Dissecting the Impact of Imports from Low-Wage Countries on Inflation

Juan CARLUCCIO
Banque de France
University of Surrey

Erwan GAUTIER
Banque de France
Université de Nantes

Sophie GUILLOUX-NEFUSSI
Banque de France

THIS VERSION: MARCH 31, 2020

Carluccio: juan.carluccio@banque-france.fr
Gautier: erwan.gautier@banque-france.fr
Guilloux-Nefussi: sophie.guilloux-nefussi@banque-france.fr

We have benefited from discussions with Nathalie Chen, Huw Dixon, Romain Faquet, Guillaume Gaulier, John Lewis, Romain Restout, Sebastian Stumpner, Gonzague Vannoorenberghe. We also thank participants at the 3rd Conference - Using Micro Price Data Workshop (Cardiff U., 2017), the 3rd Bank of England & Banque de France International Macroeconomics Workshop (Paris, 2017), the 2018 T2M Conference (Dauphine University, Paris), the CEBRA annual conference (Columbia U., 2019), ECB Inflation Conference (Frankfurt, 2019) and seminars at Surrey University, Louvain-la-Neuve University, OECD and French Treasury for helpful suggestions and comments. All remaining errors are our own. The views expressed in this paper are those of the authors and do not necessarily reflect those of Banque de France.

Abstract

Using micro data on import values and quantities by product and countries of origin, we quantify the effect of imports of consumption-goods from low-wage countries (LWC) on inflation in France from 1994 to 2014. Imports of varieties produced in LWC affect the cost-of-living price index through pure-price and taste-shift variations. The pure-price effect includes both the contribution of imported inflation (given the share of imports in consumption) and the pro-competitive effect on domestic prices. The taste-shift effect cannot be directly observed but is recovered from actual expenditure shares and relative prices. We derive an expression of inflation that allows us to disentangle the impact of imports of consumption goods from LWCs on cost-of-living versus CPI inflation – the latter abstracting for composition effects. Overall, we estimate that imports from LWCs lowered CPI inflation by 0.05 pp per year on average, and had a much larger effect on cost-of-living inflation (between 0.13 to 0.17 pp per year depending on the preferences specification).

JEL codes: E31, F62
Keywords: inflation, low-wage countries, imports, globalization, price index, consumers

1 Introduction

During the past decades consumers in developed economies continuously switched expenditures towards goods produced in low-wage countries (LWC). In France, the share of LWC in total imports of consumer goods increased from 26% in 1994 to over 43% in 2014. The weight of goods imported from LWC as a percentage of total consumption tripled, passing from 2.4% to 6.9%. How did this change in the structure of consumption affect inflation and welfare?

In this paper, we quantify the effect of imports of consumption goods from low-wage countries (LWC) on French inflation and consumer welfare during 1994-2014. Our results show that imports from LWCs lowered Consumer Price Index (CPI) inflation by 0.05 *pp* per year on average, and had a much larger effect on welfare-relevant cost-of-living (COLI) inflation, estimated to lie between -0.13 and -0.17 *pp* per year depending on the assumption about consumer preferences. The difference between both measures arises because the CPI, as computed by statistical agencies, is a pure-price index that holds the consumption basket constant, whereas composition effects arising from changes in relative preferences across goods are essential to cost-of-living measures.

We make two contributions to our understanding on how imports of consumption goods from LWC affect inflation and consumer welfare. Our first contribution is empirical. We use quasi-exhaustive firm-level data from the French Customs with information on quantities and values of imports by product and country of origin, from which we construct detailed import price indices based on unit values. We define a product variety as a combination of a product (at 8-digit level of the CN classification) and a country of origin. The use of detailed product-level data by origin country is key for our empirical exercise since it allows us to obtain measures of differences in price *levels*. We create a concordance table to assign each of the imported products to a consumption category in the French CPI, for which data on the value of consumption expenditures is publicly available. We measure the overall effect of LWC imports on inflation by quantifying separately three additive channels. First, imports from LWC replaced goods that were previously produced domestically, with the corresponding shift in the consumption basket resulting in lower overall prices. Our estimations suggest that this *Substitution Channel* reduced French inflation by 0.05 pp per year on average, accounting for about one third of the overall effect. A second channel, labeled the *Imported Inflation Channel*, transits via the evolution of import prices: the rate of growth of imported good prices affects inflation proportionally to the share of these goods in total consumption. It reduced French inflation by 0.06 pp per year on average. Finally, raising LWC imports affect the price-setting behavior of domestic firms, thus affecting inflation indirectly. This effect, labeled *Competition Channel*, accounted for a reduction of inflation by 0.06 pp per year on average. We estimate it using data on domestic producer price indices and adopting a shift-share instrumental variable approach that uses exports from LWC to the rest of the world to measure exogenous export supply shocks in these countries (Auer and Fischer [2010]; Autor et al. [2013]). The sum of these three channels gives an overall effect of -0.17 pp per year on inflation. China, whose share in French consumption grew from 0.7% to 3.5% over the sample period, contributed to about half of the total.

Our second contribution is methodological. We show how to measure the impact of imports on inflation and welfare using increasingly available trade data and publicly-available consumption expenditures data. We obtain our quantification from a theory-derived methodology to construct macro-level price indices from product-level import price indices and consumption expenditures. We derive a simple expression for price dynamics of individual products that decomposes linearly in a "pure price" term, holding constant the composition of the consumption basket, and a "taste-shift" term, representing changes in relative consumption shares across varieties which, for given price levels, arise from shifts in the relative preferences for varieties. The form of the pure-price term is the same whatever the elasticity of substitution (holding for Leontief, Cobb-Douglas or Dixit-Stiglitz preferences) and corresponds to the impact of LWC on CPI inflation. Our empirical estimation of this effect is about -0.05 pp per year on average. The taste-shift term has a different form depending on the elasticity of substitution. Measuring the contribution of taste-shifts under Cobb-Douglas preferences is straightforward because they directly map into observable variety-level expenditure shares. This effect is estimated to be close to -0.12 pp per year on average. In the general CES setup with higher-than-unity elasticity of substitution, taste-shifts are not directly observable but can be recovered from expenditure shares and relative prices, for any given value of the elasticity of substitution. We show in our case that a higher elasticity of substitution substantially reduces our estimates of this effect: when the elasticity of substitution ranges from 4 to 6, it is about one-third lower. The contribution of taste shifts to cost-of-living inflation is between -0.12 (in the Cobb-Douglas case) and about -0.08 pp for more standard values of elasticity of substitution (e.g. about 4).

Our approach encompasses micro and macro questions in one integrated framework, therefore contributing to literatures that evolve separately. On the one hand, there has been increasing interest in the recent macroeconomic literature on the link between globalization and inflation. Several mechanisms have been advanced (see e.g. Rogoff [2003] for an early survey), with one of them being that imports, especially from low-wage countries, were an important factor in determining the low levels of inflation observed in developed economies. However, empirical evidence is scarce, and statements on the role of imports on inflation have been rather conjectural.[1] Our results show that the impact has been quantitatively quite modest. Moreover, by construction, the CPI does not take into account up to two thirds of the effect of LWC imports on the cost of living. Our paper complements early work by Auer and Fischer [2010] and Auer et al. [2013], who estimated pro-competitive effects of import penetration from nine low-wage countries in the US and Europe respectively. We present a thorough analysis that includes pro-competitive effects as part of the total effect, and we show that composition effects played a larger role. We also present a flexible methodology to quantify the impact of imports on macro inflation that is easy to implement with increasingly available data.

We also contribute to the extensive literature on the welfare gains from trade that followed upon the seminal contribution of Arkolakis et al. [2012]. While a very large amount of work has been devoted to understanding the labor market impact of imports from LWCs, and in particular, China, little is known thus far about prices and welfare, which are key variables in virtually all trade models. Recent contributions include evidence on the impact of the "China shock" on prices using US scanner data (Bai and Stumpner [2019]) or CPI data (Jaravel and Sager [2018]). Such works focus on pro-competitive effects and do not provide estimates of overall macroeconomic effect. Moreover, their findings are not straightforwardly interpretable because the data do not allow to disentangling imported from domestic goods in the left-hand side variable. Berlingieri et al. [2016] find that trade EU agreements increased consumer welfare by 0.24%, with stronger effects for high-income countries. Breinlich et al. [2019] study the impact

[1] See for instance a statement from ECB president Mario Draghi: "*Falling import prices partly explain the subdued performance of core inflation, too. This is because imported consumer products account for around 15% of industrial goods in the euro area*" Draghi [2017].

of the pound depreciation following the Brexit referendum. Like these works, our focus is on the direct impact of imports of consumption goods on French prices.[2] We contribute to this literature by shedding light on the relative magnitudes of the different mechanisms through which imports of consumption goods from LWCs affected prices in a developed country, for a period in which these imports surged. One key result of our paper is that substitution effects matter the most.

Finally, we complement recent works on price index measurement by Redding and Weinstein [2018] and Redding and Weinstein [2020] by developing a macro price index based on theoretically consistent aggregation of price indices of individual goods, and by showing how to apply the decomposition using available data on trade and domestic expenditures. While Redding and Weinstein [2020] focus on import price indices to develop a novel measure of comparative advantage, we focus on the price and welfare effects of imports quantifying their impact on both the CPI inflation and the Cost of Living inflation.

The rest of the paper is organized as follows. Section 2 provides a simple analytical framework that develops an expresion for the impact of imports from LWCs on inflation. Section 3 presents the data sources and the construction of the main variables. Section 4 presents the results of the quantification of imports from LWCs on inflation. Section 5 discusses the aggregate effect of imports from LWCs on French CPI and Cost-of-living inflation.

2 Theoretical Framework

This section presents the inflation decomposition upon which we base our empirical exercise. We first derive expressions for price changes of individual tradable goods (indexed by i) that make explicit the role of imports from LWC, and then show how to aggregate them into an economy-wide inflation rate.

[2] Our paper also relates to a previous literature studying the impact of import penetration on other price indices, either *import prices* or *producer prices*. A first group of works focuses on the evolution of *import prices* (Kamin et al. [2006] for the United States, Glatzer et al. [2006] for Austria, Mac Coille [2008] and Nickell [2005] for the United Kingdom, Pain et al. [2008] for the Euro Area and the United States). The general conclusion is that the rapid increase in LWC imports depressed import prices in these countries because of the lower prices of imported goods. Interestingly, the magnitude of the effects reported by these works is very close to what we find.

2.1 Product-level Inflation Decomposition

A representative French consumer obtains utility from the consumption of a bundle of N products in quantity Q_i: $U(Q_1, ...Q_i, ...Q_N)$. Some goods are tradable and other goods are non-tradable. For each tradable good i, there is a number J_i of varieties available, differentiated by country of origin, and including one French variety. As a benchmark case, we assume that each tradable good i is a Cobb-Douglas aggregation of a fixed number of varieties indexed by j.[3] As discussed below, this specification allows a very clean comparison of the quantification provided in the paper with the Consumer Price Index actually measured by statistical agencies. We discuss in Section 5 the more general case of a CES-aggregation.[4] For now, at each time t:

$$Q_{it} = \prod_{j \in \Omega_i^J} Q_{ijt}^{\omega_{ijt}}, \text{ with } \sum_{j \in \Omega_i^J} \omega_{ijt} = 1 \text{ and } \Omega_i^J \text{ represents the set of all varieties for good } i \quad (1)$$

Variations in ω_{ijt} over time reflect taste shifts: conditional on prices, the French consumer switches expenditures between varieties of different origins as its relative preferences across varieties do evolve. The Cobb-Douglas demand structure has the particular feature that ω_{ijt} equals the expenditure share on variety j of good i at time t.

The price index of tradable good i is $P_{it} = \prod_{j \in \Omega_i^J} P_{ijt}^{\omega_{ijt}}$. Denoting Ω_i^F the set of foreign varieties for good i, the share of imports in total consumption of i is $\eta_{it} = \sum_{j \in \Omega_i^F} \omega_{ijt}$. Writing log prices with small letters, we have: $p_{it}^T = (1 - \eta_{it}) p_{it}^D + \eta_{it} p_{it}^F$, where superscripts D and F refer to domestic and foreign varieties, and the price index of imports of good i is $p_{it}^F = \sum_{j \in \Omega_i^F} \frac{\omega_{ijt}}{\eta_{it}} p_{ijt}$.

The rate of change of the price index p_{it} is denoted $\pi_{it} = \frac{dp_{it}}{dt}$. It can be decomposed as:

$$\pi_{it} = \pi_{it}^D + \eta_{it} \left(\pi_{it}^F - \pi_{it}^D \right) + \frac{d\eta_{it}}{dt} \left(p_{it}^F - p_{it}^D \right). \quad (2)$$

[3] In this paper the number of varieties is assumed to be fixed over time, hence we do no capture the gains from trade stemming from new varieties. The reason is that our object of interest is imports originated in LWCs and we take this group as a whole for the quantification. For each year in our sample, imports of any good i comprises a variety imported from LWCs. Therefore, we do not implement the adjustment à la Feenstra for entry/exit of new varieties.

[4] To relate both easily, think of the Cobb-Douglas form a degenerated case of a Dixit-Stiglitz CES function. Suppose that each good i is a CES-aggregation of varieties with elasticity of substitution θ and taste parameter for each variety ω_{ij}, such that, $Q_i^{\frac{\theta-1}{\theta}} = \sum_{j \in \Omega_i^J} \omega_{ij}^{\frac{1}{\theta}} Q_{ij}^{\frac{\theta-1}{\theta}}$. If the elasticity of substitution tends to one, the relation is equivalent to $Q_i = \prod_{j \in \Omega_i^J} Q_{ij}^{\omega_{ij}}$. Hence we interpret the weight ω_{ijt} in the Cobb-Douglas function as the taste parameter.

π_{it} is the sum of three terms: 1) inflation of domestic goods, 2) differential inflation for foreign and domestic goods, weighted by the expenditure share of the former and 3) changes in the expenditure shares of foreign goods $\left(\frac{d\eta_{it}}{dt}\right)$, scaled by their price-level differential.

The price index of imported varieties, p_{it}^F, can in turn be expressed as the combination of prices of varieties originated in low-wage and high-wage countries (respectively denoted LWC and HWC), with γ_{it} representing the share of LWC varieties in total imports of good i: $p_{it}^F = (1-\gamma_{it})p_{it}^{HWC} + \gamma_{it}p_{it}^{LWC}$.[5]

Combining expressions for p_{it} and p_{it}^F and rearranging, we obtain:

$$\pi_{it} = \underbrace{\frac{d\eta_{it}}{dt}\gamma_{it}\left(p_{it}^{LWC} - p_{it}^{D}\right)}_{\text{Substitution}} + \underbrace{\eta_{it}\left[\frac{d\gamma_{it}}{dt}(p_{it}^{LWC} - p_{it}^{HWC}) + \gamma_{it}\left(\pi_{it}^{LWC} - \pi_{it}^{HWC}\right)\right]}_{\text{Imported Inflation}} + \underbrace{(1-\eta_{it})\pi_{it}^{D}}_{\text{Competition}}$$
$$+ \underbrace{\eta_{it}\pi_{it}^{HWC} + (1-\gamma_{it})\frac{d\eta_{it}}{dt}\left(p_{it}^{HWC} - p_{it}^{D}\right)}_{\text{indirect contribution of imports from LWCs}} \tag{3}$$

In decomposition (3), imports from LWCs affect π_{it} through different additive terms, that we label "channels":

- *Substitution*: changes in the share of consumption of LWC goods and domestic varieties.
- *Imported Inflation*: variations in the import price index arising from changes in the share of LWC in total imports. It is the sum of (within-imports) "substitution" and "differential inflation" effects.
- *Competition*: impact on domestic producer prices' inflation through increased competitive pressures, affecting π_{it} in proportion to the share of domestic varieties in good i's consumption.

The last term summarizes the contribution of imports from high-wage countries to domestic inflation, through imported inflation (π_{it}^{HWC}) and substitution between imports from high-wage countries and domestic goods.[6]

[5] Denoting $\Omega_i^{LWC} \subset \Omega_i^F$ the subset of imported varieties originated in low-wage countries: $\gamma_{it} = \sum_{j\in\Omega_i^{LWC}} \frac{\omega_{ijt}}{\eta_{it}}$ and $p_{it}^{LWC} = \sum_{j\in\Omega_i^{LWC}} \frac{\omega_{ijt}}{\gamma_{it}\eta_{it}} p_{ijt}$. Similarly $p_{it}^{HWC} = \sum_{j\in\Omega_i^{HWC}} \frac{\omega_{ijt}}{(1-\gamma_{it})\eta_{it}} p_{ijt}$, with $(1-\gamma_{it}) = \sum_{j\in\Omega_i^{HWC}} \frac{\omega_{ijt}}{\eta_{it}}$.

[6] Supply shocks in LWC can affect prices of French imports from HWC, for example through competition effects, or through worldwide commodity prices. In our analysis we observe equilibrium prices p^{HWC} that potentially incorporate these effects.

2.2 Constant Utility Price Index *versus* Fixed-Basket-of-Goods Price Index

We now discuss the relationship between formula (3) and the Consumer Price Index. The CPI is constructed by most statistical agencies using a *geometric Laspeyres* formula, defined as the geometric weighted average of prices of a *fixed basket of goods*, where the weights are expenditure shares calculated in a reference period. Indices are most commonly computed following the "chain-linking method", in which the reference period at t is $t-1$ and weights are updated every year.[7] By construction, the CPI is a *pure price* index, also labeled *Fixed-Basket-of-Goods* (FBG) index since it holds constant the structure of consumption between two periods.

CPI indices differ from theoretical constant-utility indices aiming at measuring the minimum expenditure required to hold utility constant between $t-1$ and t (also referred to as Cost-of-Living indices, COLI). By construction, COLI take into account changes in consumption patterns when household substitute across varieties but CPI and COLI indices can coincide under certain assumptions. Specifically, the chained geometric Laspeyres index is the exact price index associated with Cobb-Douglas preferences under two conditions: 1) the set of varieties Ω_i^J is fixed from $t-1$ to t, and 2) taste parameters are constant between any two periods $\omega_{ij,t} = \omega_{ij,t-1}$.

In this paper we derive exact price indices p_{it} and p_{it}^F from Cobb-Douglas preferences where expenditure weights ω_{ijt} are allowed to vary (with a fixed number of varieties J_i) reflecting changes in relative tastes across varieties. Hence COLI and FBG indices do not equalize.

The COLI index differs from the FBG index by the magnitude of *substitution* effects. The interest of assuming a Cobb-Douglas structure is that decomposition of P_{it} in (2) allows a clean quantification of the difference between the two. $\pi_{it}^{FBG} = \pi_{it}^D + \eta_{it}\left(\pi_{it}^F - \pi_{it}^D\right)$ is the "pure price" inflation, whose changes are driven exclusively by changes in prices of the different varieties. The COLI inflation is $\pi_{it} = \pi_{it}^{FBG} + \frac{d\eta_{it}}{dt}\left(p_{it}^F - p_{it}^D\right)$. The difference between the welfare-consistent

[7] Note that in practice contemporaneous expenditure shares are typically unavailable at the time of price collection. At the most disaggregated level, elementary prices indices combine prices of a same good collected in different location or type of store. Statistical agencies compute unweighted geometric means of prices when a product is not perfectly homogeneous, arithmetic mean otherwise. Compared to the arithmetic mean, the geometric one assigns lower weights to relatively larger price increases. Such *Jevons indices* are then aggregated at higher levels using *weighted geometric (Laspeyres) means* of the type derived in this section. In the empirical exercise we use unit values calculated at the 8-digit level of the European Combined Nomenclature. The 8-digit level is close to a level of aggregation at which statistical agencies use weighted geometric means.

and the pure price index is $\frac{d\eta_{it}}{dt}\left(p_{it}^F - p_{it}^D\right)$, the contribution of consumer switching expenditures from relatively more expensive products to cheaper ones. This is equivalent to the *substitution bias* described by Boskin et al. [1996] and Boskin et al. [1998].

Similarly, we can re-express (3) to distinguish the respective contributions of *pure-price* and *taste-shift* terms:

$$\pi_{it} = \underbrace{(1-\eta_{it})\pi_{it}^D + \eta_{it}\gamma_{it}\left(\pi_{it}^{LWC} - \pi_{it}^{HWC}\right)}_{\text{pure price}} + \underbrace{\frac{d\eta_{it}}{dt}\gamma_{it}\left(p_{it}^{LWC} - p_{it}^D\right) + \eta_{it}\frac{d\gamma_{it}}{dt}(p_{it}^{LWC} - p_{it}^{HWC})}_{\text{taste shift}}$$
$$+\text{contribution of HWCs} \quad (4)$$

In this paper we quantify the impact of imports from LWC both on CPI inflation –via the pure-price contribution only, and on COLI inflation, that incorporates the contribution of taste shifts as well.

2.3 Aggregation Across Goods

The economy is composed of a fixed number S of sectors indexed by s, where each individual good i belongs to only one sector. Each sector spans either tradable and or non-tradable goods.[8] Generally, inflation in any sector s can be expressed as the weighted average of price changes of individuals goods $i \in s$: $\pi_{st} = \sum_{i \in s} \frac{v_{it}}{v_{st}} \pi_{it}$, with π_{it} the inflation of good i, v_{it} the share of expenditures on good i in total consumption and $v_{st} = \sum_{i \in s} v_{it}$.

$\pi_t^T = \sum_{s \in \Omega^T} \frac{v_{st}}{v_t^T} \pi_{st}$, where $v_t^T = \sum_{s \in \Omega^T} v_{st}$ and Ω^T is the set or tradable sectors.

Finally, denoting β_t, the share of tradables in total consumption and π_t^{NT} the inflation of non-tradable goods, the formula for aggregate inflation is $\pi_t = \beta_t \pi_t^T + (1-\beta_t)\pi_t^{NT}$.[9]

Hence, the aggregate effect of LWC imports on French inflation can be measured as the simple weighted average of the contributions estimated at the product level.

[8] For simplicity we interchangeably use the words "good" or "products" although some of these are services.
[9] This formula is general and does not hinge on a particular form of aggregation across sectors.

3 Data

3.1 Data Sources

We merge an administrative dataset on trade flows by product and country with publicly available data on French household consumption and domestic production. Our data cover the period 1994-2014.

Product-country level imports and exports We obtain trade data from a quasi-exhaustive administrative file collected by the French Customs Office. It provides the yearly values (in euros) and quantities of imports (by country of origin and product) and exports (by country of destination and product) for all trading firms over the period 1994-2014.[10]

Trade flows are classified at the CN 8-digit level (Combined Nomenclature of the EU). The first six digits are identical to the subheading level (6-digit) of the international Harmonized Nomenclature (HS6), and the last two digits are added by the European Commission.[11] We restrict our sample to imports and exports of manufactured goods, around 14,000 product codes.[12]

We use the customs data to construct import and export unit values and calculate the share of imports on consumption by product and country.

Product-level consumption expenditures The yearly value of household consumption is provided by INSEE at the 3-digit level of the COICOP (51 sectors), the United Nations' purpose-based classification of consumption expenditures by households. It is the classification used to build the official Consumer Price Index. Values of household consumption will allow us to measure import penetration in households consumption and son, assess the the share of imported goods into the CPI.

[10]Flows with non-EU countries whose value is below 1,000 euros are excluded from the data set. In the case of EU countries, the threshold is larger, varying from 40,000 to 150,000 euros depending on the year. These thresholds leave out a very small proportion of French trade flows.

[11]As an example, CN8 code 18061015 "Cocoa powder, containing added sugar or sweetening matter - Containing no sucrose or containing less than 5% by weight of sucrose (including invert sugar expressed as sucrose) or isoglucose expressed as sucrose" is an extension of HS6 code 18061015 "Cocoa powder, containing added sugar or sweetening matter".

[12]We exclude raw materials (HS01-15, 23, 25-27, 31 and 41) e.g., "Vegetable products", "Mineral products", "Fertilizers" and "Works of art, collector's pieces and antiques", and "Services" (HS97-99). We keep only importers whose main activity falls within NACE Rev-2 codes 10-33. Excluded trade flows are about 5% of the total value of French imports and exports.

Identification of consumer goods in the import data Our aim is to quantify the contribution of imports to the evolution of French consumer prices. We thus restrict our analysis to imports of consumption goods and we define the set of consumption goods as those goods included in the French CPI.

Implementing this definition requires mapping CN8 codes to products in COICOP classification of which the INSEE provides yearly values of consumption expenditures. There is no direct concordance table from CN8 to COICOP available. We first concord CN8 codes into 6-digit CPA codes (about 3,000 different products), and then we use a concordance table from CPA to COICOP.[13] We keep only those products in the Customs data set that match into COICOP categories (about 4,500 CN8 codes out of a total of 14,000).

By definition, products without a match are classified as imports of intermediate goods. As an example, the CN8 code 61112010, "Babies' garments and clothing accessories, knitted or crocheted: Gloves, mittens and mitts", maps into the COICOP code 03.1.2, "Garments". An example of a CN8 code that has no counterpart in the COICOP classification is 28121011, "Chlorides and chloride oxides".

One important caveat is that some products can be used either for consumption or as inputs, depending on the user (e.g., personal computers). This distinction is impossible to make in the data, and thus our import penetration measure might be overestimated. For COICOP categories that refer to services, we assume imports of consumption goods to be zero (e.g. restaurants).

Country Categories The Customs data provide information on the country origin of imports allowing us to identify imports from LWC imports. We follow Bernard et al. [2006] and Auer and Fischer [2010] and classify source countries intro three categories according to their GDP per capita relative to the French GDP per capita. "High-wage countries" are those with GDPpc higher than 75% of the French GDPpc. "Low-wage countries (LWC)" are those for which the GDPpc lies between 25% and 75% of the French GDPpc. "Very low-wage countries (VLWC)" includes countries with GDPpc lower than 25% of France's. We look separately at the cases of China and the New European Union member states (NEUMS), the former grouping countries

[13] The CPA is the statistical classification of products by activity used in the European Union. Concordance tables were obtained from the EU statistical website RAMON: $http://ec.europa.eu/eurostat/ramon/relations/index.cfm?TargetUrl=LST_REL$.

that joined the EU after 2004.[14]

GDPpc ratios are averaged over 1994-2014 and the composition of groups is fixed over time. Table A in the Appendix reports a detailed list of countries by category.

3.2 Construction of Main Variables

We consider that a good i is defined at the CN8 level, and that each CN8-country combination identifies a differentiated variety j of such good i. Denote by $(v_{ijt}, P_{ijt}, Q_{ijt})$ the value, price and quantity of variety j of good i, with $v_{ijt} = P_{ijt}Q_{ijt}$, and with g the country groups defined as above. Ideally, we would like to have data on the values and quantities of domestically produced-goods at the CN8 level. Such data is however not available: for all products i, we observe v_{ijt} and q_{ijt} for all origins j except France. Hence we match the detailed trade data with the sector-level consumption (COICOP classification). Let $v_{it} = \sum_{j\in\Omega_i^J} v_{ijt}$ denote the total value of consumption on good i by French households. We have this information at the COICOP level –that corresponds in our framework to a *sector*. So we do actually observe v_{st}, defined as $v_{st} = \sum_{i\in s} v_{it}$.

We construct our variables of interest as follows:

Expenditure shares

- γ_{it}^g is the share of imports from country group g in total imports of good i: $\gamma_{it}^g = \sum_{j\in\Omega_i^g} v_{ijt} / \sum_{j\in\Omega_i^F} v_{ijt}$, where Ω_i^g is the set of imported varieties for good i belonging to country group g.
- η_{st} is the share of imports in COICOP sector s: $\eta_{st} = \sum_{i\in s}\sum_{j\in\Omega_i^F} v_{ijt}/v_{st}$
- β_t is the share of tradable goods in total consumption: $\beta_t = \sum_{s\in\Omega^T} v_{st} / \sum_{\forall s} v_{st}$
- η_t is the share of imports in tradable goods: $\eta_t = \sum_{s\in\Omega^T}\sum_{i\in s}\sum_{j\in\Omega_i^F} v_{ijt}/v_t$, where v_t represents total consumption expenditures in France.

We scale import values with a uniform 20% distribution margin and apply VAT rates to the import values inclusive of margins (20% applies to most products since January 2014, and 5.5%

[14]Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Slovenia

applies to food products).[15]

Price levels We proxy product-level prices with unit values. We calculate unit values at the product(CN8)-country level, the most disaggregated available, in order to minimize measurement errors arising from heterogeneity at lower levels of disaggregation (still more disaggregated than the six-digit level at which the literature tends to focus). For each variety, we define: $P_{ijt} = v_{ijt}/Q_{ijt}$. Given the lack of available data on the price levels of domestically-produced goods, we proxy domestic prices with French export unit values, as in Emlinger and Fontagné [2013]. We compute export unit values similar to the case of imports.

Importantly, we compare prices by origin at the CN8 level and we assume that the definition of products is sufficiently precise so that varieties within each category i share the same "observed" quality. Hence we compare prices of goods that are observationally equivalent.[16]

Inflation rates Based on the discussion of Section 2, we build Import Price Indices in the following way. For each country category $g \in \{HWCs, LWC, VLWC, NEUMS, China\}$ and product i, we first calculate a price index $P^g_{i,0}$ as a weighted geometric average of unit values, where $t = 0$ is the first year this product is in our sample. Weights $\gamma^g_{ij,t}$ are the share of imports at time t of each product i and country j in total French imports of product i from country-group g: $P^g_{i,0} = \prod_{j\in\Omega^g_i} P_{ij,0}^{\gamma^g_{ij,0}}$. For the remaining years we compute the import price level for product i imported from country group g at time t as: $P^g_{i,t} = P^g_{i,t-1}\pi^g_{i,t}$, with $\pi^g_{i,t} = \prod_{j\in\Omega^g_{i,t-1}}(P_{ij,t})^{\gamma^g_{ij,t-1}} / \prod_{j\in\Omega^g_{i,t-1}}(P_{ij,t-1})^{\gamma^g_{ij,t-1}}$

The total import price level for good i is $P^F_{i,t} = \prod_{\forall g}(P^g_{i,t})^{\gamma^g_{i,t}}$, where $\gamma^g_{i,t}$ is the share of imports from country group g in total imports of good i. It is constructed as $\pi^F_{i,t} = \log\left(\frac{P^F_{i,t}}{P^F_{i,t-1}}\right)$.

Then, aggregate import price inflation, π^F_t, is calculated as the weighted average of all products'

[15]It is the average margin of the retail sector from Andrieux and d'Isanto [2015], inclusive of both transportation and distribution costs. The sample of products covered by Andrieux and d'Isanto [2015] for this calculation is close to the set of tradable goods purchased for consumption purposes we consider. Andrieux and d'Isanto [2015] found some heterogeneity in margin rates across products or type of outlets but we cannot apply different margin rates to different types of outlets or different goods. Overall, these differences are going from 10% in communication products sold in supermarkets to 40% for frozen products sold in specialized outlets.

[16]Another dimension of quality is the *subjective* quality, as perceived by the consumer. Even though two goods have the same observable characteristics, the *perceived* quality refers to the relative preference/taste of consumers for each variety. Section 5 shows how, for a given elasticity of substitution θ, the taste parameter for each variety can be recovered from the observed market shares and prices. We measure how changes in taste do contribute to price dynamics.

inflation $\pi^F_{i,t}$. As discussed in Section 2, these indices are exact for Cobb-Douglas preferences and are defined for goods present in both $t-1$ and t ("common goods"). When product-country pairs drop out of the sample we impute a price change equal to the average change of the remaining of the index, as prescribed by the IMF Export and Import Price Index Manual (International Monetary Fund [2009]). As highlighted by Atkeson and Burstein [2008], is equivalent to excluding these goods at the time they drop from the index and re-normalizing the weights for the remaining goods to sum up to one.

Our index has a correlation coefficient of 0.73 with the monthly import price index for the manufacturing industry, constructed by INSEE with surveys to individual firms starting in 2005, and a high correlation, of 0.55, with the import deflator from the National Accounts, in spite of the fact that such index covers a wider range, including manufacturing, services and extractive industries (the latter increasing the volatility of import inflation). Figure A in Appendix shows the evolution of π^F_t and that of the official indices for 1995-2014 (as we use 1994 as the base year, inflation measures start in 1995).

4 Results

We now provide a quantification of the impact of imports from low-wage countries on French inflation. We follow the decomposition described in Section 2 Eq. (3) and present the results for each channel successively.

4.1 Substitution

First, imports can lower domestic inflation because consumers substitute domestically-produced goods with cheaper imported goods.

Figure 1 plots the share of imports in total consumption over time. It shows a clear upward trend, going from 10% in 1994 to 17% in 2014, an average increase of 0.3 pp per year.

[Insert Figure 1 here]

Bars in light grey represent the contribution of change in the share of tradables in the consumption, $(\eta_t \times \frac{d\beta_t}{dt})$, and the bars in dark grey give the contribution of changes in the share of imports in consumption of tradables ($\beta_t \times \frac{d\eta_t}{dt}$).[17] The average year-on-year change in the share of imports in tradables is +0.8 pp, contributing to the increase import penetration by 0.37 pp on average per year (= 0.46 × 0.8). This increase happened in spite of the reduction in the share of tradables in total consumption, and the rising share of services: β_t passed from 49% in 1995 to 43% in 2014, contributing negatively to the evolution of import penetration by approximately −0.07 pp. The average share of tradables in consumption (β_t) is 46% and the average share of imports in tradable consumption (η_t) is 32%, implying an average share of imports in total consumption ($\beta_t\eta_t$) of 14%.

Figure 2 plots the average ratio of import prices to domestic prices. We approximate domestic prices with export unit values (P^X_{it}) since domestic prices are not available (see discussion in Section 3). The grey line plots the average across goods i of $ln\left(\frac{P^F_{it}}{P^X_{it}}\right)$.[18] As expected, imports are cheaper than domestic goods and the average ratio is remarkably stable over 1994-2014 around −15% (with a slightly decreasing trend). Heterogeneity across country origins is strong: the ratio with respect to imports from HWC is of 3%[19], whereas it is of around -41% in the case of LWC.[20]

The contribution of the *Substitution Effect* to inflation is then constructed by aggregating sector level measures (as an expenditure-weighted sum of sectoral effects) and accounting for the share of tradable goods in consumption (β_t).

For each year, the overall contribution of the substitution channel is given by:

$$\beta_t \sum_{s\in\Omega^T} \underbrace{\omega_{st}}_{\text{sector s weight}} \underbrace{\frac{d\eta_{st}}{dt} E_s[p^F_{it} - p^D_{it}]}_{\text{effect in sector } s} \tag{5}$$

where $\omega_{st} = v_{st}/v^T_t$ is the weight of sector s in consumption of tradable goods, η_{st} is the share of imports in sector s and $E_s(x_{it})$ denotes the expenditure-weighted mean operator across goods within sector s: $\forall x_i, E_s(x_i) = \sum_{i\in s} \frac{v_{it}}{v_{st}} x_{it}$ (recall that $v_{st} = \sum_{i\in s} v_{it}$). Then we take the

[17] The total change is $\frac{d(\beta_t\eta_t)}{dt} = \frac{d\beta_t}{dt}\eta_t + \beta_t\frac{d\eta_t}{dt}$.

[18] We select CN8 products with both positive imports and exports and compute the ratio $ln\left(P^F_{it}\right) - ln\left(P^X_{it}\right)$ by product. We add 5% to all export unit values, based on the mean estimate of the CIF-FOB margin for France during the same period of this study, given by Miao and Fortanier [2017].

[19] We obtain similar results when restricting to export prices destined to HWCs only.

[20] Emlinger and Fontagné [2013] obtain a price ratio between French prices and LWC import prices higher than 2 over the period 2000-2010. However, one difference with Emlinger and Fontagné [2013] is that we calculate price ratios at level 8 of CN classification whereas they compare prices at level 6 of the CN classification.

average over years to get an estimate of the effect "per year" over the period.

Using disaggregated measures (level 1 of the COICOP classification) of the different terms in this equation, we find that the overall effect of raising imports (irrespective of their origin) on French inflation was of −0.06 pp per year on average. We can further decompose this effect by country of origin, the substitution effect coming from LWC can be written (with the same notations) as:

$$\beta_t \sum_{s\in\Omega^T} \underbrace{\omega_{st}}_{\text{sector s weight}} \underbrace{\frac{d\eta_{st}}{dt} E_s[\gamma_{it}] E_s[p_{it}^{LWC} - p_{it}^{D}]}_{\text{effect in sector } s} \tag{6}$$

We find that the overall negative effect is almost fully coming from an increase in the share of LWC imports in the consumption (relative to domestic consumption) leading to a negative effect of −0.05 pp per year on average. Among LWC, about half of the effect is coming from Chinese imports.

[Insert Figure 2 here]

The overall effect reported above masks strong heterogeneity across sectors.[21] Table 1 provides an estimation of *Channel 1* by broad consumption category (Column (4)). The largest effects are obtained for *Clothing* and *Furnishings*, being of −0.8 and −0.2 pp respectively. The last column reports the contribution of each product category to the aggregate substitution effect (i.e. taking into account the share of each product category in the CPI): a large majority of the overall effect is due to *Clothing* and *Furnishings* (−0.04 pp out of −0.05 pp for the overall effect).

[Insert Table 1 here]

4.2 Imported Inflation

Imports from LWC can affect domestic inflation through their effect on imported inflation (i.e. because of cheaper LWC imports replacing HWC imports in the domestic consumption basket

[21] In Appendix, Figure B plots the share of imports in consumption by COICOP level 1 sector. Between 1994 and 2014, the largest increases in import penetration are observed for *Clothing* and *Furnishings*. In 2014, imports account for about 75% of French consumption of *Clothing*, 55% of *Furnishings*.

or because of differences in inflation rates between LWC and HWC imports (see Equation (3), *Imported Inflation* term)).

Figure 3 plots the share of country groups in total imports. The import basket of consumer goods continuously switched towards goods from LWC and away from those from HWCs. In 1994, high-wage countries accounted for around 76% of total French imports, declining steadily to reach 57% in 2014. The main drivers of this increase in the share of LWC are China and the NEUMS.

[Insert Figure 3 here]

The inflation differential between HWC and LWC imports over the same period (see Figure 4) was rather small, with the inflation rate of French imports from LWC slightly higher than that of imports from HWCs.

[Insert Figure 4 here]

We first look at the effect of imports from LWCs on imported inflation. Total import inflation increased by about 0.6% per year over the sample period, as shown in Figure 4 (same annual growth rate of the import deflator from the National Accounts). Imports from LWCs had a strong negative contribution, close to -0.4 pp on average per year. Figure 5 plots the two components of the imported inflation contribution (substitution in dark gray and inflation differential in light grey). The total effect decomposes in a strong negative substitution term of -0.47 pp and a positive inflation differential term of $+0.06$ pp. LWC imports gained market shares, depressing import prices, in spite of their prices increasing faster than those of HWC goods.

[Insert Figure 5 here]

The negative contribution of substitution was strongest during 2000-2012 (-0.59 pp). It is also quite heterogeneous across groups of LWC. Figure 6 plots the contribution of each country category to the substitution (within imports) and shows that almost all of variation is due to imports from China: -0.37 pp out of -0.47 pp per year on average. In particular, the highest values for the substitution effects coincide with China's entry in the WTO. The contribution of NEUMS is about -0.08 pp and that of very low-wage countries and intermediate low-wage countries around -0.01 pp.

[Insert Figure 6 here]

The contribution of the inflation differential is positive on average, but varies over time. It was negative in the years at the beginning of the 2000's (-0.24 pp on average from 2001 to 2004), meaning that import prices from LWC grew faster that those from HWCs over that period. After the crisis, the inflation differential has been positive and large from 2009 to 2012 (with a contribution of $+0.30$ pp per year on import price inflation on average). The post-crisis positive effect is almost fully driven by Chinese imports. Table B in Appendix provides an international comparison of LWC contribution to import inflation in several countries. All studies point to a negative effect of LWC imports on import inflation, and of a magnitude which is very close to the one we obtain.

Overall, we measure the contribution of *Imported Inflation* on French inflation by aggregating across imported goods i and accounting for the share of tradables (β):

$$\beta_t \sum_{s \in \Omega^T} \omega_{st} \eta_{st} \left[E_s \left[\frac{d\gamma_{it}}{dt} (p_{it}^{LWC} - p_{it}^{HWC}) \right] + E_s \left[\gamma_{it} \left(\pi_{it}^{LWC} - \pi_{it}^{HWC} \right) \right] \right] \tag{7}$$

where $\omega_{st} = v_{st}/v_t^T$ is the weight of sector s in consumption of tradable goods, η_{st} is the share of imports in sector s and the last term of the product is the contribution of LWC imports on imports inflation in France. The overall effect on average across the period is -0.06 pp per year. The import substitution effect contributes to -0.07pp whereas the contribution of import inflation differential is positive equal to 0.01pp. The overall effect of imported inflation of consumer goods is almost fully driven by Chinese imports (a little less than -0.05pp)

Looking by products (Table 2), the imported inflation channel is at play in almost all COICOP categories except *Food*, *Alcohol* & *Tobacco* and by definition in *Restaurants* & *Hotels*.

[Insert Table 2 here]

4.3 Competition Channel

The *competition* channel transits through the pro-competitive effect of imports from LWC on domestic prices. We here estimate the impact of LWC import penetration on product-level domestic producer price inflation. Our estimating equation is the following:

$$\pi_{i,t}^{D} = \Psi \Delta S_{i,t}^{LWC} + \kappa \Delta labcost_{i,t} + \eta \Delta inputcost_{i,t} + \lambda_t + \nu_i + \epsilon_{i,t} \tag{8}$$

where $\pi_{i,t}^{D}$ is the log-difference of producer prices (domestic market) between year $t-1$ and t for product i, $\Delta S_{i,t}^{LWC}$ is the variation of the share of imports from LWC in domestic consumption of good i,[22] $\Delta labcost$ is the annual growth rate of labour cost in sector i and $\Delta inputcost$ the annual change in the intermediate input cost for sector i, λ_t is a time fixed-effect and ν_i is a product fixed effect.

Ψ is our coefficient of interest. We expect $\Psi < 0$, implying that increases in the market share of low-wage imports in sector i reduce domestic inflation. Notice that the reduced-form equation (8) and the hypothesis $\Psi < 0$ are very general and arise in a broad group of theoretical models of variable markups. In Appendix B), we describe in more details a simple model that delivers this equilibrium relationship in the case of oligopolistic competition between domestic and foreign producers.

We estimate Equation (8) using data on domestic producer price inflation at the 4-digit level of the CPA classification from INSEE. LWC import penetration is defined as total imports of country category divided by total imports plus French domestic production (excluding production for exports): $S_t(LWC) = \frac{M_{i,t}^{LWC}}{Y_{i,t}+M_{i,t}-X_{i,t}}$, with $Y_{i,t}$, $M_{i,t}$ and $X_{i,t}$ representing sector i's total domestic production, imports and exports. We measure imports with the trade data described in Section 3 and we obtain domestic production from Eurostat's PRODCOM survey. We concorde trade data at the HS 6-digit level to production data at the CPA Rev2 level using a concordance table from the European Commission's RAMON website. We define S_t using imports from all LWC and alternatively using imports from China only. Following Auer and Fischer [2010] and Auer et al. [2013], the denominator is averaged over the full sample to reduce concerns that results might be driven by the responses of the French production to French

[22] Consistently with the notations in the previous sections, $S_{i,t}^{LWC} = \gamma_{i,t} \times \eta_{i,t}$.

prices.[23] Annual change in total labor costs and in intermediate input costs are calculated using sector-level data from STAN-OECD Database (at level 2 of the NACE classification). These variables capture changes in marginal costs.

OLS estimation of Ψ might suffer from endogeneity bias. Both domestic prices and imports depend positively on (unobserved) demand shocks in France, which if present would generate a positive correlation between both variables. Similarly, unobserved productivity shocks affecting French producers might lower prices and change demand towards domestic goods and away from imports. Given these considerations, OLS estimations are likely to provide upward-biased coefficients of the true effect of low-wage import penetration on domestic prices. To account for this potential bias we use instrumental variables that generate variations in low-wage countries' market shares while being exogenous to movements in France's demand and supply. We identify supply shocks in LWC with the year-on-year growth rate of manufacturing exports from each LWC to the world, excluding France, in the spirit of Autor et al. [2013]. As argued by Auer and Fischer [2010], these supply shocks should have a relatively higher impact in sectors for which LWC have a comparative advantage with respect to France. This is captured with a measure of each sector's labor intensity. Thus, the instrument combines a variable that varies over time with a time-invariant sector characteristic. Hence our instrumental variable varies both over time and across products.

We estimate Equation (8) with Panel IV 2SLS regressions. In all specifications, we compute heteroskedasticity robust standard errors. Appendix C) provides details on the variables construction and reports the results of the first-stage regressions. In the first-stage equation, our instrumental variable is significant at 1%-level for specifications using all products whereas when restricting the sample to consumption goods or high-import penetration sector estimated parameters are statistically significant at 5% or 10% level. Our instrument also passes several tests of weak instrument when considering all products whereas when we restrict our sample to some product categories we loose some identification power.

[Insert Table 3 here]

Table 3 reports the results of both the OLS and IV regressions respectively for all LWC

[23] Results are similar if we relax this assumption.

(and Appendix Table C shows the results when restricting the import penetration variable to China only: $\Delta S^{CH}_{i,t}$). Columns (1) and (2) use the full sample of 154 CPA products. An increase in the market share of imports coming from LWC has a small positive effect on domestic producer-price inflation. Controlling for endogeneity, we find a strong negative effect of LWC import penetration on producer price inflation. A 1% increase in the share of LWC in any given sector's demand decreases domestic producer prices by 1.2%, an effect statistically significant at 5%. Auer et al. [2013] report very similar magnitudes for France (between −1 and −2.7%). The regression using only China provides a negative but non-significant OLS estimates. Like for LWC, the negative effect is highly amplified in the IV regressions: a 1%-increase in Chinese import penetration leads to lower domestic inflation by 1.9 pp. Notice that IV estimates are also much less precise.

In columns (3) and (4) we restrict the sample to consumption goods (that is, those that can be matched with COICOP, in a similar vein as described in Section 3). The elasticity of French PPI to import penetration is estimated at −0.8 for all LWC and −1.1 in the case of China only. The estimates are much noisier in the light of the smaller sample size and become not significant. The last two columns of Table 3 (and Appendix Table C) report results where we restrict the sample to sectors with high import penetration (larger than 33%), obtaining qualitatively similar effects as those obtained with the full sample.

We measure the contribution of *Competition* to inflation as:

$$\beta_t \sum_{s\in\Omega^T} \omega_{st}(1-\eta_{st})\hat{\Psi}\frac{dS_t^{LWC}}{dt} \tag{9}$$

where $\hat{\Psi}$ is the elasticity of PPI inflation (π_t^D) to LWC import penetration (S_t^{LWC}) obtained from the IV estimation on the full sample of sectors (column 2): $\hat{\Psi} = 1.21$.[24]

We find that an overall contribution of *Competition* of −0.06pp on average per year. When looking at the effect of China alone, the average change in import penetration is a bit smaller (less than 0.1 pp per year) but the impact on producer price inflation is a little higher (1.9), leading to an overall effect of a little more than 0.02 pp.

[24] We prefer this estimate to the one including only consumption goods because using the sample of all goods allows us to have a better identification power. Moreover, estimates for all goods or restricting to consumption goods are not statistically different.

5 Measured Inflation and Welfare Implications

In this section we discuss the aggregate effect of LWC for French consumers.

5.1 Aggregate Effect of LWC Imports on Inflation

Table 4 summarizes our main results. The contribution of LWC on domestic inflation decomposes into three additive channels that have been estimated in Section 4: (1) The *substitution* channel, capturing the replacement of domestic production by goods from LWC, accounted for almost -0.05 pp per year on average. (2) The rise in the proportion of LWC goods in total imports reduced French inflation by -0.06 pp. (3) Import penetration led to a reduction of -0.06 pp of inflation through the *competition* channel. Overall inflation for French consumers would have been 0.17 pp higher on average each year if the share of LWC had remained at its 1994 level (China alone explaining about half of this effect). A back-of-the-envelope calculation shows that it represents savings of €1,000 per households. Indeed, total consumption of goods and services amounted to around €1,000 billion. Having access to LWC goods enabled households to save about EUR 30 billion on consumption in 2014 compared to what they would have paid in the absence of international trade openness to low-wage countries. Taking into account the total number of households (slightly less than 30 million in 2014), consumption per household was therefore on average €1,000 cheaper in 2014 compared to what it would have been in the absence of imports from low-wage countries since 1994.

5.2 CPI versus Welfare-Consistent (COLI) Measure of Inflation

One remarkable message arising from our empirical exercise is that much of the effect of increasing imports from LWC transited via changes in the consumption basket. The substitution of French or HWC products towards LWC goods plays a key role in driving aggregate price dynamics. Following the discussion in Section 2, we decompose the contribution of LWC goods to π_t into the *pure price* inflation and the *composition* terms defined in Equation (4). We use our empirical estimates from Section 4 to quantify each term:

$$\beta_t \sum_{s\in\Omega^T} \omega_{st} \left[(1-\eta_{st})\hat{\Psi}\frac{dS_t^{LWC}}{dt} + \eta_{st}E_s\left[\gamma_{it}\left(\pi_{it}^{LWC} - \pi_{it}^{HWC}\right)\right]\right] = -0.05\ pp \tag{10}$$

and

$$\beta_t \sum_{s\in\Omega^T} \omega_{st} \left[\frac{d\eta_{st}}{dt} E_s \left[\gamma_{it}^{LWC}\right] E_s \left[p_{it}^{LWC} - p_{it}^{D}\right] + \eta_{st} E_s \left[\frac{d\gamma_{it}}{dt} \left(p_{it}^{LWC} - p_{it}^{HWC}\right)\right]\right] = -0.12\ pp \tag{11}$$

The first term (10) quantifies the contribution of LWC on inflation through pure price effects. The second term (11) measures the contribution of composition effects (substitution of both HWC and domestic goods towards LWC goods). We find that the latter is almost double than the former, implying that imports from LWC reduced COLI inflation by −0.17 pp per year on average, whereas their impact on CPI inflation was substantially smaller, of around one third of the total effect (−0.05 pp).

5.3 CES (Dixit-Sliglitz) versus Cobb-Douglas Preferences

We have relied on Cobb-Douglas preferences so far because it provides linear expressions that are easily interpretable and measurable. However, most available estimates of the elasticity of substitution give values that are larger than one (e.g. Broda and Weinstein [2006] and Redding and Weinstein [2020])[25]. We therefore now discuss the general case of a CES utility function. How would the magnitude of our estimates change under such preferences? To answer this question, we compare the decomposition of inflation under the two systems of preferences.

We focus on an individual good i with a constant number of varieties j and omit subscript i for notational convenience. Consider a Dixit-Stiglitz aggregation of varieties where the taste for variety j is denoted α_t^j. The price of good i is defined as $P_t^{1-\theta} = \alpha_t^R {P_t^R}^{1-\theta} + \alpha_t^L {P_t^L}^{1-\theta}$, where P^R is the price index of domestic and HWC goods that are pooled within the "Rich" category as they exhibit a very similar evolution over time.[26] The decomposition of inflation by origin of varieties (R for rich countries and L for LWC) thus writes:

$$\pi_t = \underbrace{\pi_t^R + \gamma_t^L \left(\pi_t^L - \pi_t^R\right)}_{\text{pure price}} + \underbrace{\frac{1}{1-\theta} \left[\left(\frac{P_t^L}{P_t}\right)^{1-\theta} - \left(\frac{P_t^R}{P_t}\right)^{1-\theta} \right] \frac{d\alpha_t^L}{dt}}_{\text{taste shift}} \tag{Dixit-Stiglitz}$$

As the elasticity of substitution tends to one, this formula converges to the Cobb-Douglas

[25]See Feenstra et al. [2018] discuss macro and micro estimates of Argminton elasticities

[26]We use this approximation to keep a simple case with two categories of country and simplify the exposition and notations.

case:

$$\pi_t = \underbrace{\pi_t^R + \gamma_t^L \left(\pi_t^L - \pi_t^R\right)}_{\text{pure price}} + \underbrace{\left[\log P_t^L - \log P_t^R\right] \frac{d\alpha_t^L}{dt}}_{\text{taste shift}} \quad \text{(Cobb-Douglas)}$$

In Equations (Dixit-Stiglitz) and (Cobb-Douglas), the first two elements on the right side represent the *pure price* inflation computed by statistical agencies, while the third term captures the contribution of *taste shift* to inflation. Importantly, the *pure price* component is identical whatever the underlying system of preferences, whereas the contribution of *taste shift* differs. The Cobb-Douglas demand system has the special feature that the taste parameter – once normalized to sum up to one – is equal to expenditure shares: $\forall j, \alpha_{ijt} = \frac{P_{ijt}Q_{ijt}}{P_{it}Q_{it}} = \frac{v_{ijt}}{v_{it}} = S_{ijt}$, where α is the taste shifter and S_{ijt} denotes the market share of j in total expenditures on good i.[27] Hence the contribution of taste shift is directly observable in the data (it is exactly equivalent to the *composition* term in Section 2).

In the Dixit-Stiglitz case, α_t^L cannot be directly observed. However, noting that the expenditure share of variety j under Dixit-Stiglitz preferences is $S_{jt} = \alpha_{jt}\left(\frac{P_{jt}}{P_t}\right)^{1-\theta}$, and given that $\alpha_t^L + \alpha_t^R = 1$ and $S_t^L + S_t^R = 1$, it follows that:

$$\frac{\alpha_t^L}{1-\alpha_t^L} = \left(\frac{P_t^L}{P_t^R}\right)^{\theta-1} \frac{S_t^L}{1-S_t^L}$$

Hence the taste parameter can be recovered from observed prices and expenditure shares for any given elasticity of substitution θ:[28]

$$\alpha_t^L = \frac{\left(\frac{P_t^L}{P_t^R}\right)^{\theta-1} \frac{S_t^L}{1-S_t^L}}{1 + \left(\frac{P_t^L}{P_t^R}\right)^{\theta-1} \frac{S_t^L}{1-S_t^L}}$$

With this information at hand, we compute the evolution of taste shift ($\Delta\alpha_t^L$) and measure its contribution to inflation. Figure 7 (left panel) plots the average contribution of the taste-shift term[29] to COLI inflation for different values of θ. It is about 0.11 pp per year for $\theta = 1$,

[27] Note that in line with previous notation, $S_t^L = \eta_t \gamma_t^L$

[28] Note that differently from Khandelwal et al. [2013] who estimate quality of exports, we do not need to run estimations since we observe prices of all competitors. Hence, given θ, taste parameters for LWC can be directly calculated from available information.

[29] i.e. the third term on the right side in Equation (Dixit-Stiglitz)

which is close to our benchmark case discussed previously in the paper (-0.12 pp).[30] As the elasticity of substitution increases, the estimated contribution decreases. For θ between 4 and 6, the contribution of taste shift lies between -0.08 and -0.07 pp per year, about one-third lower than the magnitude derived with Cobb-Douglas preferences.

Why is the estimated contribution of taste shift to welfare gain decreasing in θ? First, remember that $S_t^L = \alpha_t^L \left(\frac{P_t^L}{P_t}\right)^{1-\theta}$. Thus, the variation of α_t^L over time is related to the change in the expenditure share of LWC in the following way:

$$\frac{d\alpha_t^L}{dt} = \frac{dS_t^L}{dt}\left(\frac{P_t^L}{P_t}\right)^{\theta-1} + (\theta-1)S_t^L\left(\frac{P_t^L}{P_t}\right)^{\theta-1}(\pi_t^L - \pi_t) \tag{12}$$

Figure 7 (right panel) plots the two terms of this decomposition for different values of θ. Focusing on the contribution stemming from observed variations in market shares (i.e. the first term in Equation 12), we can easily show that $\frac{d\alpha_t^L}{dS_t^L} \approx \left(\frac{P_t^L}{P_t}\right)^{\theta-1}$ is decreasing in θ since $\frac{P_t^L}{P_t} = \exp(-0.4) < 1$. When the elasticity of substitution is higher, taste shocks do contribute less in determining market shares, while relative prices do matter more. Therefore, for a given observed variation in the market share of LWC, the estimate of the contribution stemming from taste shocks is smaller when the elasticity of substitution (θ) is higher.

Overall, since the pure-price effect remains the same for any value of θ (ie. equal to -0.05pp), this would suggest that the effect of LWC imports on inflation would range between -0.17 pp for our benchmark Cobb-Douglas case and -0.13 pp for θ equal to more standard values (between 4 and 6).

6 Conclusion

In this paper, we assess empirically how imports of consumption goods from low-wage countries have affected inflation in France over the last 20 years. Our key contribution is to decompose the inflation of an exact price index into different channels and quantify separately each of them. First, the replacement of consumption goods domestically produced by imports from LWC has had a negative effect of -0.05 pp per year on inflation; second, the rise in the proportion of

[30]The small difference comes from our simplifying assumption that we have only two goods one produced by "rich" countries and on produced by "poor" countries.

LWC goods in total imports reduced French inflation by -0.06 pp; third, import penetration of consumption goods led to a reduction of -0.06 pp of inflation through a competition channel. Overall, we find that inflation for French consumers would have been 0.17 pp higher on average each year if the share of LWC had remained at its 1994 level. Chinese imports alone explain about half of this overall effect.

This exercise allows us to disentangle the impact of LWC on cost-of-living versus CPI inflation - the latter abstracting for taste-shift effects. We estimate that imports from LWC lowered CPI inflation by 0.05 pp per year on average, but had a much larger effect on the cost-of-living inflation (between 0.13 to 0.17 pp per year depending on the preferences specification). Most of the disinflationary effect on the cost of living is stemming from the reallocation of consumption towards goods produced in LWC, that is largely driven by taste shifts. CPI inflation does not account for such changes in the structure of consumption and captures pure-price effects only.

We have focused on the direct effect of consumer goods imports. An indirect channel might that transits through the productivity effects of imported intermediate goods, a topic that we leave for future research.

References

Andrieux, Virginie and Aurelien d'Isanto, "Des marges commerciales variees selon les produits, mais proches entre grandes surfaces," Insee Focus, n45, Insee 2015.

Arkolakis, Costas, Arnaud Costinot, and Andrs Rodrguez-Clare, "New Trade Models, Same Old Gains?," *American Economic Review*, February 2012, *102* (6), 2121–68.

Atkeson, Andrew and Ariel Burstein, "Pricing-to-Market, Trade Costs, and International Relative Prices," *American Economic Review*, December 2008, *98* (5), 1998–2031.

Auer, Raphael A. and Andreas M. Fischer, "The effect of low-wage import competition on U.S. inflationary pressure," *Journal of Monetary Economics*, 2010, *57* (4), 491–503.

_ , Katrin Degen, and Andreas M. Fischer, "Low-Wage Import Competition, Inflationary Pressure, and Industry Dynamics in Europe," *European Economic Review*, 2013, *59*, 141–166.

Autor, David H., David Dorn, and Gordon H. Hanson, "The China Syndrome: Local Labor Market Effects of Import Competition in the United States," *American Economic Review*, October 2013, *103* (6), 2121–68.

Bai, Liang and Sebastian Stumpner, "Estimating US Consumer Gains from Chinese Imports," *American Economic Review: Insights*, September 2019, *1* (2), 209–224.

Bank of Finland, "Finnish Import Prices and Globalization," Monthly Bulletin 3, Bank of Finland 2006.

Berlingieri, Giuseppe, Holger Breinlich, and Swati Dhingra, "The Impact of Trade Agreements on Consumer Welfare," CEPR Discussion Papers 11148, C.E.P.R. Discussion Papers March 2016.

Bernard, Andrew B., Bardford Jensen, and Peter K. Schott, "Survival of the best fit: Exposure to low-wage countries and the (uneven) growth of U.S. manufacturing plants," *Journal of International Economics*, 2006, *68* (1), 219–237.

Boskin, Michael J., Dulberger Ellen L., Griliches Zvi, Gordon Robert, and Jorgenson Dale W., "Toward a More Accurate Measure of the Cost of Living," Final Report, Senate Finance Committee 1996.

_ **, Ellen L. Dulberger, Robert J. Gordon, Zvi Griliches, and Dale W. Jorgenson**, "Consumer Prices, the Consumer Price Index, and the Cost of Living," *Journal of Economic Perspectives*, March 1998, *12* (1), 3–26.

Breinlich, H., E. Leromain, N. Novy, and T. Sampson, "Exchange Rates and Consumer Prices:Evidence from Brexit," *LSE mimeo*, 2019.

Broda, Christian and David E. Weinstein, "Globalization and the Gains from Variety," *The Quarterly Journal of Economics*, 2006, *121* (2), 541–585.

Cardoso, Fatima and Paulo Soares Esteves, "The effects of Low-Cost Countries on Portuguese Manufacturing Import Prices," Working Paper 4, Banco de Portugal 2008.

Coille, Conall Mac, "The impact of low-cost economies on UK import prices," Quarterly Bulletin, Bank of England 2008.

Draghi, Mario, "Accompanying the Economic Recovery," Introductory speech, ECB Forum on Central Banking, Sintra 2017.

Emlinger, Charlotte and Lionel Fontagné, "(Not) Made in France ," *La lettre du CEPII*, 2013, *333*, –.

Feenstra, Robert C., Philip Luck, Maurice Obstfeld, and Katheryn N. Russ, "In Search of the Armington Elasticity," *The Review of Economics and Statistics*, 2018, *100* (1), 135–150.

Glatzer, Ernst, Ernest Gnan, and Maria Teresa Valderrama, "Globalization, Import Prices and Producer Prices in Austria," *Monetary Policy & the Economy*, 2006, (3), 2443.

International Monetary Fund, "Export and Import Price Index Manual: Theory and Practice," *[Washington, D.C.]: International Monetary Fund*, 2009, *2009.*

Jaravel, Xavier and Erick Sager, "What Are the Price Effects of Trade? Evidence From the U.S. and Implications for Quantitative Trade Models," Technical Report, mimeo February 2018.

Kamin, Steven B., Mario Marazzi, and John W. Schindler, "The Impact of Chinese Exports on Global Import Prices," *Review of International Economics*, 05 2006, *14* (2), 179–201.

Khandelwal, Amit K., Peter K. Schott, and Shang-Jin Wei, "Trade Liberalization and Embedded Institutional Reform: Evidence from Chinese Exporters," *American Economic Review*, October 2013, *103* (6), 2169–2195.

Miao, G. and F. Fortanier, "Estimating Transport and Insurance Costs of International Trade," OECD Statistics Working Papers, OECD April 2017.

Nickell, Stephen, "Why has Inflation Been So Low Since 1999?," Speech at the Bank of England Monetary Policy Committee and London School of Economics, Bank of England 2005.

Pain, Nigel, Isabell Koske, and Marte Sollie, "Globalisation and OECD consumer price inflation," *OECD Journal: Economic Studies*, 2008, *2008* (1), 1–32.

Redding, S. and D. Weinstein, "Accounting for Trade Patterns," *NBER Working Paper*, 2018, (24051).

Redding, Stephen J. and David E. Weinstein, "Measuring Aggregate Price Indexes with Taste Shocks: Theory and Evidence for CES Preferences," *Quarterly Journal of Economics*, 2020, *135* (1), 503–560.

Rogoff, Kenneth S., "Globalization and global disinflation," *Proceedings - Economic Policy Symposium - Jackson Hole*, 2003, pp. 77–112.

Sveriges Riksbank, "Why are Swedish import prices so low?," Inflation Report 2005/2, Sveriges Riksbank 2005.

Table 1: Substitution Channel - Decomposition by COICOP Product Categories (average, 1994-2014)

COICOP (% of CPI)	Share of tradables β	Δ imp. pen. $\frac{\partial \eta_t}{\partial t}$	Share of LWC imp. γ	Price diff. $p^{LWC} - p^{D}$	Channel 1	Contrib. CPI infl. in pp ($\times 10^2$)
1- Food and non-alcohol. beverages (15%)	0.73	0.30	0.12	-0.27	-0.01	-0.1
2- Alcoholic beverages and tobacco (4%)	1.00	-0.03	0.11	-0.16	0.00	0.0
3- Clothing and footwear (4%)	0.97	2.23	0.56	-0.64	-0.80	-3.8
4- Housing, water, elect., gas... (14%)	0.18	0.57	0.13	-0.51	-0.04	-0.2
5- Furnishings, house services (6%)	0.85	1.42	0.26	-0.62	-0.23	-1.0
6- Health (10%)	0.27	0.88	0.17	-0.47	-0.07	-0.1
7- Transport (16%)	0.43	0.68	0.16	-0.52	-0.06	-0.3
8- Communication (3%)	0.10	0.59	0.45	-0.89	-0.02	-0.1
9- Recreation and culture (8%)	0.53	0.76	0.27	-0.38	-0.08	-0.4
11- Restaurants and hotels (8%)	0.00	-	-	-	-	0.0
12- Miscellaneous goods and services (13%)	0.29	0.87	0.30	-0.58	-0.15	-0.5

Note: The first column "share of tradables" reports for each COICOP aggregate category the ratio between total imports of a given product (source: Customs) and the total French consumption of tradable goods (source: Insee, national accounts), including VAT and distribution margins. "Δ in import pen." is the average year-on-year change in the share of imports in French tradables. "Share of LWC imports" reports the share of imports from low-wage countries in overall French imports. "Average price diff." is the average difference in the (log) level of prices of goods imported from LWCs and the ones produced in France (this latter price is proxied by French export prices) (we also take into account a wedge of 5% bewteen CIF imports an FOB exports). "Channel 1" is calculated by COICOP 1 as the product of column (1), (2), (3) and (4) and is the impact on the product inflation of the substitution of domestically produced goods with LWC imports. "Contribution" is the substitution channel effect multiplied by the share of the COICOP in CPI consumption.

Table 2: Imported Inflation Channel - Decomposition by COICOP Product Categories (average, 1994-2014)

COICOP (% of CPI)	Imports pen. $\beta\eta$	Imported inflation effect: Switching $\frac{\partial \gamma_t}{\partial t}(p^{LWC} - p^{HWC})$	Imported inflation effect: Infl. diff. $\gamma\,(\pi^{LWC} - \pi^{HWC})$	Channel 2	Contrib. to CPI infl. in pp ($\times 10^2$)
1- Food and non-alcohol. beverages (15%)	0.11	-0.06	-0.01	-0.01	-0.12
2- Alcoholic beverages and tobacco (4%)	0.14	-0.08	0.00	-0.01	-0.05
3- Clothing and footwear (4%)	0.57	-0.63	0.24	-0.22	-0.89
4- Housing, water, elect., gas... (14%)	0.37	-0.27	0.07	-0.07	-1.05
5- Furnishings, house services (6%)	0.53	-0.63	0.07	-0.29	-1.76
6- Health (10%)	0.15	-0.34	0.03	-0.04	-0.45
7- Transport (16%)	0.23	-0.43	0.05	-0.09	-1.38
8- Communication (3%)	0.56	-0.01	1.20	0.66	1.98
9- Recreation and culture (8%)	0.40	-0.64	0.04	-0.24	-1.90
11- Restaurants and hotels (8%)	0	-	-	-	0.0
12- Miscellaneous goods and services (13%)	0.24	-0.45	0.078	-0.09	-1.15

Note: The first column "Import pen." reports import penetration by COICOP aggregate category as the share of total imports (source: Customs) in the product category consumption (source: Insee, national accounts) (including VAT and distribution margins). Second and third column report the contribution of LWC imports to the product-level import inflation (following the decomposition presented in equation **??**). Column 2 reports results for the switching effect (i.e consumers switching from HWC imports to LWC imports) whereas col. 3 reports results of inflation differential (i.e. HWC import prices growing more or less quickly than LWC import prices). Column 4 reports the estimation of the contribution of LWC import to CPI inflation coming from the Imported inflation effect (Channel 2), calculated as $col.(1) \times (col.(2) + col.(3))$. "Contribution" is the channel 2 effect multiplied by the share of the COICOP in CPI consumption.

Table 3: Impact of LWC Imports on French Producer Price Inflation

	All goods		Consumption goods		High Import penetration	
	OLS	IV	OLS	IV	OLS	IV
Δ share - LWC	0.134*	-1.208**	0.198*	-0.803	0.102	-1.656
	(0.063)	(0.615)	(0.103)	(1.283)	(0.086)	(1.312)
Δ Interm. Input costs	0.226***	0.249***	0.095**	0.100*	0.245***	0.340***
	(0.041)	(0.044)	(0.048)	(0.051)	(0.058)	(0.103)
Δ Labour costs	-0.052	0.025	-0.069	0.004	-0.043	0.145
	(0.044)	(0.054)	(0.080)	(0.077)	(0.068)	(0.140)
Cragg-Donald statistic	-	24.79	-	8.38	-	6.66
Stock-Yogo crit. value	-	10%	-	20%	-	20%
F-stat. 1st stage	-	18.22	-	3.64	-	4.43
R^2	0.11	0.03	0.14	0.06	0.11	0.06
Nb products	154	154	52	52	81	81
Nb observations	1,986	1,981	699	699	984	981

Note: this table reports estimates of OLS and IV regressions where the dependent variable is the annual PPI inflation calculated as the annual change in producer price index (domestic market) for 154 products defined at level 4 of the NACE rev2 classification (manufacturing industries only) (source: Insee) on the period 1995-2014 (when available). Product and year dummies are included in all specifications. Robust standard errors are reported in brackets. "Δ share" is the annual change in the share of LWC's imports in total French imports and domestic production. Year (19 years) and product (154 products) dummies are included, controls for annual growth rate of intermediate input costs and labour costs at the sectoral level (level 2 of NACE classification, source: Stan OECD) are also included. "All goods" include all goods for which producer price inflation is available, "'Consumption goods"' include goods that can be match with CPI classification, "'High import penetration"' include goods for which the import penetration is higher than the average (about 33%). Columns (1), (3), and (5) correspond to results obtained from OLS regressions, all other columns report results of IV regressions where the instrumental variable is the sector's labor share multiplied by the annual growth rate of LWC exports (see Appendix C) for details and results of first-stage regressions).

Table 4: Average Values of Main Variables (1994-2014)

Channel 1: Substitution

	β	$\frac{\partial \eta_t}{\partial t}$	γ	$(p_t^{LWC} - p_t^d)$	Contrib CPI
LWC	0.46	0.81	0.31	-0.41	-0.05
China	0.46	0.81	0.13	-0.52	-0.03

Channel 2: Imported Inflation

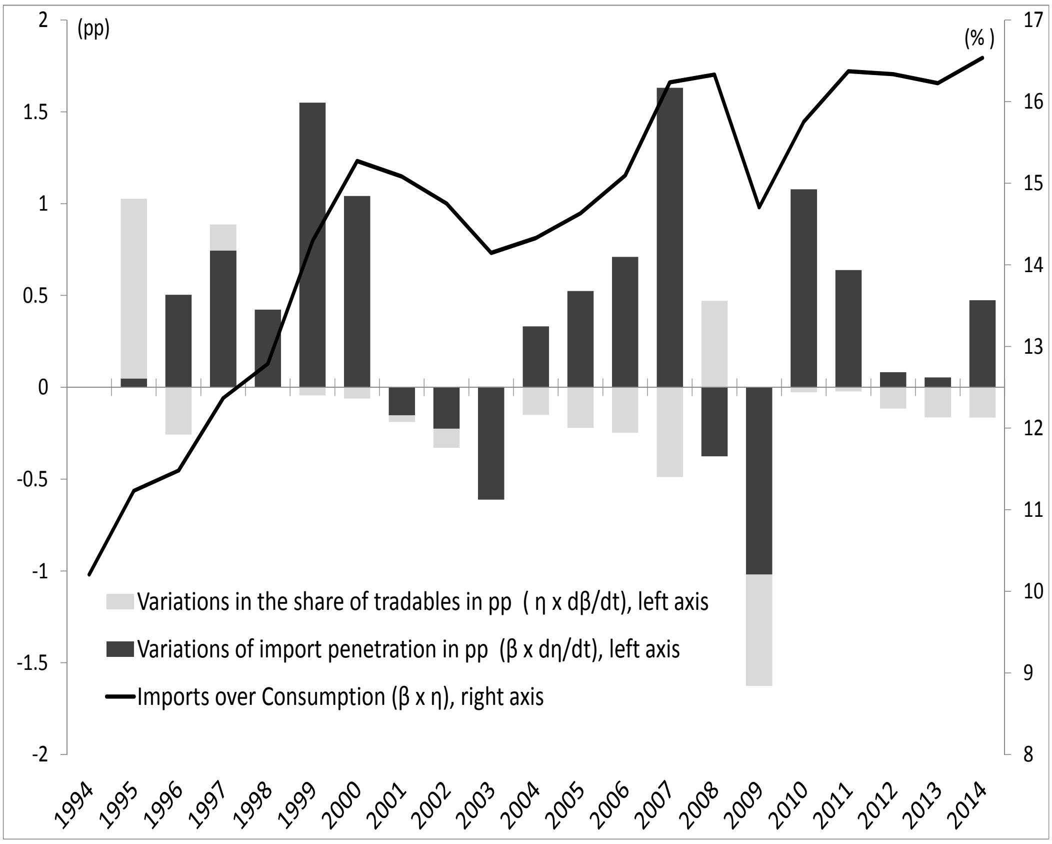
	$\beta\eta$	$\frac{\partial \gamma_t}{\partial t}(p^{LWC} - p^{HWC})$ (1)	$\gamma\,(\pi^{LWC} - \pi^{HWC})$ (2)	(1) + (2)	Contrib CPI
LWC	0.14	-0.47	0.06	-0.41	-0.06
China	0.14	-0.39	0.06	-0.33	-0.05

Channel 3: Competition

	$\beta \times (1 - \eta)$	$\frac{\partial S_t^{LWC}}{\partial t}$	$\frac{\partial \pi_t}{\partial S_t^{LWC}}$	Contrib CPI
LWC	0.32	0.17	-1.21	-0.06
China	0.32	0.05	-1.85	-0.02

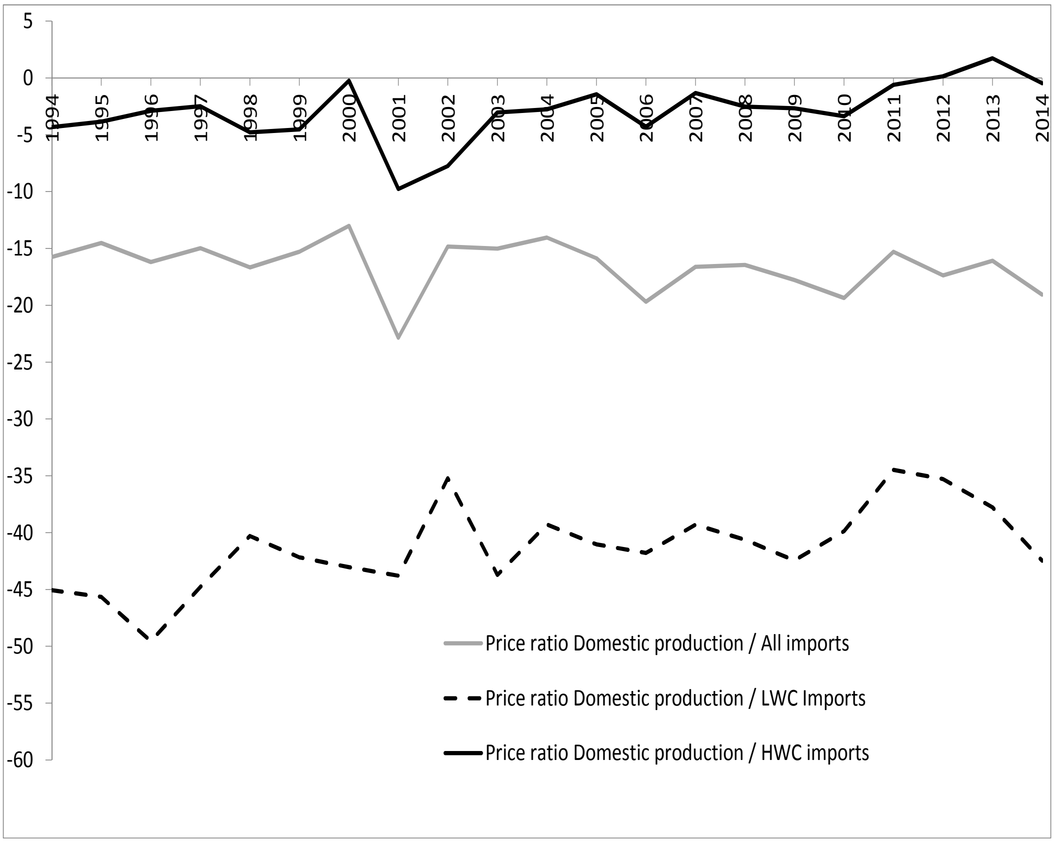
Note: The table presents the values of the main variables used in the analysis. Each variable is first calculated yearly, and then averaged over the period 1994-2014. In the case of variable denoting changes over time (i.e. $\frac{\partial \eta_t}{\partial t}$), first the year-on-year percentage change is calculated and average over the period. “Contrib CPI” is the total contribution of each channel to the evolution of French CPI inflation. Details of the variables' construction are provided in sections 2 and 4.

Figure 1: Import Penetration (1994-2014)



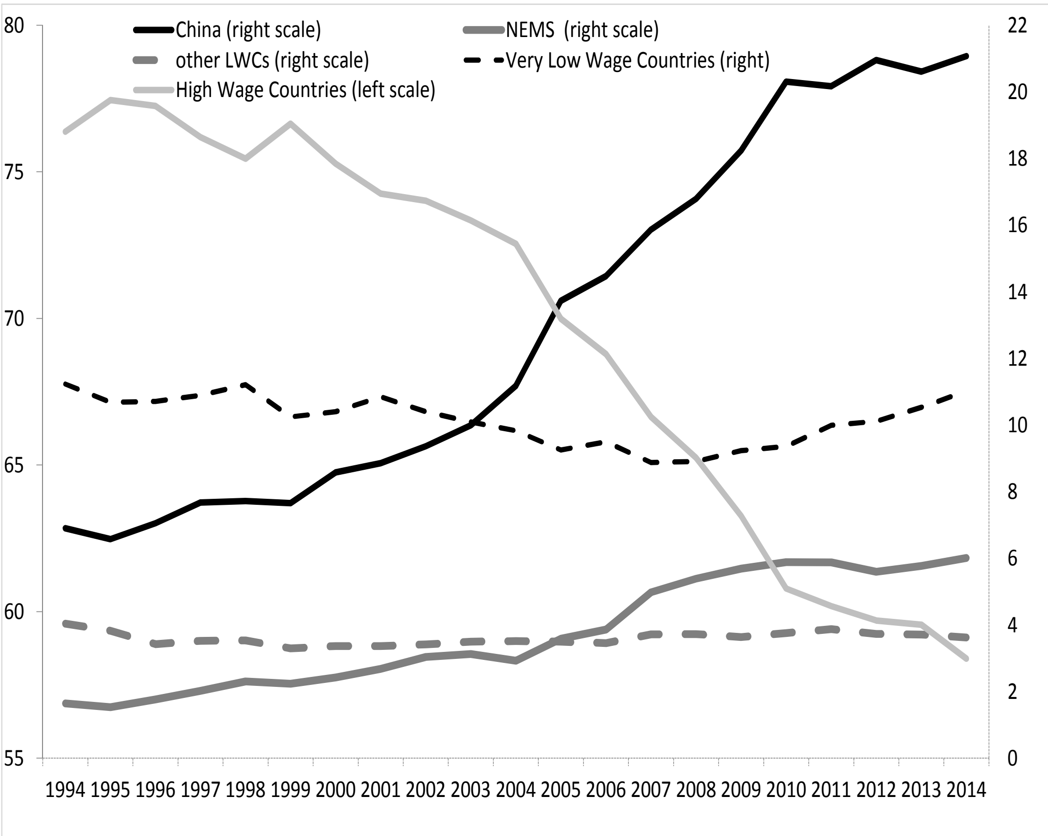
Note: this figure plots the share of imports in total CPI consumption by year (RHS scale, in percentage). Grey histograms The yearly change in import penetration (i.e. the yearly change in the back dashed line) is the sum of both histograms (LHS scale) in a given year. The plain grey histogram plots the changes in total import penetration (η_t) weighted by the share of tradable goods in consumption and the share of LWCs in imports. Once this term is multiplied by the price difference ($p_t^{LWC} - p_t^d$), we get exactly the channel 1. The dashed grey histogram represents the contribution of changes in β_t to yearly changes in import penetration from LWCs.

Figure 2: Price of Domestically Produced Goods Relative to Prices of Imported Goods (Consumer Goods)



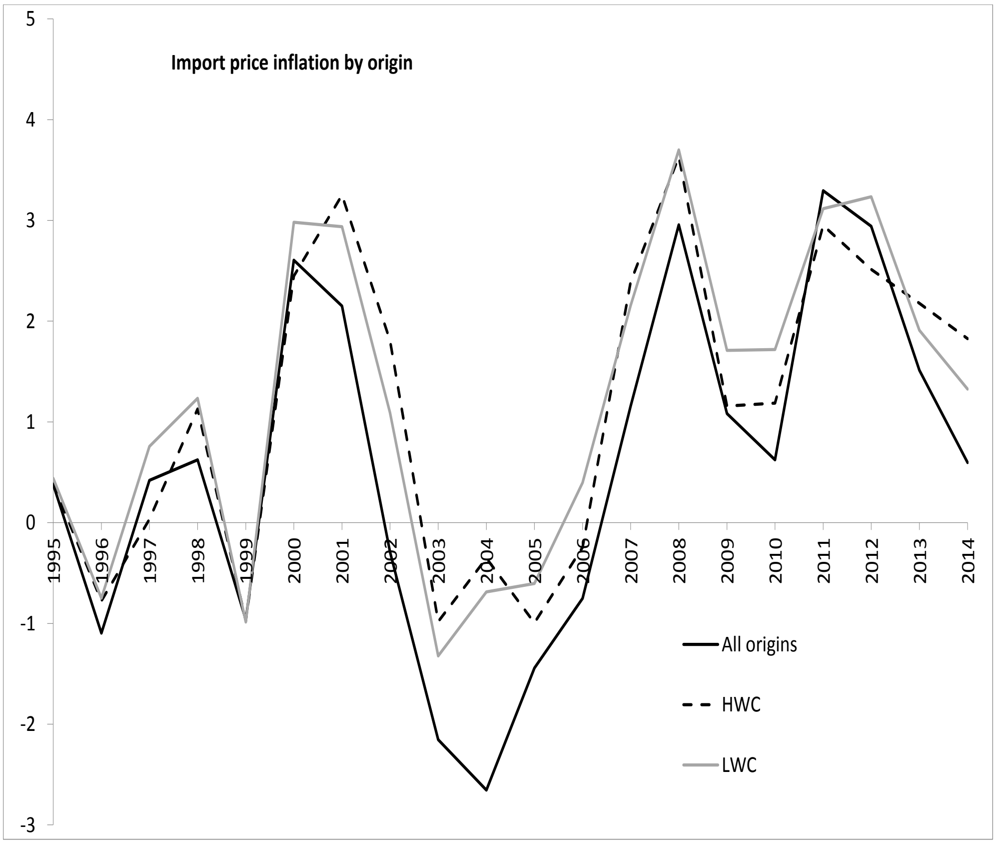
Note: We first compute the price differential (in a given year) at the level 8 of the trade product classification (HS classification) between import unit values and export unit values (considered as equivalent to the domestic producer price). The figure reports the weighted average of this price differential. The black line corresponds to the price differential between HWC imports and French export prices, the grey line corresponds to the average using price differential between imports of all origins and French exports prices, the dashed black line corresponds to the average price differential between LWC imports and French exports prices.

Figure 3: Import Market Shares over Time and by Country Category



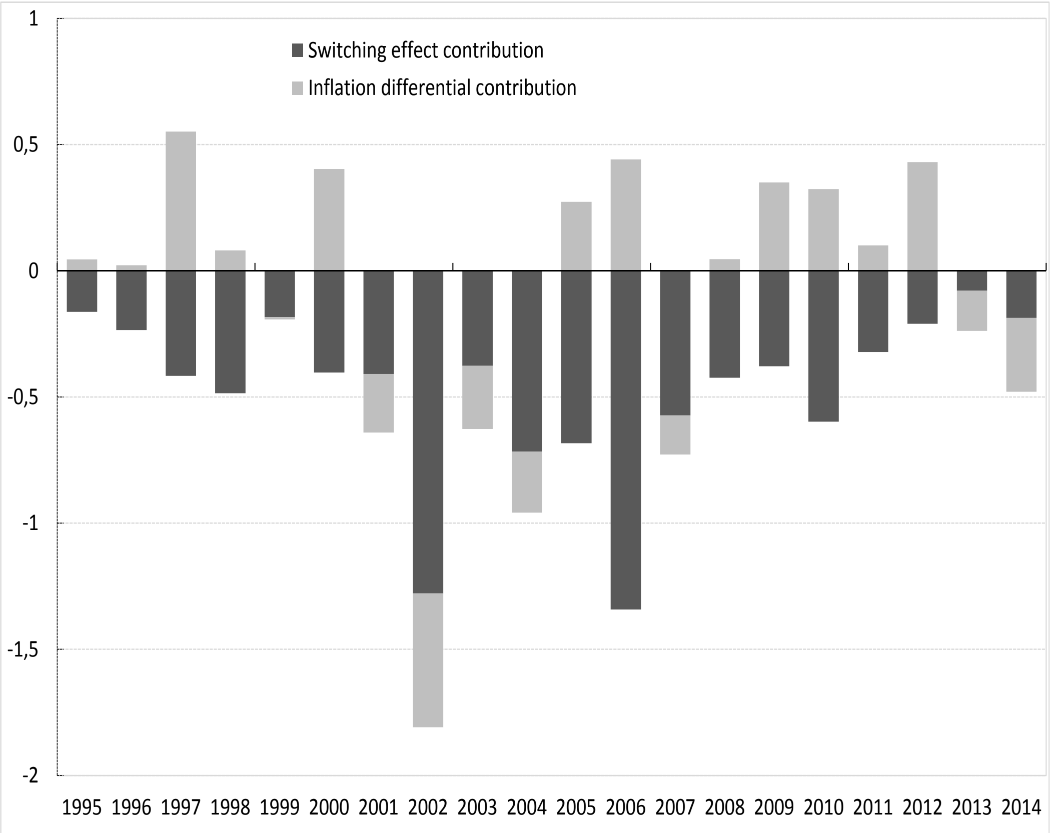
Note: the figure plots the ratio of imports value coming from a given country category over all French imports (in percent), these ratios are computed for the five country categories (see Table A). The grey line plots the share of high wage countries imports in all French imports (left axis), the black line plots the share of Chinese imports in all French imports (right axis), the dashed black line plots the share of very low wage countries imports in all French imports (right axis), the dark grey line plots the share of NEUMS countries imports in all French imports (right axis) and the dashed dark grey line plots the share of low wage countries imports in all French imports (right axis).

Figure 4: Import Price Inflation Differential: High-wage vs. Low-wage Countries



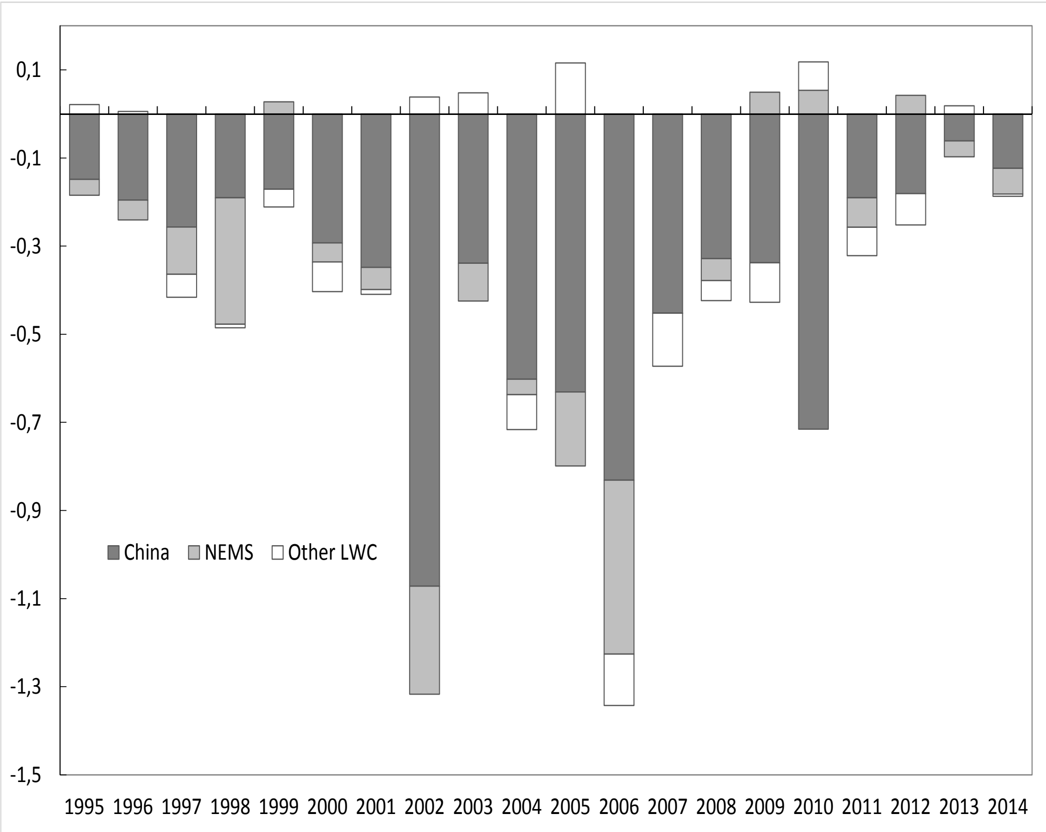
Note: the figure plots the y-o-y inflation rate of two components of the overall French import price inflation (the solid black line). The solid light-grey line is the import price inflation for goods produced in LWCs while the dashed black line corresponds to goods imported from HWCs. Note that overall import price inflation might be lower than the weighted average of the two components because a switching effect is also at play, and the weight of LWCs (with lower import prices in *level*) increase to the detriment of HWCs.

Figure 5: Contribution to Import Price Inflation: Substitution vs Inflation Differential Effects



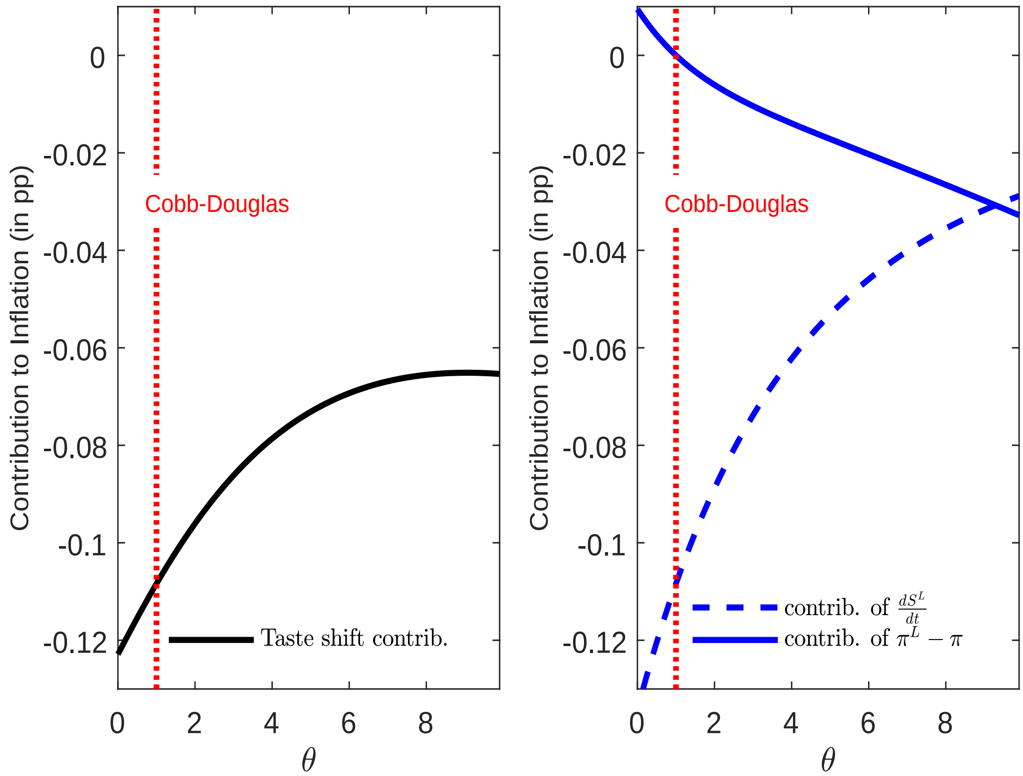
Note: We first calculate for each year and each product (restricting to consumer goods) the impact of LWC imports on import price inflation. We distinguish the impact coming from a variation of the share of LWC imports in total imports (called Switching effect) and the impact coming from differences in inflation between LWC and HWC imports (called Inflation Differential effect). The figure plots the weighted average contribution of LWC imports on French import inflation and distinguish between substitution (black histogram) and inflation differential (grey histogram) contributions. The overall impact of LWC imports on French import inflation is obtained as the sum of both histograms in a given year.

Figure 6: Substitution Contribution to Import Inflation: Country Category Decomposition



Note: we first calculate the contribution of LWC imports due to variations in the share of LWC imports in total imports by country category. The figure plots the weighted average contribution of LWC imports on French import inflation due to substitution effect by country category. The dark grey histogram plots the substitution contribution due to the Chinese imports, the light grey histogram plots the substitution contribution due to NEUMS imports, the white histogram plots the substitution contribution due to all other LWC imports (obtained as the sum of the substitution effect due the other LWC imports and other VLWC imports). The overall substitution effect of LWC imports on French import inflation is obtained as the sum of all three histograms in a given year.

Figure 7: Contribution of the Taste Shift to Inflation - Variations Over θ



Note: The left-hand-side panel represents the contribution of taste-shift to inflation. It corresponds to the second term in equation (Dixit-Stiglitz) $(-\frac{1}{\theta-1}\left(\left(\frac{P^L}{P}\right)^{1-\theta} - \left(\frac{P^R}{P}\right)^{1-\theta}\right) \times \frac{d\alpha^L}{dt})$ multiplied by the share of tradable goods in consumption. Since taste parameter for LWC, α^L, can be expressed as a function of the market share and the relative price, we decompose this effect into two sub-contributions. The right-hand-side panel presents the contribution stemming from observed variations in market shares $(\frac{dS^L}{dt})$ (dashed blue line) and the contribution stemming from inflation differential $(\pi^L - \pi)$ (plain blue line). The sum of the plain and dashed blue lines is equal by construction to the black one on the left.

Appendix

(Not intended for publication)

Date: March 31, 2020

A) Additional Tables and Figures

Table A: List of Countries by Country Categories

Group of countries	
High-wage countries	GDP per capita above 75% of France's: EU countries, US, Canada, UK, Japan,South Korea, Australia, New Zealand, Israel...
Low-wage countries	GDP per capita between 25% and 75% of France's
- New EU member states	Bulgaria, Croatia, Cyprus, Czech, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Slovenia
- Other low-wage countries	Turkey, Brazil, Mexico, Malaysia, Russia, Argentina,...
Very low-wage countries	GDP per capita below 25% of France's
- China (including Hong-Kong)	
- Other Very low wage countries	India, Thailand, Tunisia, Morocco, Indonesia, Philippines, Vietnam, Egypt, Pakistan, Ukraine, Ivory Coast,...

Table B: Contribution of LWC Imports to Import Price Inflation: an International Comparison

Country	Period	Impact of LWC imports on import inflation	Source
France	1995-2005	-0.48 pp	This study
Austria	1995-2005	-0.66 pp	Glatzer et al. [2006]
Finland	1996-2005	-1 pp	Bank of Finland [2006]
Portugal	1998-2006	-0.2 pp	Cardoso and Esteves [2008]
Sweden	1996-2004	-1 to -2 pp	Sveriges Riksbank [2005]
United States	1993-2002	-0.8 to -1 pp	Kamin et al. [2006]
France	2000-2005	-0.74 pp	This study
United Kingdom	2000-2005	-0.7 pp	Mac Coille [2008]

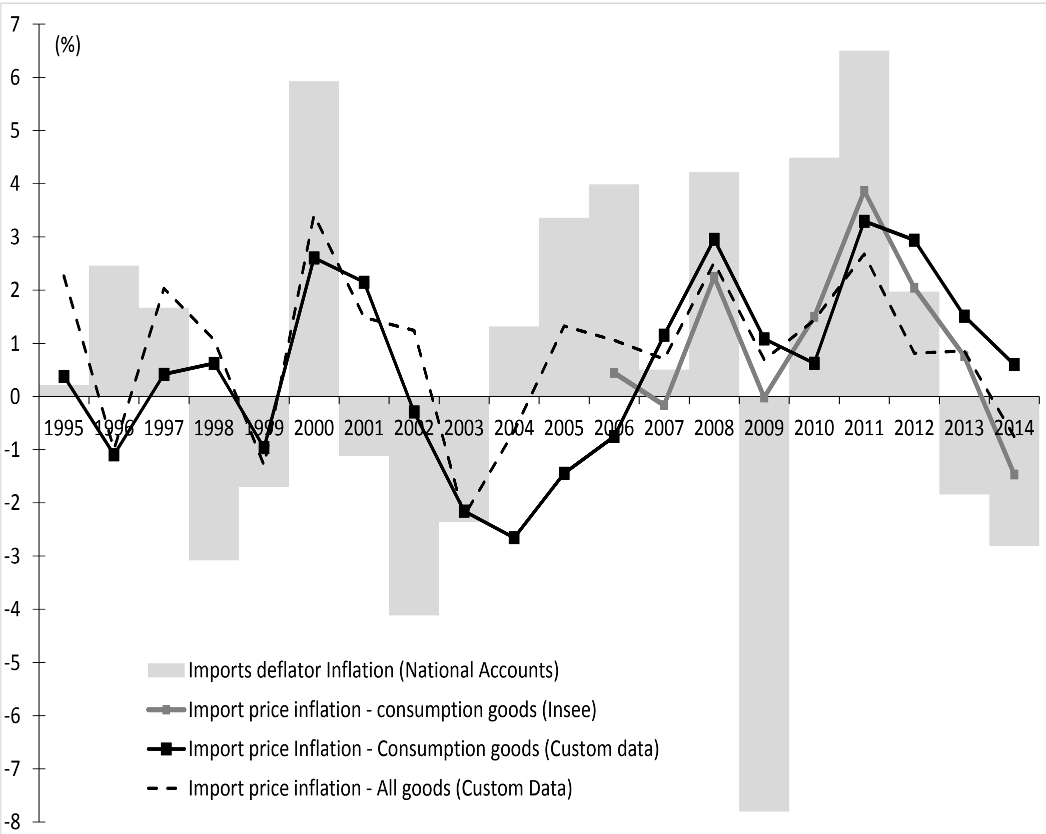
Note: this table reports estimates of the contribution of LWC imports to import price inflation in different countries. These estimates are obtained using a very similar methodology presented in section 2 and correspond to our "imported inflation effect" (Channel 2). Differences in methodologies may come from the definitions of country categories and also from the level of product disaggregation. Results presented for France are calculated over two different periods (1995-2005) and (2000-2005) to facilitate cross country comparisons.

Table C: Impact of Chinese Imports on French Producer Price Inflation

	All goods		Consumption goods		High Import penetration	
	OLS	IV	OLS	IV	OLS	IV
Δ share - China	-0.043	-1.846*	0.122	-1.124	-0.067	-1.550
	(0.082)	(0.990)	(0.116)	(1.555)	(0.087)	(1.110)
Δ Interm. Input costs	0.228***	0.224***	0.095**	0.093*	0.251***	0.254***
	(0.041)	(0.039)	(0.047)	(0.049)	(0.057)	(0.055)
Δ Labour costs	-0.043	-0.010	-0.059	-0.013	-0.028	0.032
	(0.044)	(0.047)	(0.080)	(0.083)	(0.068)	(0.075)
Cragg-Donald statistic	-	25.56	-	4.98	-	13.13
Stock-Yogo crit. value	-	10%	-	> 25%	-	15%
F-stat. 1st stage	-	15.71	-	2.83	-	9.37
R^2	0.11	0.04	0.14	0.07	0.11	0.04
Nb products	154	154	52	52	81	81
Nb observations	1,986	1,981	699	699	984	981

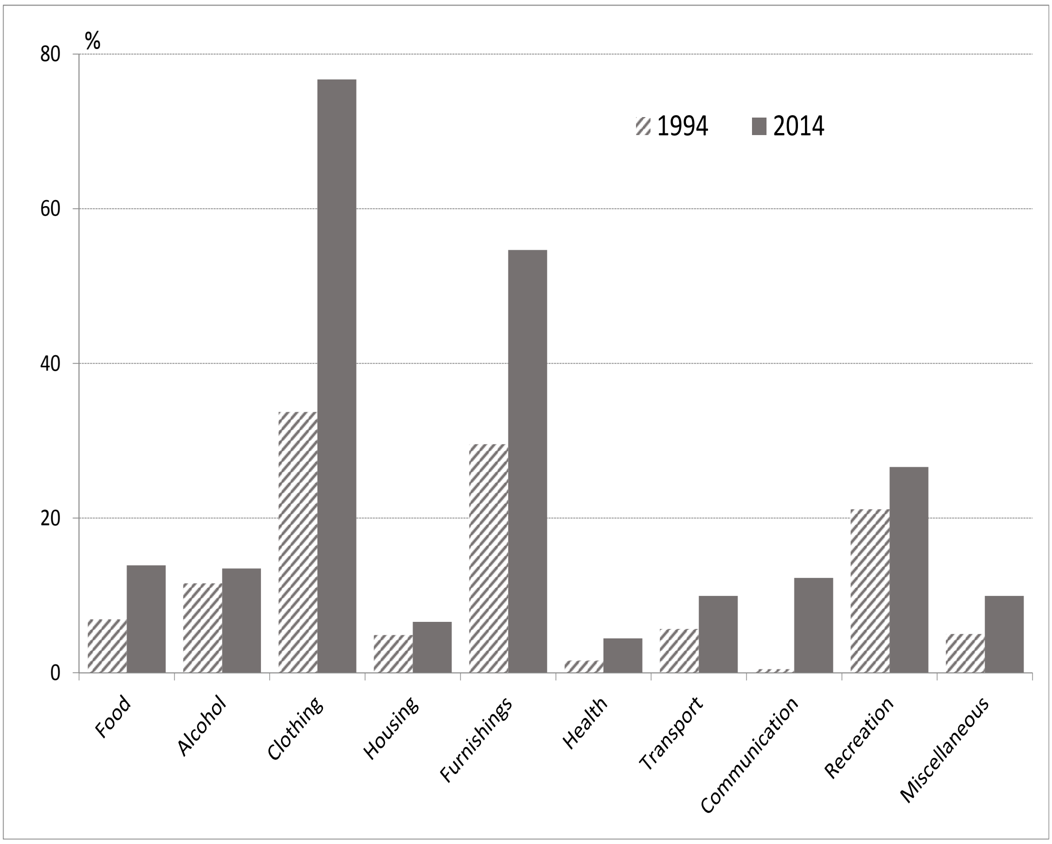
Note: this table reports estimates of OLS and IV regressions where the dependent variable is the annual PPI inflation calculated as the annual change in producer price index (domestic market) for 154 products defined at level 4 of the NACE rev2 classification (manufacturing industries only) (source: Insee) on the period 1995-2014 (when available). Product and year dummies are included in all specifications. Robust standard errors are reported in brackets. "Δ share" is the annual change in the share of China's imports in total French imports and domestic production. Year (19 years) and product (154 products) dummies are included, controls for annual growth rate of intermediate input costs and labour costs at the sectoral level (level 2 of NACE classification, source: Stan OECD) are also included. "All goods" include all goods for which producer price inflation is available, "'Consumption goods"' include goods that can be match with CPI classification (a little more than 50 products), "'High import penetration"' include goods for which the import penetration is higher than the average (about 33%). Columns (1), (3), and (5) correspond to results obtained from OLS regressions, all other columns report results of IV regressions where the instrumental variable is the sector's labor share multiplied by the annual growth rate of Chinese exports (see Appendix C) for details and results of first-stage regressions).

Figure A: Comparison between Import Price Indices



Note: the figure plots in dark grey line the annual variation of import price inflation for industrial goods (source: Insee - aggregate monthly series of import price index), in grey histogram the annual variation of the import deflator for manufactured goods including mining and quarrying (source Insee - annual national accounts) and in black lines, annual variations of our import price index computed using trade unit values and price indices by product and country categories (see section 3.2). The black dashed line corresponds to import inflation including all goods whereas the black line corresponds to import inflation only for consumption goods.

Figure B: Share of imports in consumption by COICOP category



Note: "% of imports in consumption" reports for each COICOP aggregate category the ratio between total imports of a given product (source: Customs) and the total French consumption (source: Insee, national accounts) (including VAT and distribution margins).

B) Model

This section builds a simple model of oligopolistic competition at the sector level (à la Atkeson and Burstein [2008]),that generates complementarities in price setting, from which we derive equation (8). Specifically, we suppose there are only two firms within each sector: one domestic and one foreign. Since firms are not atomistic within a sector, strategic behaviors arise and the domestic producer adjusts its price in response to changes in the market shares of its foreign competitor.

Turning to the details of the model, we assume that the final consumption good is the Dixit-Stiglitz aggregation of imperfect substitutable products, denoted by i. There are two layers of production:

1. The final consumption good, denoted Y_t, is composed of differentiated products supplied by a continuum of "sectors" (indexed by i) on $[0,1]$: $Y_t = \left[\int_0^1 Y_t(i)^{\frac{\sigma-1}{\sigma}} dk\right]^{\frac{\sigma}{\sigma-1}}$, where σ is the elasticity of substitution between products from different sectors. The demand for sectoral good is $Y_t(i) = \left(\frac{P_t(i)}{P_t}\right)^{-\sigma} Y_t$, where P_t is the consumption price index defined as $P_t = \left[\int_0^1 P_t(i)^{1-\sigma} dk\right]^{\frac{1}{1-\sigma}}$ and $P_t(i)$ is the sectoral price.

2. Each good i is produced by a retailer that combines two intermediate varieties (supplied by one domestic and one foreign firm): $Y_t(i) = \left[\sum_j x_t(j,i)^{\frac{\theta-1}{\theta}}\right]^{\frac{\theta}{\theta-1}}$ with $j \in \{D, F\}$. The associated price index is $P_t(i) = \left[\sum_j P_t(j,i)^{1-\theta}\right]^{\frac{1}{1-\theta}}$.

   The demand for good j in sector i is:

$$x_t(j,i) = \left(\frac{P_t(j,i)}{P_t(i)}\right)^{-\theta} Y_t(i) = \left(\frac{P_t(j,i)}{P_t(i)}\right)^{-\theta} \left(\frac{P_t(i)}{P_t}\right)^{-\sigma} Y_t \tag{13}$$

   The elasticity of substitution between goods within a sector is greater than the elasticity of substitution across sectors ($\theta > \sigma$). To be consistent with the benchmark model presented in section2 that relies on Cobb-Douglass aggregation across varieties, we can assume $\theta \to 1$ and $\sigma \to 0$ (i.e. Leontief demand structure across sectors).

Consider the behavior of a firm j within a given manufacturing industry i. Under Bertrand oligopolistic competition, the perceived elasticity of demand to a firm's own price, $\Theta_t(j,i)$, is not constant, although the elasticity of substitution between goods in the sector is constant (θ).

$$\Theta_t(j,i) = -\frac{\partial x_t(j,i)}{\partial P_t(j,i)} \frac{P_t(j,i)}{x_t(j,i)} = \theta - (\theta - \sigma) \underbrace{\left(\frac{\partial P_t(i)}{\partial P_t(j,i)} \frac{P_t(j,i)}{P_t(i)} \right)}_{= \left(\frac{P_t(j,i)}{P_t(i)}\right)^{1-\theta} \neq 0} \tag{14}$$

The profit maximization problem of firm j at time t given the cost function $\mathcal{C}(\dot{})$ is:

$$\max_{P_t(j,i)} P_t(j,i) x_t(j,i) - \mathcal{C}(x_t(j,i))$$
$$\text{s.t. } x_t(j,i) = \left(\frac{P_t(j,i)}{P_t(i)}\right)^{-\theta} \left(\frac{P_t(i)}{P_t}\right)^{-\sigma} Y_t$$

The first order condition implies that the firm sets its optimal price as a markup over marginal cost:

$$P_t(j,i) = \mathcal{M}_t(j,i) mc_t(j,i) \tag{15}$$

where:

$$\mathcal{M}_t(j,i) = \frac{\Theta_t(j,i)}{(\Theta_t(j,i) - 1)}$$
$$\Theta_t(j,i) = \theta - (\theta - \sigma) \underbrace{\left(\frac{P_t(j,i)}{P_t(i)}\right)^{1-\theta}}_{S_t(j,i)}$$

and $mc_t(j,i)$ is the marginal cost of production, $\mathcal{M}_t(j,i)$ is the markup function and $\Theta_t(j,i)$ the elasticity of demand to its own price.

We denote $S_t(j,i)$ the share of firm j in sector i total expenditures:

$$S_t(j,i) = \frac{P_t(j,i)}{P_t(i)} \frac{x_t(j,i)}{Y_t(i)} = \frac{P_t(j,i) P_t^{-\theta}(j,i)}{P_t(i) P_t^{-\theta}(i)} = \left(\frac{P_t(j,i)}{P_t(i)}\right)^{1-\theta}$$

The markup, $\mu_t(j,i)$, can be written as a decreasing function of the equilibrium market share of firm j, $S_t(j,i)$. This is a very useful feature because, even though equilibrium markups are unobservable, the pro-competitive channel can be captured by expressing markups as a function of equilibrium markets shares, which we observe in the data.

Rewriting equation (15) in log:

$$\begin{aligned}
&\log(P_t(j,i)) = \log(\mathcal{M}_t(j,i)) + \log(mc_t(j,i)) \\
&\frac{\partial \log}{\partial t}(P_t(j,i)) = \frac{\partial \log}{\partial t}(\mathcal{M}_t(j,i)) + \frac{\partial \log}{\partial t}(mc_t(j,i))
\end{aligned} \tag{16}$$

Besides,

$$\frac{\partial \log}{\partial t}(\mathcal{M}_t(j,i)) = \underbrace{\left[-\frac{1}{\Theta_t(j,i)-1}\right]}_{\varepsilon_{\mathcal{M}\Theta}} \underbrace{\left[-(\theta-\sigma)\frac{S_t(j,i)}{\Theta_t(j,i)}\right]}_{\varepsilon_{\Theta S}} \frac{\partial \log}{\partial t}(S_t(j,i))$$

where ε_{uv} denotes the elasticity of u with respect to v.

In the end:

$$\pi_t(j,i) = \varepsilon_{\mathcal{M}\Theta}\varepsilon_{\Theta S}\frac{\partial \log}{\partial t}(S_t(j,i)) + \frac{\partial \log}{\partial t}(mc_t(j,i)) \tag{17}$$

Equation (17), applied to the domestic producer ($j = D$), relates domestic producer price inflation in sector i to changes in the domestic producer's market share. The latter is a function of the market shares of its foreign competitor: $S_t(D) = 1 - S_t(F)$ ($\forall$ sector i). Thus, equation (17) can be rewritten as a negative relationship between domestic firm's price and the share of foreign competitor in industry sales – i.e. import penetration:

$$\pi_t(D,i) = \psi\frac{\partial \log}{\partial t}(S_t(F,i)) + \frac{\partial \log}{\partial t}(mc_t(D,i)) \tag{18}$$

We obtain the empirical counterpart by appending a residual term $\mu_{it} = \lambda_t + \nu_i + \epsilon_{i,t}$, where λ_t is a time fixed-effect and ν_i is a sector fixed effect:

$$\pi^D_{i,t} = \Psi\Delta S^F_{i,t} + \kappa\Delta labcost_{i,t} + \eta\Delta inputcost_{i,t} + \lambda_t + \nu_i + \epsilon_{i,t} \tag{19}$$

where $labcost_{i,t}$ and $inputcost_{i,t}$ capture changes in the marginal cost of production.

C) Instruments

In this Appendix, we provide details on the construction of the instrumental variables and present the results from the first-stage regressions. Our instrumental variable is defined as the product of the average French labor share ls in sector i and the annual growth rate of LWC manufacturing exports ΔX: $x_{it} = ls_i \times \Delta X_t$. The instrument provides sector × year variation obtained from the product of a time-varying country category-level variables ΔX_t and a time-invariant sector-level variable, ls_i. ls_i is averaged over the period to reduce endogeneity concerns. Labor shares are calculated using firm-level balance-sheet quasi-exhaustive administrative data constructed from tax records, labeled "BRN" (Benefices Reels Normaux). We first sum the firm-level wage bill and value-added for all firms in the same sector, we then define the labor share for each sector as the ratio of (wage bill)/(value added). Then we take the average across years. For the growth rate of exports ΔX_t we use data from the World Bank's Development Indicators Database. We obtain manufacturing exports by country and by year (in current dollars) as the product of annual merchandise exports and a variable indicating the proportion of manufacturing exports in merchandise exports. We sum exports of all LWCs to all destinations except France, then we calculate the year-on-year growth rate. In the case of the China share we use Chinese exports to all destinations except France.

The first-stage regression is the following:

$$\Delta S_{i,t}^{LWC} = a + bx_{i,t} + c\Delta labcost_{i,t} + d\Delta inputcost_{i,t} + T_t + P_i + z_{i,t} \tag{20}$$

where $\Delta S_{i,t}^{LWC}$ is the variation of the share of imports from China in domestic consumption of good i, x_{it} is our instrumental variable, $\Delta labcost$ is the annual growth rate of labour cost in sector i and $\Delta inputcost$ the annual change in input cost for sector i, T_t is a time fixed-effect and P_i is a product fixed effect, $z_{i,t}$ is the residual term.

The second stage equation is as defined in the main text by equation (8).

Table D reports results of the first-stage estimation. The first stage results show that our instrument has a significant positive effect on the change in LWC / Chinese import penetration.

Table D: Results of first-stage estimation

	All goods		Consumption goods		High Import penetration	
	(1)	(2)	(3)	(4)	(5)	(6)
Δ Export LWC × Labour share	0.236***		0.175*		0.205**	
	(0.055)		(0.092)		(0.097)	
Δ Export China × Labour share		0.135***		0.113**		0.179***
		(0.034)		(0.052)		(0.059)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Product dummies	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.10	0.05	0.08	0.06	0.13	0.08
Nb products	154	154	52	52	81	81
Nb observations	1,981	1,982	699	699	980	980

Note: this table reports first-stage estimates of our IV regressions where the dependent variable is "Δ Export LWC × Labour share", the annual change in LWC manufcaturing exports (source: WTO) times the average labour share calculated at the product-level (source: administrative firm-level data). Year (19 years) and product (154 products) dummies are included, controls for annual growth rate of intermediate input costs and labour costs at the sectoral level (level 2 of NACE classification, source: Stan OECD) are also included. Robust standard errors are reported in brackets. "All goods" include all goods for which producer price inflation is available, "'Consumption goods"' include goods that can be match with CPI classification.