of waiting



Source: Author's calculations. The estimated curves respectively represent column (1) of Table 6 and column (6) of Table 5.

6. Conclusion

Currency shocks make consumers face a trade-off between cheaper goods and slower delivery times. By lowering search costs, the internet allows consumers to easily access and compare prices worldwide. While this opens the door to international arbitrage, it also transfers some transaction costs to final consumers. With no middlemen left, consumers bear the cost of waiting. In this setting, we show that purchase exchange rate elasticities depend negatively on shipping times. From a large sample of weekly parcel flows (2010-2014), we estimate that consumers are ready to pay a 30 % premium for an immediate purchase rather than waiting 18 days for delivery.

This result may explain why international e-commerce markets are not as developed as domestic ones. Indeed, UPU official statistics show that for an average postal operator, the international parcels are only 1-2% of the amount of domestic parcels. The results here suggest that international e-commerce might be facing a 'cross-border challenge' because of substantial waiting costs.

That delivery times need to be drastically reduced for international internet markets to fluorish is corroborated by statistics of the UPU. On average, the total shipping time from collection to delivery is decomposed as follows: 22 % before exporting, 40 % of international transport and 38 % in domestic distribution. While international transport is the most important part of shipping times, the gains from it are strictly bilateral. By contrast, gains in the domestic distribution reduce shipping times multilaterally. The trade facilitation agenda rightly puts emphasis on behind the border measures but it is only half of the picture. International e-commerce needs a reduction of international shipping times as well to finally blossom.

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Appendix

Table 7: Origin Countries in the Estimation Sample

Albania	Costa Rica	Jamaica	Netherlands	Swaziland
Algeria	Croatia	Japan	New Zealand	Sweden
Antigua and Barbuda	Cyprus	Jordan	Nigeria	Switzerland
Argentina	Czech Republic	Kenya	Norway	Tanzania
Australia	Denmark	Korea, Rep.	Pakistan	Thailand
Austria	Dominican Republic	Kuwait	Panama	Tonga
Azerbaijan	Ecuador	Kyrgyz Republic	Paraguay	Trinidad and Tobago
Bahamas, The	Egypt, Arab Rep.	Latvia	Peru	Tunisia
Bahrain	El Salvador	Lebanon	Philippines	Turkey
Bangladesh	Estonia	Lesotho	Poland	Uganda
Barbados	Ethiopia	Lithuania	Portugal	Ukraine
Belarus	Fiji	Luxembourg	Russian Federation	United Arab Emirates
Belgium	Finland	Macao SAR, China	Rwanda	United Kingdom
Belize	France	Macedonia, FYR	Samoa	United States
Bhutan	Gambia, The	Malawi	Saudi Arabia	Uruguay
Bolivia	Germany	Malaysia	Serbia	Uzbekistan
Bosnia and Herzegovina	Ghana	Maldives	Seychelles	Vanuatu
Botswana	Greece	Malta	Sierra Leone	Venezuela, RB
Brazil	Hong Kong SAR, China	Mauritania	Singapore	Vietnam
Brunei Darussalam	Hungary	Mauritius	Slovak Republic	Yemen, Rep.
Bulgaria	Iceland	Mexico	Slovenia	Zambia
Canada	India	Moldova	Solomon Islands	Zimbabwe
Chile	Indonesia	Mongolia	South Africa	
China	Ireland	Morocco	Spain	
Colombia	Israel	Mozambique	Sri Lanka	
Comoros	Italy	Nepal	Suriname	

Table 8: Destination Countries in the Estimation Sample

Albania	Comoros	Ireland	Morocco	Spain
Algeria	Congo, Rep.	Israel	Mozambique	Sri Lanka
Angola	Costa Rica	Italy	Nepal	Suriname
Antigua and Barbuda	Croatia	Jamaica	Netherlands	Swaziland
Argentina	Cuba	Japan	New Zealand	Sweden
Australia	Cyprus	Jordan	Nigeria	Switzerland
Austria	Czech Republic	Kenya	Norway	Tanzania
Azerbaijan	Denmark	Korea, Rep.	Oman	Thailand
Bahamas, The	Dominican Republic	Kuwait	Pakistan	Tonga
Bahrain	Ecuador	Kyrgyz Republic	Panama	Trinidad and Tobago
Bangladesh	Egypt, Arab Rep.	Latvia	Paraguay	Tunisia
Barbados	El Salvador	Lebanon	Peru	Turkey
Belarus	Estonia	Lesotho	Philippines	Uganda
Belgium	Ethiopia	Lithuania	Poland	Ukraine
Belize	Fiji	Luxembourg	Portugal	United Arab Emirates
Benin	Finland	Macao SAR, China	Russian Federation	United Kingdom
Bhutan	France	Macedonia, FYR	Rwanda	United States
Bolivia	Gambia, The	Madagascar	Samoa	Uruguay
Bosnia and Herzegovina	Germany	Malawi	Saudi Arabia	Uzbekistan
Botswana	Ghana	Malaysia	Serbia	Vanuatu
Brazil	Greece	Maldives	Seychelles	Venezuela, RB
Brunei Darussalam	Honduras	Malta	Sierra Leone	Vietnam
Bulgaria	Hong Kong SAR, China	Mauritania	Singapore	Yemen, Rep.
Canada	Hungary	Mauritius	Slovak Republic	Zambia
Chile	Iceland	Mexico	Slovenia	Zimbabwe
China	India	Moldova	Solomon Islands	
Colombia	Indonesia	Mongolia	South Africa	