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Real exchange rate and export surge episodes: What sectors take advantage of the real exchange rate stimulus?

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ABSTRACT

What are the main characteristics of sectors that take advantage of the real exchange rate stimulus after a large and long-lasting devaluation? We aim to answer this question by analyzing the development of export sectors in Argentina during 2003–2008, after the crisis and large devaluation of 2002. This six-year period shows the highest number of sectors with export surge episodes from 1980 to 2015. We find, first, that the probability of export surge episodes increased 2.5% by each standard deviation of the higher labor intensity index during the large and long-lasting devaluation period because non-tradable costs prevail in their production function. Second, we show that export surges are more likely to occur in sectors related to already competitive sectors (mainly upstream sectors). Finally, the new export volumes in those sectors show persistent dynamics despite the end of the period of currency competitiveness, a signal of trade hysteresis.

1. Introduction

Export-led growth strategy is one of the most accepted by development scholars as a successful way to keep sustainable growth acceleration episodes after Asian miracles cases. In this strategy, the development of new export sectors is at the center of scene (Krueger, 1990; Amsden, 1994; Nelson and Pack, 1999; Weiss, 2005; Hausmann et al., 2007). What is the role of the real exchange rate (RER) level on the take-off of new export sectors? What are the main characteristics of the sectors that are able to take advantage of the exchange rate stimulus? Does it depend on the countries' previous productive capabilities? This article aims to answer these questions by examining an interesting case study of a developing country that experienced a large change in the level of the RER over a long (enough) period to take place the take-off of export sectors. Focusing on a long enough period of competitive (and stable) RER level allows us to study not the marginal effect of RER on exports, but its impact on the development of new export capabilities that might last after the end of the RER stimulus.[1]

Argentina's real effective exchange rate (REER) depreciated 57% at the beginning of 2002, during the currency and financial crisis that put end of a decade of the currency board regime. More importantly and in contrast to other currency devaluation events, the new real exchange rate level remained stable until 2008. On average, between 2003 and 2008, the REER was depreciated by 53% compared to 2001 (see Figure 4 in the appendix).[2] The magnitude and persistence of this new REER level is an excellent natural experiment to study the connection between the exchange rate and the development of tradable sectors.

Since our focus is not on the marginal effect of RER on exports, we take advantage of previous work done by Palazzo and Rapetti (2017) and analyze the cross-section characteristics of export surges episodes that occurred during this period. The so-called *export surges* capture those episodes in which sectoral exports experience a pronounced change in their growth trends, accelerate their export growth rates, and increase their international market share. In other words, they are episodes where these sectors developed capabilities and expanded their production capacity, increasing the country's tradable supply. Indeed, the authors find that during the six-year period from 2003 to 2008, Argentina shows the highest peak of export surges episodes from 1980 onwards. A total of 120 sectors fulfilled the requirements to classify their performance as an export surge episode, representing 17% of the total sectors evaluated. These numbers are well above the unconditional probability of 9% of export surges episodes, and it is 44% higher than the previous peak occurred in 1994–1999.

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[1] We define the exchange rate as the domestic price of a foreign currency. Consequently, a rise (fall) in the nominal/real exchange rate implies a nominal/real depreciation (appreciation) of the domestic currency. The RER is the relative price between tradables and non-tradables.

[2] For our purposes, defining an equilibrium RER level and its undervaluation is not relevant. A persistent change in the RER level should be enough to see some new export sectors emerge. However, Aromí et al. (2014) show that the RER remained undervalued after 2002 large devaluation and overvalued during the decade before.

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Our empirical strategy aim to test and isolate some of the main theoretical channels through which the RER level might favor export surges episodes. Since in developing countries exports are invoiced in US dollars (Gopinath, 2015), a more depreciated RER level mostly change the profitability rate for exporters and, under some conditions, might encourage the expansion of tradable supply. As a result, the net exposure of an exporting firm to changes in the real exchange rate is given by the share that non-tradable goods represent in their costs. Given that labor is the most important non-tradable cost of most production function, the RER should affect sectors differently depending on their labor intensity (Frenkel and Ros, 2006). In addition, we argue that the likelihood of new export sectors taking off also depends on the existing capabilities of the economy. This means that RER should foster the occurrence of export surge episodes in those sectors close to already competitive sectors, showing path dependence in the country's productive structure (Hidalgo et al., 2007; Hausmann and Klinger, 2006; Bahar et al., 2019).

In order to assess the determinants of the export surge episodes during the six-year period 2003–2008, we perform linear probability regression to the cross-section of the roughly 700 export sectors. We use the 4-digit disaggregation classification of the SITC, revision 2.[3] The dependent variable is a dichotomous indicator (0 or 1) of the occurrence of an export surge episode by sectors during the six-year period. Our main identification strategy is given by the theoretical hypothesis that labor-intensive sectors and sectors related to other already competitive sectors should benefit the most from the large and long-lasting RER devaluation. Then, the main explanatory variables are a proxy of the sector's labor intensity (workers per million of gross output value) and an agnostic relatedness index provided by the product-space built by Hidalgo et al. (2007). We argue that it is reasonable to consider the large depreciation that occurred in 2002 as an exogenous and unexpected event at the sectoral disaggregation level at which effects are assessed. However, given the multiplicity of macroeconomic changes during the whole six-year period, we are cautious and interpret the results obtained mainly as correlations. In any case, our paper's main novelty is concentrating on the cross-section heterogeneities of RER on the occurrence of export surge episodes.

Our main findings are summarized as follows. First, export surge episodes are more likely to occur in sectors with a higher share of non-tradable costs during the stable and competitive real exchange rate period. More precisely, the probability of an export surge episode increases by 2.5% by each standard deviation of a higher labor intensity index during the six-year period 2003–2008. These effects are significant and economically relevant, given that the unconditional probability of export surges is only 9.1% from 1980 to 2015. Second, export surge episodes are also more likely to occur in sectors related to other already existing competitive sectors during this period (2003–2008). A standard deviation in the sector's agnostic relatedness density index increases the probability of an export surge by 4%. This finding indicates that not all sectors can take advantage of the exchange rate stimulus, but mostly those where the current productive structure assures some degree of prior capabilities (Hidalgo et al., 2007). If we evaluate the specific connection channels to competitive sectors, we find that only upstream sectors of competitive ones manage to take advantage of the exchange rate impulse. There is no positive effect for downstream sectors, sectors that share similar workforce characteristics, or sectors that use or provide similar technology to competitive sectors. Finally, we show evidence of hysteresis effects in sectors with export surges. The sectors with export surges keep the export level gap over the rest of the exporting sectors once the real exchange rate competitiveness period is over. This finding justifies our focus on export surges and not on the marginal effects of RER on exports.

We do not intend to provide a detailed review of the very extensive literature on this topic but to point out some relevant papers that serve to situate our contribution. First, the connection between RER and labor intensity is proposed by Frenkel and Ros (2006) and tested empirically by Dao et al. (2021). This channel becomes even more critical after the contribution done by Gopinath (2015), Gopinath et al. (2020), Adler et al. (2020) and Boz et al. (2022), which highlight that export prices are invoiced in dollars for developing country's firms and, then the RER affects mainly through changing their profitability and incentives to invest (supply channel).[4] Since Palazzo and Rapetti (2023) have already shown a higher marginal effect of RER on exports of labor-intensive sectors in Argentina, we concentrate here on the development of new export capabilities. Second, our paper also relates to the literature that has used episodes of large devaluations, studying the exchange rate on the passthrough (Burstein et al., 2005), distributional effects (Cravino and Levchenko, 2017), and more importantly, the export dynamics (Alessandria et al., 2013) and its relationship with financial frictions (Kohn et al., 2020). The last two papers show that exports increase gradually after a large devaluation, which justify why we concentrate on a long enough period of time. Third, our paper might be understood as a country case study in line with Bahar et al. (2019), which analyzes the relationship between the sectors with export take-offs and their relatedness to already competitive sectors in a cross-country-sector panel data study. However, they do not focus on the effect of RER depreciation on them. The connection between RER depreciation and aggregate export surges episodes where already studied by Freund and Pierola (2012), from where we take and adapt the definition of export surges but at a sectoral level. Fourth, this paper might be served as an empirical test of one of the channels proposed by macro-development literature showing a positive correlation between real exchange rate levels and economic growth (Hausmann et al., 2007; Gala, 2007; Rodrik, 2008; Eichengreen, 2007; Frenkel et al., 2004; Rapetti et al., 2012; Cimoli et al., 2013; Bresser-Pereira et al., 2014; Guzman et al., 2018). One of the main theoretical hypotheses in this literature suggests that a higher real exchange rate level positively influences the profitability and rate of investment in modern tradable sectors and, through this channel, fosters economic growth (Libman et al., 2019; Caglayan and Demir, 2019; Marconi et al., 2021, 2022; Benigno et al., 2022). In addition, our paper is related to the Brazilian New Developmentalism literature, which highlights the potential damages on the potential long run growth rate caused by RER overvaluation due to inducing premature deindustrialization and a primarization of the export basket, decreasing (increasing) income elasticity of exports (imports) (see, for example, Bresser-Pereira et al. (2014); Marconi et al. (2021, 2022); Missio et al. (2017); Oreiro et al. (2020) and Blecker (2023)). Moreover, a currency that is too strong can cause companies to go bankrupt even if they would be able to compete if the exchange rate was closer to the appropriate level for the industry or even the

[3] Following Bahar et al. (2019), we refer to 4-digit disaggregation goods indistinctly as products or sectors. However, this disaggregation level is not sufficiently detailed for the product label to be accurate, but the omission of production linkages undermines the classification as sectors.

[4] Our assumption of how firms in developing countries set prices is motivated by the new empirical evidence proposed by the Dominant Currency Paradigm mentioned above (Gopinath, 2015; Gopinath et al. 2020). This literature highlights that prices of exports in emerging countries are usually invoiced in USD and remain stable in that currency. This evidence favors the idea that, in this case, the mechanism by which the real exchange rate influence on export performance is not a demand channel, but a supply channel, as suggested by Frenkel and Ros (2006), Rapetti et al. (2012), Razmi et al. (2012), Caglayan and Demir (2019) and Palazzo and Rapetti (2023). After a RER depreciation mark-ups and profitability of the tradeable sectors increase and foster investment. Interestingly, there is also some microeconomic evidence that supports this channel for some specific firms and sectors. Chen and Juvenal (2016) show that high-quality wines from Argentina increase their mark-ups more than low-quality wines after an RER depreciation. The same is true for high-performance firms in a developed country (Berman et al., 2012).

trade balance equilibrium. In this sense, some researchers argue that the overvaluation and the Dutch Disease could be seen as a market failure that prevents some tradable sectors from developing despite the fact of using the best technology and practices (Bresser-Pereira, 2013, 2020) and keeping a competitive and stable real exchange rate could be the second-best solution of this market failure. Last but not least, our paper is also related to the literature on RER, hysteresis in trade and learning by exporting where Krugman (1987), Dixit (1989), Campa (2004), De Loecker (2013) and Atkin et al. (2017) summarize some of the principal contributions.

The rest of the article is structured as follows. After this introduction, Section 2 establishes our main hypotheses to justify the export surges methodology, the determinants to be tested, and the mechanisms by which they operate. Section 3 defines the variable that establishes the existence of an export surge through the algorithm proposed by Palazzo and Rapetti (2017) and Freund and Pierola (2012). We provide robustness analyses to determine the episodes of export surge episodes. Section 4 is the heart of the paper, in which we present the main econometric exercises to study the determinants of the episodes. Section 5 performs a battery of robustness exercises. Next, Section 6 shows, on the one hand, evidence of the specific connection channels between the sectors with surges and already existing competitive sectors and, on the other hand, the existence of long-lasting hysteresis effects on the export levels of the sectors with surges. Section 7 concludes.

2. Real exchange rate, labor intensity, and export surges: Main hypotheses and mechanisms

We define the real exchange rate (q_t) as the relative price between tradable (P_t^T) and non-tradable goods (P_t^N). From this definition, it is straightforward to show that, assuming that the non-tradable sector produces under a regime of imperfect competition, there is an inverse relationship between the RER and tradable product wages (W_t/P_t^T), as well as a positive relationship between tradable profitability of exporting firms and the RER. The intuition is simple: from the point of view of an exporting firm, the wage is essentially a non-tradable cost. Non-tradable prices are set as a constant mark-up over unit cost–mainly wages–which are sticky in the short and medium run.[5] An increase in the relative price of tradable relative to non-tradable goods and services (real exchange rate depreciation) will improve its profitability to the extent that it reduces (relatively) its non-tradable costs. In the appendix, we make a formal derivation of this relationship.

This positive relationship between the real exchange rate and tradable profitability gives us the chance to propose and test this simple supply mechanism–without unrealistic assumptions and built on previous empirical findings–that connects the large and long enough currency depreciation occurred in Argentina with the tradable performance of that period.[6] The tradable prices of an exporting firm in a developing country are set as $P^T = eP^f$, where e is the nominal exchange rate and P^f is the price of the product invoiced in US dollars, which means their prices in dollars are fixed, at least in the short and medium run (Gopinath, 2015; Adler et al., 2020; Gopinath et al., 2020; Boz et al., 2022).[7] A depreciation in the nominal exchange rate increases export prices in domestic currency (P^T) that firms get, but not the costs of non-tradable goods and services. Indeed, in Argentina's 2002 large devaluation, non-tradable goods and services only increased by 13% during that year, when the nominal exchange rate raised 124% (Burstein et al., 2005). In other words, the pass-through to non-tradable goods and services is imperfect and considerably less than 100%.[8]

These differences in pass-through are important because some exporters' costs are non-tradable goods and services. Therefore, an increase in the RER reduces exporters' relative costs and increases their profitability, depending on the importance of these non-tradable production costs in their production function.[9] Since labor is the most important non-tradable factor in most of the production functions of any sector, labor-intensive sectors will benefit the most from the drop in costs in US dollars after the change RER level.[10]

However, the higher tradable profitability acts on export performance through two channels with very different expected impacts: (a) increasing the production of exporting firms by intensifying the use of their existing productive capacity; (b) increasing the number of exporting firms, number of products and stimulating new investments, which expand productive and trade capacity. In other words, the higher profitability rate encourages firms to expand their exports using their current productive capacity and, more importantly, expand the stock of exporter, their productive capabilities and commercial ties with other

[5] We have to keep in mind the Balassa–Samuelson hypothesis, which suggests that the real wages in non-tradable activities tend to closely follow the rate of labor productivity growth in the tradable sector over extended periods of time (as shown by Summers and Heston (1991)). Accordingly, if the productivity of the tradable sector continues to increase, we may see a long-term appreciation of the real exchange rate. However, it is important to note that in the short and medium run, significant shifts in the nominal exchange rate can still cause substantial changes in the RER, despite the Balassa–Samuelson effect. In addition, an important aspect of the mechanism studied in this paper is influenced by the behavior of wages in the short and medium term in the face of a depreciation of the RER. A realistic way to model it is through wage bargaining mechanisms depending on the relative bargaining power of workers and firms. Furthermore, the price of tradable wages is only one part of the consumption basket and wages and non-tradable prices should be considered sticky in the short-run, allowing changes in the level of real exchange rate. For a general equilibrium model with consideration of wage settings in different sectors, see, for example, Razmi et al. (2012) and Rapetti (2013).

[6] Rapetti (2020), Demir and Razmi (2022) and Blecker (2023) are recent and thorough literature reviews.

[7] We assume that exporting firms act as an international price taker of the P^f price in US dollars.

[8] The price of non-tradable goods and services would increase after depreciation to the extent that their costs increase. This may be due either to the use of tradable inputs in their production function or to the rise in the nominal wage in the economy. Likewise, workers' salaries will seek to maintain their purchasing power, and the demand for wage increases will be higher the larger the share of tradable goods in their consumption basket and the more relative bargaining power they have.

[9] It is important to stress that the use of domestic tradable inputs might not be relevant. For example, if import-competing machinery is used, a devaluation will also increase its price. Depending on the degree of differentiation, the pass-through to domestic prices will be higher (Burstein et al., 2005; Burstein and Gopinath, 2014). The key distinction is between tradable and non-tradable inputs.

[10] One alternative assumption might be that the export prices are set in domestic currency. In this case, after an RER depreciation, the export prices decrease for consumers abroad and, because of that, increase their demand. Berman et al. (2012), for example, found that this is the case for medium- and low-performance firms in France. Then, their export volumes should be more sensitive than high-performance firms because the demand for their export increase. However, these finding corresponds to a country which invoiced most of their export in domestic currency (euros), explaining why their export prices are more flexible than developing economies such as Argentina, in line with the Dominant Currency Paradigm literature. While Argentina invoiced more than 96% of their export in USD dollars (foreign currency), France invoiced only 22% in USD and 72.3% in Euros (domestic currency) in 2019 (Boz et al., 2022). Following this literature, as exports in emerging countries are usually invoiced in USD and remain stable in that currency, the best option is to assume export prices are fixed in dollars in the case of Argentina exports. Given that, the mechanism we proposed is not through an increase of export demand but through an increase in export supply. However, we provide evidence that our results are robust to include measures of sector-level productivity.

countries.[11] Nevertheless, a higher profit rate that lasts only a very short period–transitory RER movements–will not put in work the last channel and will not have a significant impact on firms' investment decisions. Firms will only invest and expand tradable supply capabilities if the expected profit keeps high for a considerable time to make it rewarding to pay the sunk costs associated with the investment.

In formal terms, the elasticity of exports concerning the RER affects the following two margins. In the appendix, we offer a theoretical model where we formalize and expand all the intuitions.

$$\frac{\partial E_t(X_{i,t})}{\partial q_t} = \frac{\partial X_{i,t}}{\partial q_t} Pr(I_{i,t} = 1) + X_{i,t} \frac{\partial Pr(I_{i,t} = 1)}{\partial q_t} \quad (1)$$

Where $X_{i,t}$ is the export volumes of firm i at time t, q_t is the real exchange rate and $I_{i,t}$ is a state variable taking values 0 or 1. $Pr(I_{i,t} = 1)$ indicates the probability that firms i decide to pay the one-time sunk cost to produce and trade a new product or to expand to a new destination. The first term on the right-hand side is the static margin: the firm decides in each period t its level of production. The second term is a dynamic margin that involves the payment of sunk costs and consequently increases production and export capabilities in the following periods.[12] The RER only makes a difference on this dynamic margin if its new depreciated level is sustained and internalized in future expectations for a considerable period of time (see online appendix for more theoretical details).

Our focus is on the dynamic margin. Although both decisions influence the sectoral export performances, only the last one might induce a significant increase in exports and implies the acquisition of new production capabilities. The core idea is that while firms or sectors can increase their exports based on their installed capacity–static margin–this increase is limited and is unlikely to be responsible for an export surge episode. However, if the real exchange rate remains competitive for a sufficiently long time, so will the expected profitability and the firm will decide to increase its productive capacity. It is this investment–dynamic margin–the one that can probably explain an export surge episode in the sector.[13]

Moreover, the payment of sunk costs might generate a so-called hysteresis effect on exports, producing long-lasting improvements in export performances despite an eventual RER appreciation to the previous levels. Instead, the static margin, in which firms use only their current capacity, is improbable to be responsible for significant export growth with lasting export and growth effects.

Given the lack of information on non-tradable inputs, we use the degree of labor intensity by sectors as a proxy of non-tradable costs. We construct this index as the number of employees relative to the sectoral output $\left(\frac{L_j}{Y_j}\right)$. This proxy allows us to identify the differential impact of RER on export performance. Our identification strategy is based on this expected theoretical heterogeneity. We expect large and long-lasting devaluation has a more significant impact on sectoral export performances the higher labor intensity index is. Dao et al. (2021) use a similar proxy to test the effect of RER on export performance.

The magnitude and duration of the change in the RER level make it plausible to argue that there was an outright change in the expected profitability of the tradable sector in Argentina. This higher profitability, in turn, was reaffirmed by the fact that the government authorities declared several times in favor of an undervalued currency (Damill et al., 2015). Because of all of this, we believe that the depreciation and stability of the RER level in Argentina during 2003–2008 is an interesting natural experiment to assess the impact of RER on export sector developments. Cross-sectional heterogeneity in sectors' labor intensities will allow us to identify the relationship between RER and export surge episodes, testing the theoretical mechanisms we expect to be responsible for the effects.

3. Export surges episodes: Definition and simple stylized facts

In this section, we construct and show some stylized facts of the dependent variable studied in the rest of the article. We aim to identify episodes of export surges by sectors because they likely involve firms that invest and expand their supply capacity by paying sunk costs and/or opening up new markets. Moreover, we want to isolate our variables of other possible determinants of export sectoral growth rates, such as high foreign demand, or higher growth rates because of the life cycle of the sector worldwide. In terms of the framework proposed in the previous section, we seek to capture the dynamic margin, not the marginal changes in exports.

To this end, we build on the algorithm proposed by Freund and Pierola (2012)– and already used in Palazzo and Rapetti (2017)–for detecting sectoral export surges in Argentina. There are two main differences with Freund and Pierola (2012): (1) First, we focus on six-year periods instead of the seven years proposed by the authors. Reducing the timespan allows us to concentrate on the period 2003–2008. This period is the first one after Argentina's large devaluation and financial crisis (2002) and, additionally, does not include the year 2009, in which the subprime crisis had a full impact on developing economies. (2) Second, instead of focusing on the aggregate manufacturing export goods, we analyze more than 700 products exported by Argentina, covering the whole export basket.

Following Palazzo and Rapetti (2017), we calculate the export surge episodes in six-year rolling windows covering the timespan from 1980 to 2015.[14] We focus on explaining the particular identification of export surges during 2003–2008. However, the requirements are valid for

[11] The increase of exporting firms in Argentina during this period was studied by Albornoz et al. (2018). They divide the effects between intensive and extensive margins and found, at the microeconomic level, that during this period, firms expanded sales abroad, entered new destinations, and added new products. Additionally, an acceleration of investment in machinery and equipment is observed in the period of analysis according to data from the Penn World Tables. Libman et al. (2019) shows evidence of the relationship between RER and investment surges.

[12] Traditionally, the literature distinguishes between intensive and extensive margins. The first one is referred to changes of export volumes in established bilateral trade relationships. The second one referred to export volume changes because new trade relationships are established or existing ones are abandoned. The extensive margin could be expanded because an exporter starts selling a new product to an old destination country, start selling an old product to a new destination country, or new firms start exporting. Given that our analysis is not at a firm level, the extensive margin could mainly be measured as old sectors exporting to new destinations. The extensive margin in the sectors with and without export surges has played a negligible role in monetary terms. This justifies why we do not discuss these margins separately in the analysis and focus on what we call static and dynamic margins. For example, the new destinations for each sector with export surge episodes represent 1.3% of their volume exported during 2003–2008. Notwithstanding, we found a considerable increase in the number of new export destinations: the sectors with export surge episodes increased their average number of destinations per sector by 78% (2003–2008 vs.1996–2001), while the sectors that did not have export surges did so by 55%.

[13] Ruhl et al. (2008) claims that the transitory nature of RER movements explains the differences in magnitude found by the relevant literature between RER-elasticities and microeconomic (tariffs or prices) elasticities. For a discussion on differences between the calculation of price-elasticity and RER-elasticity, see also Fitzgerald and Haller (2014), and Fontagné et al. (2018).

[14] We use the same timespan as Palazzo and Rapetti (2017). The main reason for restricting the calculation to 1980 is the quality of the data on world exports. The number of countries reporting consistent data becomes progressively smaller as we try to go further back in time. In addition, during the 1970s, Argentina suffered military coups, and democracy only returned in 1983, consolidating from then on. In other words, we keep the sample as large as possible, but minimize problems in data quality and disruptive political episodes that could influence export performance.

any six-year rolling period. We consider that one sector experienced an export surge in the six-year period from, i.e. 2003 to 2008, if it simultaneously satisfies the following five requirements:

1. High export growth. Argentina's exports of sector j between 2003 and 2008 must have grown at an annual rate at least 33% higher than the long-run growth rate of world exports of sector j. Long-run growth has been defined as the average growth rate over a 20-year period from 1996 to 2015.[15]
2. Export growth rate accelerates. We consider the export growth rate of sector j accelerates between 2003 and 2008 if the average annual growth rate was at least 33% higher and was three percentage points (p.p.) above the average growth rate of the previous comparable six-year period (in this case, 1997–2002). The threshold of 33% and the 3 p.p. difference are identical to the ones required by Freund and Pierola (2012). The 3 p.p. difference aims to avoid export growth accelerations starting from very small or negative growth rates.
3. The export surge is not a rebound. We require that the peak of the sector exports j at the end of the undervalued currency period should be at least 60% higher than exports at the end of the previous period. The 60% threshold represents the cumulative growth of worldwide goods exports between 2000 and 2008, and it changes for the corresponding window of years when calculating export surges in another six-year period. This condition requires the level of exports of product j to exceed, at the end of the period, the level it would have reached if its growth had not been interrupted at any point in time and had followed the aggregate world trend. Because 2008 includes the onset of the global financial crisis, we consider a broader endpoint, allowing the maximum value to be taken between 2007 and 2008. Similarly, due to the local economic crisis in 2002, the highest final value for the previous period is taken from any year between 2001–2002.[16]
4. Higher cumulative export volumes than the previous six-year period. During 2003–2008, the sector should have exported a higher accumulated amount of goods than in the previous period. To this end, we require that the accumulated export (constant dollars) of the period is at least 20% above the amount accumulated during the previous period. This 20% corresponds to the accumulation of the 3 p.p. differential during six years of duration of the episode. The 3 p.p. follows the threshold of the second requirement.[17]
5. Export growth is not driven by world demand. This requirement establishes that exports of product j must have grown at an average annual rate higher than that of world exports of j during the same six-year period (i.e.2003–2008). Thus, this requirement ensures that the export surge episode was not the outcome of an external phenomenon such as higher foreign demand in a specific six-year period.

These five requirements can be summarized and formalized as follows:

R.1 $x_j^{A,t} \geq (1+1/3)x_j^{W,t^*}$

R.2 $x_j^{A,t} \geq (1+1/3)x_j^{A,t-1} \quad y \quad x_j^{A,t} - x_j^{A,t-1} \geq 3\%$

R.3 $Max[X_j^{A,07}, X_j^{A,08}] \geq 1.6 Max[X_j^{A,01}, X_j^{A,02}]$

R.4 $XA_j^{A,t} \geq (1,2)XA_j^{A,t-1}$

R.5 $x_j^{A,t} > x_j^{W,t}$

Where j represents the 4-digit SITC sectoral exports, x is the average growth rate of exports in constant dollars, A refers to Argentina, W to the world, t represents the six-year period of interest (i.e.,2003–2008), $t-1$ the previous six-year period, t^* the 20-year period used to calculate long-run growth (i.e.,1996–2015), XA is the accumulated export level in constant dollars during the six-year period, and X is the level of exports at constant dollars.

The international trade data used for the baseline exercise are provided by COMTRADE. We use the Standard International Trade Classification (SITC), revision 2, at 4-digit disaggregation. For the calculation of exported volumes, we compute our own price indices based on the methodology used by Fares et al. (2018), which replicates the one used by the National Institute of Statistics and Censuses (INDEC) at 2 and 4 digits of disaggregation from 1996 onwards. Nevertheless, we also use data provided by Feenstra and Romalis (2014) as an alternative to our price calculation to show that the main results remain invariant to using different price indices. The authors calculate 4-digit quality-adjusted indices from SITC revision 2 covering 1984 to 2011.

Using this dichotomous variable has several advantages regarding the hypotheses we intend to test. First, the algorithm allows us to isolate some possible determinants that might contaminate our estimates, such as export growth explained by foreign demand, worldwide innovations, or export recoveries from previous maximums. These determinants might be challenging to control if we use the accumulated export growth in the six years because we are interested in cross-section heterogeneities and cannot control by sector fixed effects. Second, we want to detect those sectors that paid sunk cost and invested in expanding their productive capabilities. When that happens, it might end up that some sectors have a higher potential catch-up than others or face a higher foreign demand, but still, all of them were successful in gaining market share because of the RER stimulus. Using a dichotomous variable, weigh those sectors equally without contaminating our estimation with some successful cases facing bigger markets. Finally, Palazzo and Rapetti (2023) already have estimated the usual RER-elasticities using continuous values of exports by sectors. Those estimations show how Argentina's exports respond to short and medium-term movements in the real exchange rate. Then, the econometric strategy used there is most likely to capture the static margin and it also has shown higher RER-elasticities in labor-intensive sectors. Our estimates complement their findings.

We summarized the main results of this algorithm as follows.[18] In economic terms, export surge episodes during the period 2003–2008 account for 14.6% (17%) of the period's exports of goods measured in current (constant) dollars, which implies 3.0% of the average gross

[15] Freund and Pierola (2012) require exports to grow at an average rate of 6% per year to ensure that export growth is higher than world growth. Given that different products may grow at distinct rates depending on their product life cycle, this may not be appropriate when seeking to identify export surges by sector. For this reason, we decided that the requirement of "high export growth" by sector should be relative to the global long-run trend for each sector. Given this, we use the 33% threshold set by Freund and Pierola (2012) for the "accelerating export growth" requirement (second requirement), and we use it to define high export growth for each sector. Palazzo & Rapetti (2017) provide different robustness tests to the algorithm for detecting export surges in Argentina. However, we are aware that the threshold could still be considered arbitrary.

[16] 2001 and 2002 are the last two years from the six years (1997–2002) previous to 2003–2008. We compare to the end of that period–and not the maximum of the whole previous period–because we still want to capture if there is a change in the trend of the export performance of sector j. We keep the window of the last two years when assessing the occurrence of an export surge episode during another six years.

[17] If we do not demand this requirement, high levels in the export volumes during the previous period might imply higher cumulative exports during that period and still find an export surge episode. Such an event would require an initial sharp fall and rapid growth afterward. This condition complements the requirement that the export surge is not a rebound. This was not required in Palazzo and Rapetti (2017) but the results are almost identical.

[18] See Palazzo & Rapetti (2017) for a detailed descriptive analysis of export surge episodes.

domestic product (GDP) for the period. The acceleration of exports in these sectors compared to the period 1996–2001 contributes 1.21% to the annual GDP measured in current dollars. The period 2003–2008 shows an increase of 39.5% in the number of sectors with export surges compared with the previous peak of the series (period 1994–1999). In absolute terms, it means 120 compared to the 86 export surge episodes during the previous peak.

Fig. 1 helps us to visualize the sectoral heterogeneity and relevance of depreciation of the RER in the probability of surges. Using six-year rolling windows, we show the percentage of sectors with export surges by type of goods. These categories correspond to primary goods, natural resource-based manufacturing, and low, medium, and high technological content manufacturing goods (Lall, 2000).[19] There are three key reasons why Lall's classification is beneficial for analyzing export surges. First, it is widely used, which allows us to connect our findings to existing literature. Second, it is possible to argue that sectors with a high level of technology tend to experience faster growth due to their greater income elasticity, ability to create new demands, quicker substitution of older products, and potential for further learning and spillovers to other industries (Lall, 2000). Therefore, it is interesting to classify sectors based on their technological content and find out if the RER levels influence their performance. Finally, earlier studies have identified differences in RER-elasticities across these categories (see, for example, recent empirical evidence from Palazzo and Rapetti (2023) and Caglayan and Demir (2019)). Table 9 in the appendix shows the complete list of sectors that satisfies the export surges criteria by Lall's categories.

The vertical axis indicates the ratio of sectors with export surges, while the horizontal axis marks the starting year of the six-year period rolling window in which the surge episodes are identified. As a clarifying example, the value reported for the year 1986 in panel (a) indicates that 12.2% of the exported products experienced a surge during the six-year period from 1986 to 1991. These export surges are identified compared to the export performance from 1980 to 1985. The year 2003 corresponds to the period after the financial and currency board crisis, in which the RER level keeps stable and more competitive compared to the previous decade (2003–2008). We marked it with a vertical red line. The earlier period that does not include any year of the undervaluation period is the one starting in 1996 and contains the years from 1996 to 2001. From 1997 onward, subsequent periods progressively incorporate the years after the large devaluation (2002), so we expected an upward trajectory in the proportion of surges. The last period of the analysis is the one that starts in 2010 and ends in 2015. During this period, the real exchange rate appreciates, and the government imposes exchange controls and non-tariff import barriers.[20] Confidence intervals are computed at 90% through an ordinary least squares regression exercise with year-fixed effects.

The first panel 1(a) shows that the probability of the occurrence of export surges is, historically, low in the whole period span analyzed (1980–2015). The unconditional probability of an export surge episode is 8.9%, marked by the horizontal line. Such a low probability of occurrence indicates that the identification algorithm for our dependent variable is demanding enough, and it fulfills the goal of capturing the new development or take-off of exporting sectors rather than marginal changes in their exports. During the period 2003–2008, a relatively high proportion of sectors experienced export surges (16.4%). This export performance is an overall maximum for the entire period and is particularly salient compared to the (non-overlapping) six-year periods before and after, corresponding in the figure to 1996 and 2010.

The figure shows two other local maximums with similar proportions of surges between them but below the currency undervaluation period. These peaks correspond to the years 1986–1991 and 1994–1999. The first one reaches a share of 12% (83 sectors), starting the same year as the aggregate manufacturing export surge episode detected by Freund and Pierola (2012) in Argentina. The second period corresponds to the years 1994–1999. It overlaps with the period of MERCOSUR integration and the overvaluation of the Brazilian currency. In this last six-year period, 86 sectors achieved export surges, corresponding to a share of 12.1%, statistically different from the unconditional probability of export surges.

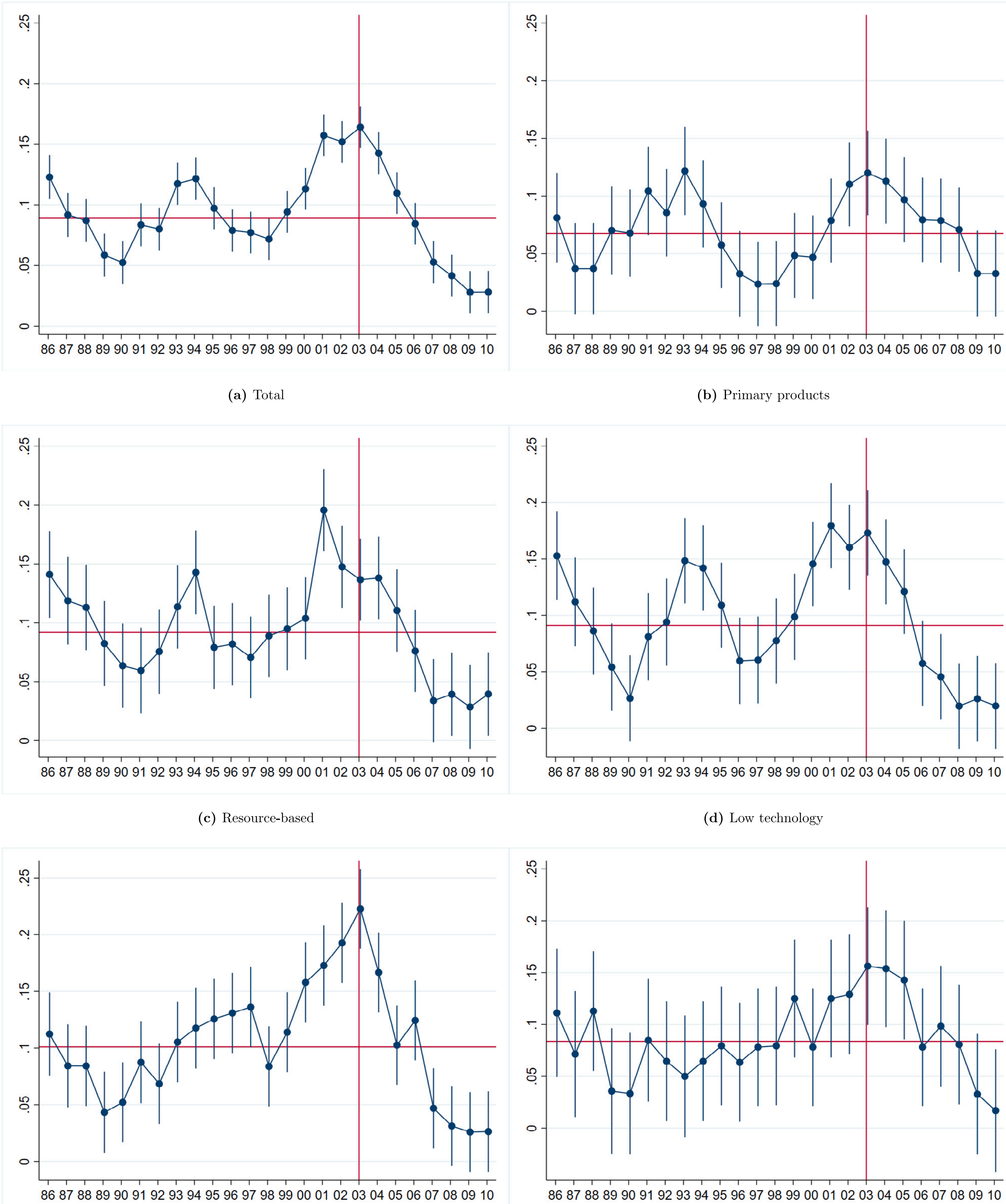
Performances by Lall's categories show similar behavior to the whole but with some interesting subtle differences. All categories show the highest peak around 2003–2008 and smaller local peaks starting around 1994–1999. However, we find some interesting differences between the periods 1994–1999 and 2003–2008. The six-year period 2003–2008 stands out because all sectors perform above the unconditional probability. Finding the highest peak of all categories during the stable and competitive real exchange rate (SCRER) period is interesting since it might indicate that a higher level of RER fosters the internationalization and tradable capacity of a broad range of sectors, including some primary products and high-technology content manufacturing, which usually are found not responsive to variations of the RER. One of the reasons for this result could be due to our focus on sufficiently long periods of competitive exchange rates–and not just short-lived depreciation–as it may encourage the search for new markets or investments in improving product quality and technology, even for primary products that were previously only placed on the domestic market.[21] The finding concerning high-tech sectors is, however, less surprising since Palazzo and Rapetti (2023) also find a positive and significant RER-elasticity for the Argentinean case. In any case, and in line with the empirical evidence, our figures show a more dynamic behavior in the low- and medium-technology sectors than in the rest of the categories between 2003–2008, which could be related to a greater weight of labor costs in these sectors.[22] During 1994–1999, in contrast, the figures do not show that all categories have a higher likelihood of export surges compared to the historical average. Both medium and high technological sectors show a performance that does not exceed the unconditional probability of the category, while the best performances are observed in primary products, natural resource-based manufacturers, and low-technology manufacturing. Nonetheless, it would be

[19] Some considerations on how the classification was built up according to Lall (2000). Primary products include, for example, fresh fruit, soybeans, coffee, tea, crude petroleum, and gas. Some examples of resource-based manufacturers are prepared meats/fruits, beverages, vegetable oils, ore concentrates, petroleum/rubber products, glass and cement. The competitive advantages of these products arise, in general, from the local availability of natural resources. Regarding low-technology category, products tend to have stable, well-diffused technologies, and labor costs tend to be a significant cost element in competitiveness. This category includes, among others, textile fabrics, clothing, leather manufacturers, furniture, simple metal parts, toys and plastic products. Medium-technology products are those such as passenger vehicles and parts, fertilizers, industrial machinery, watches, and engines. These products have complex technologies and require moderately high levels of research and development, high labor skills, and lengthy learning periods. The engineering and automotive sub-groups are particularly linkage-intensive. High-tech products have rapidly changing technologies, with significant investments in research and development and a strong emphasis on product design. The most cutting-edge technologies require sophisticated infrastructure, specialized technical skills, and close collaboration between firms, universities, and research institutions. This category includes turbines, pharmaceuticals, optical/measuring instruments, aerospace and cameras, among others. However, some products more labor-intensive such as electronics, are also part of this category (Lall, 2000).

[20] See Bernini and Garcia-Lembergman (2020) for a study of the impact of import controls through non-automatic import licenses on export performance.

[21] See Bernini et al. (2018) for a discussion about how some primary and resource-based manufacturing products could also be differentiated products and invest in quality and marketing.

[22] See, for example, Katz and Bernat (2012), Caglayan and Demir (2019) and Palazzo and Rapetti (2023).



(a) Total

(b) Primary products

(c) Resource-based

(d) Low technology

(e) Medium technology

(f) High technology

Fig. 1. Share of sectors with export surges.
Source: Own elaboration based on COMTRADE data. Confidence intervals at 90%. The vertical line corresponds to the six-year period 2003–2008. The horizontal line marks the unconditional probability of the period.

incorrect to attribute the complete performance of all categories in these figures exclusively to the differences between RER levels. We delve into other potential factors through econometric exercises in the following sections.

Figure 5 in the appendix shows that the temporal dynamics of the proportion of export surges are robust to different specifications in the detection algorithm. Results are robust to using the export price quality-adjusted indices proposed by Feenstra and Romalis (2014) to deflate the exported values or remove Brazil as an export destination over the whole sample. The latter strengthens the argument that the surge detection algorithms succeed in capturing supply expansion phenomena and are not a consequence of an increase in foreign demand because Brazil is one of main Argentina's trade partners and experienced fast economic growth during the period.[23] Finally, Palazzo and Rapetti (2017) show other robustness tests and analyses of the export surges episode. Among them, they exclude the year 2002 from the previous six-year period to calculate the 2003–2008 episodes. In that case, the acceleration and no rebound conditions are modified using 1996–2001 as the benchmark period.[24] The results are always robust and support the finding claimed by Albornoz et al. (2018), which also documented the high export growth during the period.

3.1. Database: Labor intensity index, revealed comparative advantages and Lall's classifications

Using Lall's classification is helpful in analyzing the data because the categories show differences in the degree of labor intensity and the initial degree of competitiveness of the sectors, offering some preliminary clues about what we should expect from our regression analysis. In Fig. 2, we show the Kernel density functions of the logarithm of labor intensity (panel a) and sectoral initial competitiveness levels (panel b).

Sectoral competitiveness is measured by the revealed comparative advantages (RCA) of 1996, defined as the ratio between the export share in current dollars of each sector in Argentina's export basket relative to the export share of each sector in the world economy.[25] We chose 1996 because it is the last year before the six-year period (1997–2002) used to assess the export surges during 2003–2008. Regarding labor intensity, we use as a proxy the number of workers relative to the gross production value of Argentinean industries at 4-digit ISIC disaggregation.[26] Unfortunately, we only have data available on labor intensity for 2004 at this level of disaggregation. This proxy is similar to the one used by Dao et al. (2021) to assess the effect of the RER on exports through the labor intensity channel. Although the authors focus their analysis on a database of 25,416 firms from 66 countries, they do not have a firm-country level indicator and approximate labor intensity with the labor share at 3-digit NAICS of US firms.[27] They argue that these data allow them to exploit variation in the labor share across sectors that depend on technology and product characteristics but do not depend on firms' investment and hiring decisions. The latter would have the weakness that depends on profitability shocks and tax regimes. We aim to exploit the same variability in our estimations. This index is our main variable of interest, allowing us to identify and evaluate the heterogeneity impact of the real exchange rate.

Panel (a) makes it clear that low technological content manufacturing goods have the most rightward-skewed distribution, indicating a predominance of more labor-intensive sectors. Medium technological manufacturing comes next in terms of labor utilization if we use the average as a benchmark. While the average for low technological manufacturing goods reaches 5.54 workers per million gross production value, the average for medium technological is 3.9. They are followed by high technological manufacturing goods (3.7), primary products, and natural resource-based manufacturing with 3.15 and 3.1, respectively. There is also heterogeneity within each category, which will be helpful for the econometric specification, as we can control for the type of products' fixed effects (Lall's categories). We consider it useful to include Lall's categories as fixed effects to ensure control over unobservable factors related to product types, such as technological innovation, differences in the speed of technology change, cost elements affecting competitiveness, ease of technology duplication, quality requirements, labor skills, length of learning periods, and export performance related to factor endowments (Lall, 2000). In addition, as we already mentioned, previous research has found differences in RER-elasticities between these categories, making it important to control for this co-founder variable.

Regarding the initial competitiveness, the figure shows that the highest RCA levels are found in primary products and natural resource-based goods, while the lowest RCA levels are in the high-tech category.

We do not expect a positive relationship between initial RCA and export surge episodes. On the one hand, Argentina specializes in primary products, exhibiting a RCA distribution skewed to the right. In this type of product, we do not expect a strong response to the exchange rate stimulus because the agricultural frontier is a natural constraint to their expansion. On the other hand, even in manufacturing goods, sectors with a very high level of RCA are already on the technology frontier without the possibility that a catch-up phenomenon will cause an export surge episode. Moreover, they likely are mature sectors where accelerated expansion is very challenging since they might face diminishing returns to scale or they already have probably paid the sunk cost of entering the international market before, independently of the change in profitability due to RER depreciation. In this line, Bahar et al. (2019) find a negative relationship between export take-offs and initial RCA. Finally, since we do not have estimates of capital stock by sector for TFP calculations, including revealed comparative advantages is the best possible proxy for controlling for relative productivity to the rest of the world. Including a productivity index proxy is relevant because previous work has found that the price pass-through of exchange rate movements may differ for high-performing firms or firms

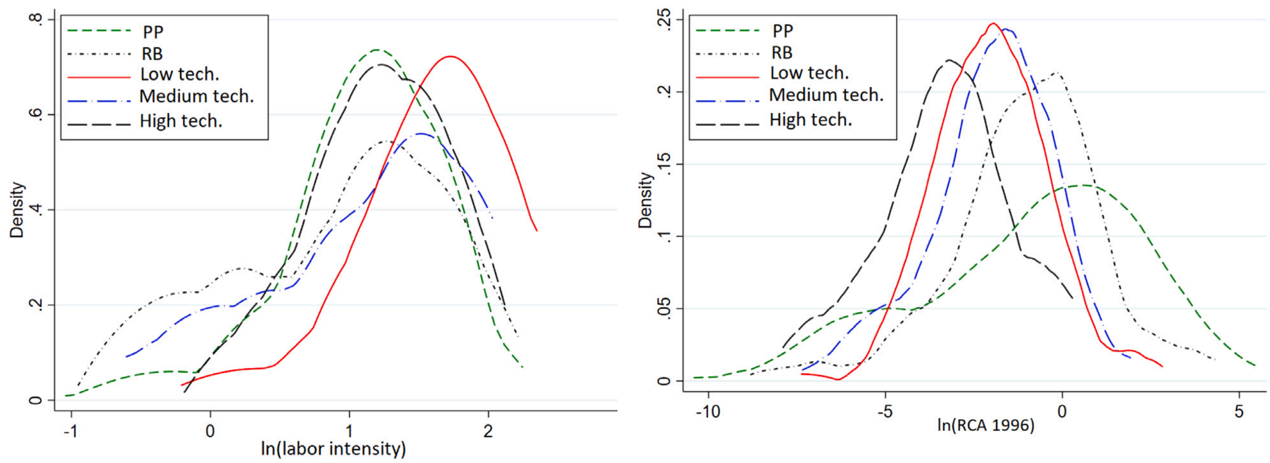
[23] During the six-year period 2003–2008, Brazil grew by around 3% per capita and 4.2% on average per year–both in purchasing power parity–while Brazilian imports of Argentine products grew at an average annual rate of 11.9% in quantities and 18.9% in current dollars.

[24] In that case, 112 instead of 120 sectors experienced export surge episodes during 2003–2008 but still represented 19.8% of total export in constant dollars.

[25] It is calculated as $RCA_{A,j} = \frac{\frac{x_{A,j}}{\sum_{j\in P} x_{A,j}}}{\frac{x_{W,j}}{\sum_{j\in P} x_{W,j}}}$, where A refers to Argentina, W to the world economy and j is a specific sector

[26] The gross production value is measured at current prices in millions. We build this variable by crossing values of formal employment and aggregate gross value reported by the INDEC at four digits of disaggregation of the ISIC. Afterward, we make the correspondence of the ISIC classification to SITC. However, the ISIC classification shows a lower level of disaggregation than the SITC rev. 2. It has 301 categories and is reduced to 152 for tradable industries. Still, the matching is many-to-many. In that case, we compute a simple average of different ISIC sectors.

[27] We chose to use the number of workers to gross production value as an indicator of labor intensity instead of using the wage share. There are several reasons for this. First, the income data at these levels of detail may not be reliable for the informal sector. We only have consistent disaggregated data for the average formal wage. Second, wage premiums in specific sectors may not accurately reflect labor intensity, but rather a shortage of labor in that particular sector. This can limit production expansion after a RER depreciation, even if they are enjoying higher profitability. Additionally, high wage levels are typically found in high-skilled sectors, which increases the complementarity of capital and labor (Kaiser and Siegenthaler, 2016). Third, in a sector where the wage share is very high but because of a small number of workers have significant wage premiums, those workers may have more bargaining power and respond to depreciation by demanding higher nominal wage increases, offsetting the gain in exchange rate competitiveness. Lastly, we only have gross production value data for 2004, so we can only calculate the wage share for that year, which may be influenced by temporary shocks or differences in wage recovery adjustment speeds after the 2002 crisis. Using the proxy of the number of workers per gross value of output has the advantage of being a proxy for the technical coefficients of a production function (following our model, Leontief), which should be more stable over time and less affected by temporary shocks. Nevertheless, we test the robustness of the results in Table 3, where we control for formal sector wages, replace our variable of labor intensity by a proxy of the sectoral wage share and control for the skill level of the labor force.



(a) Workers per million GVP (b) Comparative Advantages Revealed

Fig. 2. Kernel density functions: Labor intensity and RCA indices by Lall classification.
Source: Own elaboration based on data from COMTRADE, Ministry of Economy and INDEC.

specializing in high-quality products (Berman et al., 2012; Chen and Juvenal, 2016). Hence, the response to RER movements of exports might also be different.[28]

For the regression exercises, the rest of the variables used as controls come from INDEC, Ministry of Economy, Permanent Household Survey, International Monetary Fund, World Bank, Ellison et al. (2010) and Greenstone et al. (2010) for the specific linkages indices and Growth-Lab-Harvard (2019) the data referred to the product space. Table 10 in the appendix shows descriptive statistics for the main variables that we use throughout the paper.

4. Determinants of the export surges during the six-year period 2003–2008

So far, we have shown some preliminary evidence that suggests a positive impact of the depreciation of the RER on sectoral export surges: the global maximum of export surge episodes occurred during the period in which the RER depreciated and kept competitive relative to the previous decade (2003–2008). Moreover, they occur mainly in manufacturing goods, which is very unlikely to be related to the commodity price boom that occurred with some years of overlap. However, we must delve deeper to claim a more robust correlation. To understand and analyze the role of the real exchange rate in these dynamics, we test the theoretical channel explained in the previous sections, where we argued that the RER fosters–especially–labor-intensive sectors. By doing this, we provide evidence supporting the link between the RER level and export surge episodes, from which we expect the RER to impact on export surges during the six-year period 2003–2008.

The abrupt change in relative prices in 2002 and its subsequent stability is an excellent opportunity to observe the effects of the exchange rate policy on the export basket. It is possible to argue that the devaluation was an exogenous variation to sectoral decisions and, in particular, is not related to the labor intensity of each sector. The devaluation and new exchange rate regime were hard to anticipate during the previous years, so we do not expect firms to have anticipatory behavior that questions causality. The previous currency board regime was established by law, and its end implied the breaking of contracts, making it difficult to stipulate a definite exit date.

This assumption is not unusual in the relevant literature. Ekholm et al. (2012) and Alfaro et al. (2018), for example, argue that nominal exchange rate movements are difficult to predict and exogenous to firms' export decisions, import decisions, or innovation activities. In any case, if endogeneity exists, the reverse causality could go from poor export performance to further currency depreciation. As a result, our estimates will suffer from a downward bias, and the estimated impact of the episode would be the low bound of the actual impact. However, our event is not only the devaluation but its lasting undervaluation period (2003–2008). Therefore, there are different–sometimes unobservable–variables that need to be controlled for over the period. This fact implies that the argument about the exogeneity of the initial devaluation loses strength for causal identification. For this reason, we interpret our results as suggestive correlations of expected effects and the mechanisms through which the real exchange rate impacts the probability of export surges.

We run the following regression model as a first approximation to the problem. Its goal is to unpack cross-section sectoral characteristic and provide suggestive evidence of the mechanism through which the depreciation of the RER impact the probability of export surges, controlling for some unobservable factors by product type (using Lall's categories) and the initial level of competitiveness:

$$y_i^{0308} = \theta_0 + \sum_{j=1}^{5} \theta_j D.Lall_i + \gamma(\textit{labor-intensity})_i + \rho RCA_i + \beta X_i + \epsilon_i \quad (2)$$

Where y_i^{0308} is a variable that takes values 0 and 1, indicating the occurrence of the 120 export surges detected during 2003–2008. $Lall_i$ is a categorical variable for each type of good i that identifies belonging to one of the five Lall's categories. $\textit{Labor-intensity}_i$ assesses the expected impact of the RER through the logarithm of labor intensity, while RCA_i refers to the comparative advantages revealed in the year 1996. This variable was standardized to have a mean of 0 and a standard deviation equal to 1 to facilitate the interpretation of the coefficient. The proxy for labor intensity is kept fixed to avoid endogeneity problems, although ideally, one would like to use a year outside the evaluated period. The coefficient of labor intensity variable is interpreted as an elasticity. Finally, X_i refers to several controls that will be added in future regressions.

The coefficient of interest is γ, which corresponds to the labor intensity index. This variable might be thought as a RER sensitivity

[28] According to these studies, after an RER depreciation, low-quality wines and medium- and low-performance firms reduce their export prices, by which their demand increase. Then, their export volumes should be more sensitive than high-performance firms because the demand for their export increase. However, this is not supported by the evidence provided by Gopinath (2015), Gopinath et al. (2020), Adler et al. (2020) and Boz et al. (2022), among others.

index. The RER does not appear explicitly in the regression. Nevertheless, we evaluate the episodes occurring during the period 2003–2008, through a variable that measures the expected strength of the RER impact. Why do we not include the RER in the regression? Given the findings provided by Gopinath (2015), Adler et al. (2020), Gopinath et al. (2020) and Boz et al. (2022), the only relevant exchange rate for exports is the bilateral real exchange rate relative to the USA since export are invoiced in US dollars. Therefore, it is useless to try to gain cross-section variability using the real effective exchange rate (REER) because it would not be relevant for sectoral export performance. Then, our variable of interest does not have cross-section variability to estimate its effect on export surges. Including other six-year periods could be helpful, but we will still lose all the time-series variability if we include period-fixed effects. However, we provide some robustness tests using the REER as a shift variable in the following sections.

Then, the identification strategy lies in the heterogeneity of each sector's labor intensity, which we consider exogenous to the unanticipated movement of the large and long-lasting change in the RER. Controlling for the type of product and initial competitiveness is helpful to rule out the potential correlation between labor intensity and the probability of surges, which might be a consequence of characteristics unrelated to RER level. As we mentioned before, Lall's categories are helpful to control for unobservables by product type—e.g., technological innovation, differences in the speed of technology change, differences in the relevance of cost elements affecting competitiveness, ease of technology duplication, quality requirements, differences in labor skills, length of learning periods, broad industrial policy by type of goods, as well as export performance related to factor endowments. Controlling for the initial level of RCA prevents bias in our estimates because, for example, the less labor-intensive sectors might have a lower probability of export surges because they are already in the domain of diminishing returns to scale (high RCA levels). In addition, since we do not have estimates of TFP by sectors, including revealed comparative advantages is the best possible proxy for controlling for differences by sector of relative productivity relative to the rest of the world, allowing to control for potential differences in export strategies and responses of high-performing sectors (Berman et al., 2012; Chen and Juvenal, 2016; Caglayan and Demir, 2019).

Table 1 shows in columns (1–7) what happens when we incorporate the different variables of interest sequentially. We use linear probability models (OLS) as a preferred method of estimation, except for column 6, where a probit model is estimated. However, table 11 in the appendix shows the robustness of all specifications and results using probit models. In all cases, robust errors are clustered at the same level that labor intensity varies.

We start replicating in column 1 the heterogeneity evidence shown in Fig. 1(a). This column uses Lall's categories and finds that the only two categories with a significant impact above the base category (primary products) during 2003–2008 are low- and medium-tech manufacturing goods. This is in line with the evidence provided by Caglayan and Demir (2019) and Palazzo and Rapetti (2023). Interestingly, when controlling for labor intensity proxy (column 2), the low technology manufacturing goods dummy loses statistical significance, while the effect of labor intensity is significant and positive. This result suggests that the most relevant feature that makes low technology-intensive sectors respond more pronouncedly to RER is their higher labor intensity. A 1% increase in the sector's labor intensity adds 0.04% to the probability of an export surge during the long-lasting RER depreciation period. For a sector with one standard deviation of higher labor intensity than the mean, the export surge probability increases by 2.55%. Given that the unconditional probability over 1980–2015 was around 9.55%, the differential effect is statistically and economically significant.

When controlling for the RCAs of each product (column 3), the category of medium technology content decreases in significance and magnitude, while the role of labor intensity increases slightly and maintains its statistical significance. The estimated coefficient of the impact of RCA 1996 is negative and significant. An increase of one standard deviation decreases the probability of an export surge episode by 1.5 percent. This result indicates that higher initial competitiveness reduces the probability of a sectoral export surge episode. This finding is in line with the hypotheses outlined above and occurs despite controlling for the type of product approximated by Lall's categories, meaning it holds even considering that primary products and related manufacturing goods in Argentina are those with the highest levels of revealed comparative advantage. Therefore, this is our preferred specification.

Columns 4 and 5 show that the positive differential impact on labor-intensive sectors holds even without controlling for any other variables (column 4) or only for the initial revealed comparative advantages (column 5). Column 6, on the other hand, shows the robustness of our preferred specification using a probit regression model.

Finally, to dig into the differential behavior according to the initial competitiveness of each sector, we control for the quintiles of 1996's RCA (column 7). We argue that it is not evident that the exchange rate impact should be monotonic according to the degree of RCA. For example, it might very hard for a critical mass of firms starts to successfully compete globally in sectors with very low initial competitiveness levels only because of a more competitive RER. Given our hypothesis that RER might not be a relevant variable for very competitive sectors, we expect that sectors with medium capabilities have more opportunities to increase production through technology adoption and productive catch-up. This hypothesis, a priori, is supported if we look at the proportion of products with export surges by RCA quintile (Figure 6 in the appendix). We find partial evidence that supports this hypothesis even when conditioned by other variables. From quintile 2 to 5, the probability of export surge episodes increases relative to quintile 1, but the maximum probability occurs in quintile 3, with the coefficient decreasing significantly in the fifth quintile. Furthermore, this finding aligns with the hypothesis regarding price strategy differences by high-performing firms, resulting in different export RER-elasticities (Berman et al., 2012; Chen and Juvenal, 2016).

All in all, these results confirm that the correlations implied by the previous descriptive analysis are statistically significant and robust to different specifications and regression models. The RER effect through labor intensity proxy survives in all specifications, indicating that the positive role during the long-lasting RER depreciation period (2003–2008) was not due to a mere coincidence in terms of product type or initial product competitiveness. We interpret this finding as preliminary evidence supporting the hypothesis that the RER played a positive role in the realization of export surges through the theoretical channel indicated above.

4.1. Prior productive capabilities

Before evaluating whether the results are robust to controlling for other variables, we include another determinant of new export developments, which has already been tested in the relevant literature and might be biasing our results.

Following Bahar et al. (2019), we evaluate whether the probability of export surges solely depends on the RCA of each sector or whether it is a function of the general production structure of the economy. Hidalgo et al. (2007) provide solid evidence that countries move through the product space (a.k.a. relatedness between products) by developing sectors close to those they currently produce competitively. Countries might mainly diversify into activities that already possess prior capabilities, which do not depend only on the sector's productive capacity but on cross-industry linkages. If this is the case, it is not only interesting to discover such a link for understanding the RER role, but it is also necessary to control for it to avoid omitted variable bias.[29]

[29] In addition, this might be a better way to capture how RER undervaluation increase the probability of an export surge episode in sector with medium capabilities than using RCA quintiles.

Table 1
Determinants of export surge episodes during currency undervaluation period: Labor Intensity, Revealed Comparative Advantages (RCA), and Lall's categories. Linear probability model.

	(1) Export surges b/se	(2) Export surges b/se	(3) Export surges b/se	(4) Export surges b/se	(5) Export surges b/se	(6) Export surges b/se	(7) Export surges b/se
ln(labor intensity)		.0446**	.0481**	.0437**	.0447**	.0504**	.0408*
		(.0204)	(.0222)	(.0208)	(.0220)	(.0248)	(.0225)
z.RCA 1996			−.0152***		−.0194***	−.0314**	
			(.0042)		(.0042)	(.0140)	
Resource-based	.0228	.0184	.0108			.0058	−.0003
	(.0347)	(.0370)	(.0396)			(.0422)	(.0398)
Low tech.	.0643*	.0279	.0106			.0058	−.0008
	(.0389)	(.0437)	(.0457)			(.0443)	(.0453)
Medium tech.	.1084***	.0950**	.0789*			.0726	.0673
	(.0384)	(.0434)	(.0460)			(.0466)	(.0479)
High tech.	.0481	.0209	.0011			−.0039	.0444
	(.0510)	(.0519)	(.0532)			(.0528)	(.0541)
Quintiles RCA 1996=2							.1375***
							(.0383)
Quintiles RCA 1996=3							.2221***
							(.0385)
Quintiles RCA 1996=4							.1691***
							(.0388)
Quintiles RCA 1996=5							.1173***
							(.0357)
Constant	.1034***	.0772**	.0915**	.1164***	.1223***		−.0258
	(.0254)	(.0329)	(.0365)	(.0269)	(.0284)		(.0413)
Obs.	773	707	679	707	679	679	679
R2	.012	.017	.018	.008	.011	–	.052
Model	ols	ols	ols	ols	ols	probit	ols
vcetype	Robust	Robust	Robust	Robust	Robust	Delta-method	Robust
Clusters	–	231	227	231	227	dy/dx	227

Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

What does "prior capabilities" mean? The idea is that each product requires a particular combination of inputs and specific capabilities, but there is a certain degree of substitutability between them. The imperfect input and factor substitutability indicate that for each pair of goods, there is a notion of productive distance between them which quantifies the similarities concerning the capabilities/inputs needed for their production. For example, leather shoes may be located *close* to leather bags in productive terms but much further away from car engines because of differences in the labor skills, know-how and machinery required. Moreover, the production of leather shoes has nothing to do with the production of soybeans. Crucially, while tradable inputs can be easily acquired, non-tradable inputs or know-how must be developed locally or depend on a specific geographical endowment. The required productive capabilities that restrict diversification possibilities are, according to Hausmann and Hidalgo (2011), essentially non-tradable.

In the appendix, we show how the maximization problem is modified to include this economic feature and how it interacts with the RER level. We add a non-tradable sunk cost to the profitability that depends on the (productive) proximity between sectors. As long as the expected benefit of producing the new product/sector is higher than the cost, the firms will decide to pay this new sunk cost and acquire the required capabilities. Given that we follow Hausmann and Hidalgo (2011) and assume that these capabilities are mostly non-tradable, the role of RER is enhanced since a more competitive RER implies a decrease in this new sunk cost, promoting export diversification. However, even if we assume it is another tradable sunk cost, the RER would increase profitability due to the falling of non-tradable costs (labor) and still encourage the sunk cost's payment.

We use the proximity and density measures proposed by Hidalgo et al. (2007) and used by Bahar et al. (2019) to analyze the determinants of export take-offs. We consider that Argentina has capabilities developed in a particular sector when it exceeds a certain threshold of revealed comparative advantage (RCA). Given this, we expect that sectors related to already competitive sectors share a large part of the productive requirements of the latter and, therefore, show a greater probability of being able to start producing competitively. Therefore, export surges are more likely to occur in sectors related to sectors with high RCAs, despite their own RCA level. Bahar et al. (2019) referred to this channel as *production agnostic relatedness*. This relationship is *agnostic* as it does not determine by which mechanism these products are related. For example, they could be related because of similarities in technologies, workers and labor skills, input–output relations, or similarities in requirements of climate and soil conditions.

The proximity index is provided by Growth-Lab-Harvard (2019) based on Hidalgo et al. (2007). This index is the main indicator of product-space and determines how likely the same country will export a pair of different products competitively. In particular, the proximity between product j and p is the minimum conditional probability that a country is a competitive exporter of one sector if it exports the other competitively.[30] Combining the proximity index with an indicator of Argentina's RCAs, we build the *agnostic relatedness density index* which captures the average proximity of each sector to all those already competitive sectors of Argentina's export basket:

$$\phi_j = \frac{\sum_{p \neq j} \lambda_{j,p} * R_p(1|RCA_p > p75)}{\sum_{p \neq j} \lambda_{j,p}} \tag{3}$$

Where $\lambda_{j,p}$ is the proximity between product j and p and is provided by Growth-Lab-Harvard (2019). R_p takes value 1 when product p is among the 25% of the exports with the highest RCA of a base year (in this case, 1996) in Argentina. This equation means that the density index weighs the sectors' proximity to those where the country already has developed capabilities. Both Hidalgo et al. (2007) and Bahar et al. (2019) use a more demanding criterion, identifying only proximities with sectors with RCAs greater than 1. The definition of the bound

[30] The proximity index is calculate as $\lambda_{j,p} = min[Pr(RCA_j \geq 1|RCA_p \geq 1), Pr(RCA_p \geq 1|RCA_j \geq 1)]$.

Table 2
The role of prior capabilities. Linear probability model. Export surges 2003–2008.

	(1) Export surges b/se	(2) Export surges b/se	(3) Export surges b/se	(4) Export surges b/se	(5) Export surges b/se	(6) Export surges b/se	(7) Export surges b/se	(8) Export surges b/se
ln(labor intensity)	.0481**	.0475**	.0525***	.0433**	.0498**	.0525**	.0433**	.0525***
	(.0222)	(.0190)	(.0202)	(.0202)	(.0197)	(.0204)	(.0204)	(.0200)
Agnostic relatedness (RCA≥ p75)		.0470***	.0558***	.0462**				.0618***
		(.0176)	(.0195)	(.0191)				(.0233)
z.RCA 1996	−.0152***		−.0271***		−.0263***	−.0270***		−.0273***
	(.0042)		(.0060)		(.0053)	(.0063)		(.0059)
Agnostic relatedness (RCA≥ p50)					.0717***			
					(.0178)			
Agnostic relatedness (RCA≥1)						.0522***	.0435**	
						(.0198)	(.0195)	
Quintiles RCA 1996=2				.1351***			.1368***	
				(.0383)			(.0382)	
Quintiles RCA 1996=3				.2181***			.2204***	
				(.0378)			(.0381)	
Quintiles RCA 1996=4				.1509***			.1547***	
				(.0378)			(.0378)	
Quintiles RCA 1996=5				.0825**			.0861**	
				(.0360)			(.0361)	
ln(labor intensity) ×Agnostic relatedness (p75)								−.0053
								(.0177)
Constant	.0915**	.0231	.0279	−.0617	.0323	.0308	−.0623	.0275
	(.0365)	(.0357)	(.0400)	(.0430)	(.0367)	(.0405)	(.0435)	(.0397)
Lall Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	679	703	676	676	676	676	676	676
R2	.018	.026	.029	.059	.043	.027	.058	.029
Model	ols	ols	ols	ols	ols	ols	ols	ols
vcetype	Robust	Robust	Robust	Robust	Robust	Robust	Robust	Robust
Clusters	227	231	227	227	227	227	227	227

Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

is, however, ad-hoc both in those papers and in ours. We argue that our criterion seems more appropriate and useful for countries with concentrated export baskets. However, the 75th percentile RCA value is 0.7084, not far from one. We also perform robustness tests with more ($RCA \geq 1$) and less demanding ($RCA \geq 50$) criteria. We show in the table 12 of the appendix the correlation of the density indices if $RCA \geq 1$, the 75th percentiles or the median. Finally, as in the case of RCA, it is standardized so that the indices have zero mean and standard deviation equal to 1.

Table 2 incorporates this variable in the estimation of the probability of export surges during the six-year period 2003–2008. Our interest is to estimate whether there is a higher probability of surges in those export sectors with a higher network density populated with other already competitive sectors and how controlling for it modifies the coefficient associated with the labor intensity index. Column 1 replicates our preferred model of the Table 1 (column 3) to make it easier for the reader to compare the results. The coefficient related to labor intensity and the role of the RCAs for each product remains unchanged, adding robustness to our previous results.

Regarding the agnostic density index, we find that sectors related to those with prior capabilities (*Agnostic relatedness*) increase the probability of an export surge by a magnitude between 4.6 (column 2 and 4) and 5.5 (column 3) percent, depending on whether the RCA control is included. Moreover, the results are robust to more ($RCA \geq 1$) and less demanding ($RCA \geq 50$) density criteria or to controlling for quintiles of RCA, with no relevant changes and stable coefficients. Finally, column (8) explores whether the labor intensity effect is enhanced in sectors close to the competitive ones. The interaction between both variables is not significantly different from 0, which allows us to conclude that the proximity and labor intensity effects channels are not enhanced by each other. In short, we conclude that the large and long-lasting RER devaluation encouraged the emergence of export surges in those labor-intensive sectors, sectors with RCA at medium levels, and those with close connections to already competitive sectors.

5. Robustness exercises: Macroeconomic determinants,1994–1999 episode, and panel data analysis

The empirical strategy used in the previous section was the simplest regression design we could have done. It shows evidence of the mechanism through which the real exchange rate increases the probability of an episode of rising exports without adding many control variables or relying on other periods to identify the effects. Finding the expected result in that simple regression design is encouraging because it highlights the strength of the mechanisms tested. However, if we want to be able to claim that our hypotheses are valid, these mechanisms should survive to include several control variables and use more complex regression designs.

We focus on four different kinds of robustness tests. First, we check that the cross-section results hold when: (a) controlling for previous export trends, a different proxy of labor intensity, sectoral average workers' wages, skills, or formality status, and firms' sizes; (b) changing our export surge episodes variable by the one calculated with the database provided by Feenstra and Romalis (2014) or calculating export surges using 2003–2008 vs. 1996–2001 (excluding 2002 from the benchmark period because of the crisis). Second, we then check if the results hold when controlling for changes in import tariffs of trading partners, differences in macroeconomic variables by sector according to the weight of trading partners, and changes in Argentinean tariffs on intermediate inputs. These exercises focus on the robustness of the 2003–2008 period results.

Third, the peak of export surges in 1994–1999 is an excellent event to test the relationship between exports and labor intensity. Given that the RER kept overvalued during that period (Aromí et al., 2014), there is no reason to expect a positive influence related to the degree of sectoral labor intensity. Last but not least, pooling non-overlapping six-year periods will allow us to assess the determinants using panel techniques and incorporate time variability into the analysis. This last exercise allows us to interact different real exchange rate levels with our (kind of) shift-share variable (labor intensity) that assigns the expected heterogeneity impact to export performance. Indeed, some readers might feel more comfortable with this type of identification strategy to ensure causal effects.

5.1. Additional controls: Past export trends, wages, sectors' characteristics, and robustness in the export surges identifications

Here, we run three econometric robustness exercises. The first one is presented in Table 3 and confirms the results both qualitatively and quantitatively, using two additional sets of controls.

The first group of variables controls for the sectoral average growth rate of exports during the periods prior to the large devaluation to avoid capturing relationships explained by past export trends. This variable fulfill the same role as *momentum* variable in Bahar et al. (2019).

The second set of control variables includes data from INDEC's household surveys to control for workers' educational level, size of establishments, and degree of formality at the ISIC 3-digit sector level.[31] More relevant, we control for workers' average wages at the 4-digit ISIC level in 2004 using data provided by the *Observatorio de Empleo y Dinámica Empresarial*. Although wages are part of labor costs, their level is also an indicator that might capture the degree of complementarity between labor and capital or a shortage of workers with the required skills in a particular sector.[32] Indeed, Kaiser and Siegenthaler (2016) shows that exchange rate appreciations have a more negative effect on the employment of low-skilled workers. Also, we only have data on formal wages, but we do not have reliable data on other employment-related costs paid by firms, nor do we have data on informal wages. That is why we prefer to add this variable as an independent variable of our labor intensity index proxy. However, we also test changing our labor intensity variable for the one that weighs the number of employees by its average sectoral wage in the formal sectors. This variable is the most similar we could approximate to the wage share by sector at this level of disaggregation.

All the regressions highlight the robustness of our main results. In every case, the labor intensity and agnostic relatedness indices are significant and show stability in their magnitudes. Column (5) shows that controlling for average sector wages does not change our result, and the variable itself is statistically not different from 0. Moreover, if we change our main variable of interest (labor intensity) using the average wages by sector as weights, the new labor intensity index continues to be significant and similar in magnitude.

The second and third exercises are shown in the appendix in table 13. In this case, we repeat the last section's principal analysis but apply it to other measures of export surge episodes. The first four columns re-do our main regressions using export surge episode calculated with Feenstra and Romalis (2014)'s database. This database provides quality-adjusted export prices, and we used it as one of the robustness exercises performed on the surge detection algorithm. The last four columns re-do our main regressions but using export surges detected when comparing the period 2003–2008 to 1996–2001 instead of 1997–2002. In this way, we leave out 2002, which was the year of the domestic financial crisis and the end of the currency board. Yet, results remain robust in both cases.

5.2. Tariff policy and macroeconomic determinants

A possible concern for our identification strategy is that Argentinean labor-intensive exports have as destinations countries that reduced import tariffs, accelerated their growth more than average, or that the bilateral real exchange rate has depreciated more than the currency of other partners during the period analyzed. For example, suppose labor-intensive sectors export mainly to Brazil and capital-intensive sectors export to the United States. In this case, we would have a problem interpreting the results if the bilateral RER depreciated more against the Brazilian Real than the US dollar or if Brazil's economy grew at a higher rate than the US. In such a situation, the bias toward labor-intensive sectors would not reflect a heterogeneous impact of the RER on the export structure but rather the difference in the determinants of export growth in each case.

We incorporate different macroeconomic variables in our estimations to control for these possible omitted determinants. These variables are constructed by sector using the share of each export destination. We incorporate these control variables in cross-sectional regressions using the average change between 2003–2008 and 1997–2002. Remember that the measurement of the export surge itself takes into account the differential behavior between these periods. In table 14 of the appendix, we report some descriptive statistics of the variables incorporated for several six-year periods of reference. We use the following control variables:

1. Real effective exchange rate by sector (REER): we use consumer price indices, nominal exchange rate, and trading partners' shares for each export destination at the sector level in 1996.
2. Exchange rate volatility: We use the standard deviation of the REER by sector during the six-year period.
3. Trading partners' demand by sector (trading partners' GDP): we use the GDP in purchasing power parity dollars of trading partners and their share in 1996 of each product. We control for this variable in terms of its average level change between six-year periods and also for the differences in growth rates between periods (growth acceleration).
4. Trade openness: TRAIN−WITS provides data since 1989 on import tariffs by trading partners. We use percentage point change in simple averages of tariffs by sectors for Latin America, the European Union, and the USA relative to the previous six-year period.

Additionally, import tariffs imposed by Argentina for imported inputs can be a relevant cost influencing export performance. There is growing evidence on the relevance of access to high-quality inputs, identifying it as the key mechanism for productivity gains and good export performances in the case studies of trade openness (Amiti and Konings, 2007; Goldberg et al., 2010; Topalova and Khandelwal, 2011; Irwin, 2019; Bas, 2012). To construct the intermediate input tariff index, we use the data provided by Greenstone et al. (2010) to approximate potential upstream production linkages for each sector and combine it with Argentina's import tariffs reported by TRAIN−WITS.[33] Figure 7b in the appendix reports the average upstream tariff by origin region. It shows a fall in upstream tariffs during the period of analysis. Tariff reduction was concentrated in Latin America and not in the rest of Argentina's relevant trading partners.

Table 4 shows that our key results are robust in all specifications. The coefficients associated with labor intensity, RCA, and agnostic

[31] We use 2003–2015 (average) for all these variables. The educational level and size of establishments are included as dichotomous variables that take a value of 1 when the percentage of workers with at least secondary education and the number of employees per establishment is higher than their mean in the sector. The degree of formality is incorporated as a percentage of formal employees. Wages are in logarithms.

[32] This shortage of workers with specific skills and abilities may be a country-specific phenomenon and does not represent that the sector is labor-intensive. Therefore, in comparing relative profitability with other countries, this proxy for labor intensity could be misleading.

[33] The upstream relationships are built using the US input–output matrix, which is the same database used by Bahar et al. (2019) to approximate potential export linkages in a panel of 4-digit SITC countries-sectors. The last section of this paper discusses the advantages and disadvantages of this indicator.

Table 3
Robustness test: past export trends (momentum), sectoral characteristics, wages, skills, and labor share. Linear probability model.

	(1) Export surges b/se	(2) Export surges b/se	(3) Export surges b/se	(4) Export surges b/se	(5) Export surges b/se	(6) Export surges b/se	(7) Export surges b/se	(8) Export surges b/se	(9) Export surges b/se
ln(labor intensity)	.0629***	.0625***	.0590***	.0622**	.0532**		.0599***	.0513**	.0471**
	(.0238)	(.0227)	(.0215)	(.0241)	(.0233)		(.0205)	(.0198)	(.0208)
Agnostic relatedness (p75)	.0579**	.0565**	.0553***	.0554**	.0551***	.0546***	.0576***	.0574***	.0487**
	(.0229)	(.0218)	(.0208)	(.0236)	(.0193)	(.0193)	(.0192)	(.0194)	(.0200)
z.RCA 1996	−.0318***	−.0317***	−.0300***	−.0325***	−.0269***	−.0266***	−.0252***	−.0259***	−.0280***
	(.0065)	(.0066)	(.0066)	(.0068)	(.0059)	(.0057)	(.0062)	(.0061)	(.0075)
Average export growth 86–91	.0270			.0220					
	(.0180)			(.0200)					
Average export growth 90–95		.0015		.0164					
		(.0297)		(.0455)					
Average export growth 97–01			.0106	.0044					
			(.0275)	(.0428)					
ln(wages)					.0023				
					(.0442)				
ln(Labor intensity) (adjusted)						.0534**			
						(.0234)			
Skilled workers							.0672*		
							(.0375)		
Firms size								−.0293	
								(.0337)	
Formality									−.0008
									(.0009)
Constant	.0397	.0329	.0366	.0486	.0119	−.3440*	.0113	.0458	.0863
	(.0527)	(.0479)	(.0440)	(.0568)	(.3259)	(.1920)	(.0404)	(.0479)	(.0811)
Lall Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	574	600	623	564	682	682	682	682	644
R2	.036	.034	.033	.035	.031	.028	.036	.032	.032
Model	ols	ols	ols	ols	ols	ols	ols	ols	ols
vcetype	Robust	Robust	Robust	Robust	Robust	Robust	Robust	Robust	Robust
Clusters	219	221	223	219	231	231	231	231	227

Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

relatedness to competitive sectors do not suffer relevant changes and maintain their sign, magnitude, and significance. The first four columns evaluate robustness by incorporating the variation of tariffs imposed by Argentina on input products. We find a positive impact of lowering tariffs on inputs from Latin America. Columns 5 and 6 incorporate the changes in destination tariffs, while columns 7 and 8 incorporate changes by sectors in the REER, the REER volatility, and the trade partners' GDP growth differential. As we argue before and expected from Gopinath (2015) and Adler et al. (2020) findings, the real effective exchange rate is not relevant by its own and that the bilateral RER level keeps its effect through the mechanism we proposed. On the other hand, the trade partners' growth differential and the average aggregate demand change show no significant coefficients. These results add robustness to our hypothesis that the growth of our trade partners did not explain the occurrence of export surge episodes. The requirement imposed on detecting export surges achieves its goal of avoiding being demand-driven.

5.3. Export surges episodes from 1994–1999

The 1994–1999 period is an excellent natural experiment to test our results. During these six years, Argentina experienced the second highest local peak of export surges from 1980 onwards, only lower than 2003–2008. However, the Argentine currency remained overvalued during those years (Aromí et al., 2014), and we should not find a positive relationship between export surges and the labor intensity index.

Table 5 confirms our hypothesis and shows no relationship between labor intensity index and the probability of surges during 1994–1999. Indeed, all coefficients show a negative relationship between the probability of export surges and the labor-intensity index during an overvalued currency period. This result is in line with the theoretical channel proposed in this article and, therefore, strengthens our finding. In addition, the RCA coefficients remain negative but insignificant, as do those associated with proximity to competitive sectors. The last one was an expected result because building capabilities is essentially a non-tradable phenomenon, as we emphasized before (Hausmann and Klinger, 2006). No controls alter the main results.[34]

Our results are consistent with the fact that this period was characterized by productive specialization rather than diversification toward new sectors because of the trade opening. In this line, Fernández Bugna and Porta (2007) claims that during the currency board period, the productive structure shifted in favor of non-tradable services, specific sectors benefiting from the MERCOSUR agreement, and capital-intensive activities due to the higher relative labor costs. Our findings support these observations and reinforce the connection between RER and labor-intensive sectors.

5.4. Non-overlapping six-year periods: Panel data analysis

This last exercise is not only a robustness test but also a complementary identification strategy for the RER effect on export surges episodes. Here, we exploit the time dimension and use panel techniques to evaluate our central hypothesis using more than one six-year period. This regression design allows (and forces) us to include the interaction between RER movements and labor intensity index. The identification strategy is very similar to a shift-share design, where the labor intensity index acts as the *share* variable and the RER level as the *shift*. The coefficient associated with the interaction between both variables is

[34] For upstream tariffs, we use the change between the average 1994–1999 vs.1992–1993, since no previous data is available. For tariffs by export destination, we use the average change of 1989–1993 vs. 1994–1999 since we do not have the 1988 data to comply with the previous six-year period. The rest of the variables compare the six-year period 1988–1993 vs.1994–1999.

Table 4
Robustness test of export surges 2003–2008: Tariffs on final goods, upstream tariffs, and macroeconomic variables by sectors.

	(1) Export surges b/se	(2) Export surges b/se	(3) Export surges b/se	(4) Export surges b/se	(5) Export surges b/se	(6) Export surges b/se	(7) Export surges b/se	(8) Export surges b/se	(9)
ln(labor intensity)	.0463**	.0492**	.0516**	.0529**	.0448*	.0444**	.0494**	.0491**	
	(.0207)	(.0206)	(.0212)	(.0208)	(.0253)	(.0214)	(.0213)	(.0216)	
z.RCA 1996	−.0239***	−.0257***	−.0250***	−.0253***	−.0329***	−.0279***	−.0283***	−.0233***	
	(.0061)	(.0060)	(.0062)	(.0060)	(.0083)	(.0076)	(.0074)	(.0087)	
Agnostic relatedness (p75)	.0559***	.0593***	.0567***	.0549***	.0571***	.0595***	.0612***	.0610***	
	(.0204)	(.0203)	(.0206)	(.0206)	(.0204)	(.0205)	(.0206)	(.0206)	
Upstream tariffs LatAm $(08-03vs02-97)$	−.0248	−.0264**				−.0173	−.0185	−.0188	
	(.0169)	(.0131)				(.0145)	(.0154)	(.0157)	
Upstream tariffs EU $(08-03vs02-97)$	−.0882*		−.0224						
	(.0484)		(.0174)						
Upstream tariffs USA $(08-03vs02-97)$	.0596*			−.0039					
	(.0307)			(.0127)					
Tariff change $(08-03vs02-97)$– LatAm					−.0197**	−.0214***	−.0198**	−.0192**	
					(.0089)	(.0078)	(.0084)	(.0083)	
Tariff change $(08-03vs02-97)$– USA					−.0037				
					(.0062)				
Tariff change $(08-03vs02-97)$– EU					−.0001				
					(.0001)				
REER change $(08-03vs02-97)$							.0991	.0294	
							(.1300)	(.0964)	
REER volatility chg $(08-03vs02-97)$							.0002	.0010	
							(.0011)	(.0008)	
Trade partners' growth chg. $(08-03vs02-97)$							1.3810		
							(1.3829)		
Trade partners' GDP change $(08-03vs02-97)$								−.1979	
								(.2155)	
Constant	−.0891	−.1042	.0011	.0304	−.0086	−.1200	−.2096	−.0900	
	(.1010)	(.0876)	(.0576)	(.0605)	(.0547)	(.0896)	(.1458)	(.1150)	
Lall Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Obs.	625	625	625	625	612	624	605	605	
R2	.040	.035	.031	.030	.033	.046	.047	.047	
Model	ols	ols	ols	ols	ols	ols	ols	ols	
vcetype	Robust	Robust	Robust	Robust	Robust	Robust	Robust	Robust	
Clusters	219	219	219	219	227	219	217	217	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Standard errors in parenthesis.

the one that captures the RER impact on export surge occurrence probability.

We perform two regression exercises using different time spans of data. In exercise (a), we use the six-year periods 1996–2001, 2003–2008, and 2010–2015. These six-year periods show marked differences in RER levels and dynamics.1996–2001 and 2003–2008 are six-year consecutive periods with very stable overvalued and undervalued exchange rates, respectively. Regarding 2010–2015, it is a period of constant and very predictable exchange rate appreciation (see Figure 4 in the appendix). In exercise (b), we use the six-year periods 1986–1991, 1994–1999, and 2003–2008. These six-year periods are the three local peaks of export surge episodes from 1980 onwards.[35] The regression model proposed in all exercises contains sector fixed effects at 4-digit disaggregation.

Several clarifications are necessary regarding the control variables incorporated and the use of fixed effects by sectors and six-year periods. First, cross-sectional variables are absorbed by the sector-fixed effects. Therefore, we do not include them in the regression, except for the labor intensity index (our central hypothesis), which is interacted by the RER. Thus, the control variables included are import tariffs and macroeconomic variables because of their time series dimension. Our preferred estimation uses the bilateral real exchange rate relative to the USA (RER USA) as a shift variable, given the empirical finding provided by Gopinath (2015). However, we test the robustness of our results using the real effective exchange rate (REER), which has the empirical advantage of showing some variability between sectors because of the different sets of trading partners. To sum up, we include import tariffs imposed by trading partners and Argentina's import tariffs in upstream sectors, the trading partners' GDP, and two proxies of the exchange rate (in)stability: the stability of the nominal exchange rate using the data provided by Aizenman (2013)[36], and the REER volatility index used in previous sections. When including fixed effects per six-year period, the common temporal component between sectors is controlled, and macroeconomic variables that do not have sector variability (RER US and nominal stability) are absorbed. For this reason, our preferred estimates are those without including period-fixed effects.

Second, as we previously mentioned, the identification strategy of the exchange rate effect is slightly different from previous exercises but relies on the same theoretical channel. Since the bilateral exchange rate relative to the USA does not vary between sectors, assessing its effect in a short panel regression is tricky because the effect identification relies on very small time variability. Using the REER might help, but it is not perfectly aligned with our theoretical channel and the evidence provided by Gopinath (2015). In addition, the REER indices also vary similarly across sectors over the six-year periods, and period-fixed dummies might absorb much of their impact. However, the identification

[35] As we mentioned before, we did not perform the calculation of export surges episodes for periods prior to 1980 because the quality and quantity of data reported by other countries for the construction of world exports gets increasingly worse the further back in time we want to go. Additionally, Argentina's tumultuous history of democratic interruptions would further complicate the analysis.

[36] This index is calculated as the annual standard deviation of the monthly nominal exchange rate of the domestic currency relative to the USD, normalized between 0.01 y 1: $ERS = 0.01/[0.01 + st.dev(\Delta log(TCN))]$.

Table 5
Robustness test: export surges during currency overvaluation period (1994–1999).

	(1) Export surges b/se	(2) Export surges b/se	(3) Export surges b/se	(4) Export surges b/se	(5) Export surges b/se	(6) Export surges b/se	(7) Export surges b/se
ln(labor intensity)	−.0194	−.0201	−.0334	−.0570	−.0163	−.0290	−.0357*
	(.0208)	(.0208)	(.0218)	(.0346)	(.0233)	(.0228)	(.0211)
z.RCA 1993	−.0013	−.0031	−.0047	−.0064	−.0057	−.0068	−.0038
	(.0098)	(.0107)	(.0116)	(.0112)	(.0119)	(.0143)	(.0131)
Agnostic relatedness (p75)		.0082	.0129	−.0055	.0121	.0203	.0146
		(.0171)	(.0184)	(.0278)	(.0187)	(.0202)	(.0188)
Tariff change LatAm (94–99 vs. 1989–93)			−.0042**	−.0006		−.0047***	−.0038**
			(.0017)	(.0024)		(.0018)	(.0019)
Tariff change USA (94–99 vs. 1989–93)				.0098*			
				(.0050)			
Tariff change EU (94–99 vs. 1989–93)				.0087***			
				(.0021)			
Upstream tariffs LatAm (94–99 vs. 92–93)					.0111		
					(.0278)		
Upstream tariffs USA (94–99 vs. 92–93)					−.0629**	−.0159	
					(.0261)	(.0101)	
Upstream tariffs EU (94–99 vs. 92–93)					.0582*		
					(.0310)		
REER change (94–99 vs. 88–93)							.1720
							(.1490)
Trading partners' GDP chg (94–99 vs. 88–93)							−.3470**
							(.1407)
REER volatility chg (94–99 vs. 88–93)							−.0013**
							(.0006)
Constant	.1250***	.1168***	.1259***	.1646**	.1549**	.1767***	.1416**
	(.0386)	(.0391)	(.0438)	(.0678)	(.0597)	(.0625)	(.0636)
Lall Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	666	663	633	465	608	583	621
R2	.009	.010	.018	.041	.017	.023	.026
Model	ols	ols	ols	ols	ols	ols	ols
vcetype	Robust	Robust	Robust	Robust	Robust	Robust	Robust
Clusters	233	233	227	195	221	216	225

Note: standard errors in parentheses. * p < 0,10, ** p < 0,05, *** p < 0,01.

strategy used in this paper allows us to overcome this drawback by using the theoretical channel through which the RER affects sector profitability. The effect of the RER must be different for each sector depending on the degree of labor intensity used in their production function. This fact allows us to identify the exchange rate impact on exports through the interaction between the RER and the labor intensity of each sector.

Therefore, our identification strategy points toward the interaction between the RER-USA and labor intensity index. We expect a positive coefficient, which would indicate that in periods of more competitive real exchange rates, labor-intensive sectors increase the probability of an export surge episode. Robust clustered errors are used at the level that the labor intensity data vary.

Table 6 shows the results comparing the 1996–2001, 2003–2008 and 2010–2015 episodes and Table 7 uses the three peak surges 1986–1991, 1994–1999 and 2003–2008.[37] The results are always robust, and the interaction between RER and labor intensity exhibits a significant and positive coefficient in all specifications and time slices. Interestingly, the results are robust enough of using the REER instead of RER, and including period-fixed effects. However, when we include the RER-USA and the REER in the same regression, only the bilateral RER survive. These exercises are found in columns 5 and 8 of both tables and aim to assess whether one of the two variables has greater explanatory power than the other. Similar to the results of the Dominant Currency Paradigm (Gopinath, 2015; Gopinath et al., 2020; Adler et al., 2020; Boz et al., 2022), our findings favor the bilateral real exchange rate as the most relevant variable due to the predominance of dollar price invoicing in developing economies. However, given the potential multicollinearity between these variables, our preferred regressions are when only one of the two exchange rate competitiveness variables is included.

Regarding the nominal stability and REER volatility, they always have the expected sign supporting the hypothesis that it is not only the level but also the stability of the RER relevant for export sector development. Finally, in the last column of both tables, we include a regression without sector and period fixed effects in order to be able to include the labor intensity variable separately and not only its interaction with the RER. This exercise serves to prove that the dynamism of the labor-intensive sectors occurs only in periods of a competitive and stable real exchange rate and that it is not an intrinsic characteristic of these sectors in Argentina. In line with our hypothesis, this variable is not significant, while the interaction remains positive and significant in both tables.

We conclude that there is sufficient evidence to confirm our main hypotheses. The RER has a stronger influence on labor-intensive activities and was a vehicle for achieving a large proportion of export surges in these sectors during 2003–2008. In addition, the probability of export surges during the period of 2003–2008 is higher in sectors with a certain level of initial development (at the median of the distribution of RCAs) and which are related to already competitive sectors. These findings indicate that the development of export sectors depends on the economy's production structure and that the possibility of new take-offs in tradable sectors is influenced by the country's productive capacities.

[37] Table 7 does not control for upstream tariffs because we only have data for Argentinean tariffs since 1992. However, in the case of tariffs in country destinations, data is available from 1989. This is why we include as control the average tariffs from 1989 to 1991 as a proxy of the trade policy during 1986–1991.

Table 6
Panel data: determinants of export surges in the periods 1996–2001, 2003–2008 y 2010–2015.

	(1) Export surges b/se	(2) Export surges b/se	(3) Export surges b/se	(4) Export surges b/se	(5) Export surges b/se	(6) Export surges b/se	(7) Export surges b/se	(8) Export surges b/se	(9) Export surges b/se	(10) Export surges b/se	(11) Export surges b/se
ln(RER USA)×ln(labor intensity)	.0738**	.0822**	.0822**		.0807**	.0807**	.0862**	.0861**		.0845**	.0738**
	(.0336)	(.0357)	(.0357)		(.0342)	(.0342)	(.0428)	(.0405)		(.0379)	(.0336)
ln(REER)×ln(labor intensity)				.0984**					.1106**		
				(.0380)					(.0446)		
ln(RER USA)	.0683	.1718***	.		.2287**		.1507*	.3524**		.1654*	.0683
	(.0463)	(.0608)	.		(.1133)		(.0853)	(.1461)		(.0954)	(.0463)
ln(REER)				.1666***	−.1040	−.1040		−.2682**	.1642**		
				(.0582)	(.1143)	(.1143)		(.1249)	(.0649)		
ln(exchange rate stability)		.0919*			.0472		.0587	.0659		.0521	
		(.0525)			(.0602)		(.0771)	(.0840)		(.0965)	
ln(REER volatility)				−.0579***	−.0374**	−.0374**			−.0616***		
				(.0164)	(.0180)	(.0180)			(.0178)		
ln(trading partners' GDP)		−.0849	−.0849	−.2525***	−.0467	−.0467	−.1109	.0017	−.2189***	−.0831	
		(.0813)	(.0813)	(.0475)	(.1054)	(.1054)	(.0890)	(.1147)	(.0771)	(.0856)	
Period=2003–2008			.0426			.1233*					
			(.0414)			(.0707)					
Period=2010–2015			−.0396			.0054					
			(.0353)			(.0400)					
Tariff LatAm (sa)							.0017	.0006	.0023		
							(.0044)	(.0047)	(.0036)		
Tariff EU (sa)							−.0002***	−.0003***	−.0002***		
							(.0000)	(.0001)	(.0000)		
Tariff USA (sa)							.0002	.0006	−.0003		
							(.0008)	(.0008)	(.0008)		
Upstream tariffs LatAm										.0009	
										(.0062)	
Upstream tariffs UE										.0179	
										(.0308)	
Upstream tariffs USA										−.0004	
										(.0216)	
ln(labor intensity)	.	.	.	.	.		.	.	.	.	.0079
	.	.	.	.	.		.	.	.	.	(.0081)
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Obs.	2130	2001	2001	1960	1960	1960	1845	1805	1805	1830	2130
R2	.044	.068	.068	.067	.075	.075	.072	.077	.071	.072	.031
Model	fe	fe	fe	fe	fe	fe	fe	fe	fe	fe	ols
vcetype	robust	robust	robust	robust	robust	robust	robust	robust	robust	robust	robust
Clusters	235	229	229	229	229	229	229	228	228	218	235

Note: own elaboration. Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The number of clusters reaches a number greater than the number of sectors of the 4-digit CIIU because the correspondence between CUCI and CIIU is many to many.

6. Cross-industry linkages and hysteresis effects: Some preliminary explorations

Finally, we explore two interesting extensions to understand the relevance and nature of the export surges found during 2003–2008. First, we have established that there is a greater probability of export surges in those sectors that are close–in productive terms–to other already competitive sectors. However, we have not delved into the type of cross-industry linkages between these sectors. These linkages could be due to upstream or downstream connections (input–output matrix), similarities in technologies, or similarities in workers and labor skills. It is, therefore, relevant to delve into the linkage channels between sectors with export surges and sectors with a high level of RCAs to understand how the export basket might diversify when countries choose different exchange rate policies.

Second, it is also critical to investigate the existence of hysteresis phenomena in the exports of those sectors with export surges. Specifically, the question is if the export surge episodes showed a better performance even when the exchange rate stimulus disappeared. This might imply that these sectors acquire new capabilities and, therefore, there is resilience in the exports of the sectors that took off. This question is not only interesting but also justifies why we focus on export surges episodes and not on the traditional macroeconomic trade elasticities as we have done in Palazzo and Rapetti (2023).

6.1. Unpacking cross-industry linkages

The agnostic relatedness density index does not reveal which are the connection channels between already competitive sectors and those that increase their export surge probability. Sectors might be related through different linkages. They are known as Marshallian linkages (Marshall, 1920) and explain why activities tend to be clustered or spatially agglomerated due to cost or productivity advantages arising from these connections. Their relevance has been pointed out for a long time by scholars of development (Hirschman, 1958, 1977).

We delve into this network of relatedness between sectors and the relevance of each type of linkage on the probability of export surge episodes during the period of competitive and stable real exchange rate (2003–2008). We analyze three possible linkages between export surge sectors and already competitive sectors: (a) similarities in workers and labor skills, (b) similarities in technology, ideas, and innovation, and (c) supplier–customer relationships (input–output linkages). The agnostic relatedness index used before capture all of these linkages but cannot distinguish between them. Moreover, it also covers the possibility that the export surge episode is not influenced by any of those specific linkages between sectors but by sharing natural comparative advantages. So, it might be useful to keep it as a control variable. To assess the relevance of each linkage, we will closely follow the guidelines proposed by Bahar et al. (2019), applying them to this particular case study.

Table 7
Robustness test: export surges during 1986–1991, 1994–1999, 2003–2008. Panel data.

	(1) Export surges b/se	(2) Export surges b/se	(3) Export surges b/se	(4) Export surges b/se	(5) Export surges b/se	(6) Export surges b/se	(7) Export surges b/se	(8) Export surges b/se	(9) Export surges b/se	(10) Export surges b/se
ln(RER USA)×ln(labor intensity)	.0488*	.0557**	.0557**		.0591**	.0591**	.0763**	.0770**		.0488*
	(.0266)	(.0280)	(.0280)		(.0279)	(.0279)	(.0361)	(.0353)		(.0266)
ln(REER)×ln(labor intensity)				.1133***					.1612***	
				(.0429)					(.0506)	
ln(RER USA)	−.0294	.3064**	.		.3314**		.4862***	.6605***		−.0294
	(.0336)	(.1327)	.		(.1614)		(.1863)	(.2175)		(.0336)
ln(REER)				.1517	.0153	.0153		−.2536**	.0846	
				(.1094)	(.1121)	(.1121)		(.1144)	(.1346)	
ln(exchange rate stability)		.1661***			.1175*		.2657***	.2719***		
		(.0613)			(.0695)		(.0909)	(.0987)		
ln(REER volatility)				−.0749**	−.0644**	−.0644**			−.0740**	
				(.0295)	(.0312)	(.0312)			(.0366)	
ln(trading partners' GDP)		−.3298**	−.3298**	−.1302	−.3471**	−.3471**	−.6114***	−.5751**	−.1418	
		(.1549)	(.1549)	(.0946)	(.1740)	(.1740)	(.2111)	(.2348)	(.1182)	
Period=1994–1999			.1251***			−.0073				
			(.0448)			(.0587)				
Period=2003–2008			.2173***			.1475				
			(.0795)			(.0897)				
Tariff LatAm (sa)							.0004	.0002	.0003	
							(.0012)	(.0012)	(.0011)	
Tariff EU (sa)							.0002	.0001	.0001	
							(.0002)	(.0002)	(.0002)	
Tariff USA (sa)							.0002	.0006	.0017	
							(.0028)	(.0027)	(.0026)	
ln(labor intensity)	.	.	.	.	.		.	.	.	.0061
	.	.	.	.	.		.	.	.	(.0111)
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Obs.	2130	2001	2001	1991	1991	1991	1599	1594	1590	2130
R2	.004	.014	.014	.016	.020	.020	.015	.019	.015	.004
Model	fe	fe	fe	fe	fe	fe	fe	fe	fe	ols
vcetype	robust	robust	robust	robust	robust	robust	robust	robust	robust	robust
Clusters	235	229	229	229	229	229	229	228	228	235

Note: own elaboration. Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The number of clusters reaches a number greater than the number of sectors of the 4-digit CIIU because the correspondence between CUCI and CIIU is many to many.

We use the data provided by Ellison et al. (2010) and Greenstone et al. (2010) and used by Bahar et al. (2019).[38] The indices correspond to three-digit ISIC US manufacturing sectors. The linkages cover only manufacturing goods; therefore, the number of products in our sample is reduced, and it will not be possible to assess these particular linkages for primary products.

It could be argued that the optimal approach would be to use Argentina's own data. On the one hand, there are several operational constraints, including the lack of disaggregation of the input–output matrix and the absence of data for shared technology between sectors. On the other hand, the main argument for using data referring to a country such as the US lies in the degree of development of its productive structure. Our article focuses on assessing the exceptional growth of exporting sectors and the development of new ones. Many of these sectors were underdeveloped before the export surge, and their linkages with suppliers and customers or their role in the labor market were practically nil then. In this case, country-specific data would hide potential linkages with already developed sectors because the sector in question had not yet taken off. Indeed, it must not be forgotten that the proposed proximity indices for the agnostic channel are not inherent to the particular country but are given by the probability that any country exports both products competitively. Only the density indices are *nationalized*, using each country's comparative advantages to assess sectors close to those already competitive as we also do with the other specific proximity channels. As Bahar et al. (2019) states, the identifying assumption to interpret our results as valid is that the connections in the US productive structure are related to potential channels in the country analyzed (in our case, Argentina). Far from being perfect, finding results similar to Bahar et al. (2019) reinforces our belief in the strategy followed.

The indices, in particular, are (1) proximity to customers and suppliers (input–output); (2) worker mobility between sectors; (3) regarding technology, authors provide data on the proportion of patents generated in a 3-digit ISIC industry that cite patents generated in other 3-digit ISIC industries. In addition, the authors created another indicator with the amount of research and development (R&D) of an industry that is then a supplier to another 3-digit ISIC industry. We use all these different linkages channels and build density indices in the same way as in the agnostic density index, weighing proximities by the connection to sectors with high RCA in Argentina. Descriptive data on the proximity indices of each linkage and the correlation of their densities (relatedness) indices can be found in tables 15 and 16 in the appendix.

Table 8 shows which of the linkages play a role in explaining the export surges during the competitive and stable RER period (2003–2008). First, we should highlight that the labor intensity index is robust to each channel added. Regarding the new variables, the linkages through technology or the flow of workers are not statistically significant in any case. Only one channel of the input–output matrix connection obtains statistical and economic significance. In this sense, sectors supplying inputs to sectors with a certain level of initial competitiveness are 4.64% more likely to exhibit an export surge if they are one standard deviation closer. The result survives and increases when controlling for the agnostic channel simultaneously and for the rest of the channels evaluated. Finally, again in the appendix, table 17 corroborates

[38] For the correspondence between sectors, we follow the one proposed by Bahar et al. (2019), keeping the 4-digit disaggregation degree of the SITC because we find sufficient variability in the density indicators.

Table 8
Unpacking cross-industry linkages between export surge sectors and competitive sectors (2003–2008).

	(1) Export surges b/se	(2) Export surges b/se	(3) Export surges b/se	(4) Export surges b/se	(5) Export surges b/se	(6) Export surges b/se	(7) Export surges b/se	(8) Export surges b/se
ln(labor intensity)	.0525***	.0425**	.0484**	.0481**	.0444*	.0472**	.0484**	.0390*
	(.0202)	(.0212)	(.0236)	(.0215)	(.0228)	(.0234)	(.0215)	(.0232)
Agnostic relatedness (p75)	.0558***							.0613***
	(.0195)							(.0203)
Downstream with RCA		.0464**						.0677*
		(.0185)						(.0380)
Upstream with RCA			.0031					−.0148
			(.0191)					(.0327)
Labor proximity with RCA				.0273				−.0134
				(.0208)				(.0686)
R&D to RCA sectors					.0051			−.0095
					(.0182)			(.0354)
R&D from RCA sectors						.0021		−.0219
						(.0220)		(.0372)
Patents from RCA sectors							.0326	.0003
							(.0207)	(.0728)
z.RCA 1996	−.0271***	−.0210***	−.0143***	−.0188***	−.0136***	−.0131**	−.0190***	−.0267***
	(.0060)	(.0057)	(.0047)	(.0060)	(.0051)	(.0055)	(.0059)	(.0065)
Constant	.0279	.0468	.0943	.0566	.0962*	.0964*	.0511	.0350
	(.0400)	(.0537)	(.0586)	(.0596)	(.0512)	(.0543)	(.0586)	(.0645)
Lall Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	676	626	628	628	592	600	628	581
R2	.029	.029	.019	.022	.018	.019	.023	.044
Model	ols	ols	ols	ols	ols	ols	ols	ols
vcetype	Robust	Robust	Robust	Robust	Robust	Robust	Robust	Robust
Clusters	227	219	219	219	215	216	219	214

Standard errors between parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

the main results of this subsection using the export surge episodes calculated with the data provided by Feenstra and Romalis (2014).

These results are in line with those found in Bahar et al. (2019) for export take-offs. The only channel they find to have a significant and robust impact is the one referring to upstream sectors of already competitive ones, with values ranging from 4.1 to 5.0% increase in probability by each standard deviation of the degree of density. We interpret these findings as consistent with Albert Hirschman's ideas on the role of upstream sectors in productive structure development.

6.2. Hysteresis

Up to this point, we found evidence that the probability of export surges correlates positively with the degree of labor intensity and linkages with competitive sectors during the period of large and long-lasting RER devaluation (2003–2008). If this process is due to the payment of sunk costs, some persistence should be observed in these sectors' new level of exports, despite the continuous appreciation of the real exchange rate that started in 2010 in Argentina. Finding some degree of export persistence would be suggestive evidence of a hysteresis phenomenon relevant to understanding the dynamics of foreign trade and the development of export sectors.

In this sub-section, we explore how the export performances of the export surge sectors continued after the end of the stable and competitive RER period. In particular, we study the average export performance of sectors with surges during 2003–2008 relative to sectors without export surges. We use annual export data in constant and current values and we include fixed- and year-effect dummies to control for common temporary shocks and constant sector characteristics despite meeting the export surge requirements. In addition, we also control for tariffs and macroeconomic variables to prevent the export dynamics from being explained by different growth rates in the main destination countries, the evolution of the real effective exchange rate, or changes in tariffs in the destination countries. The hypothesis is that a group of exporting firms in the sectors with the export surges made the necessary investments, paying the sunk costs to open new markets or developing new production capabilities.

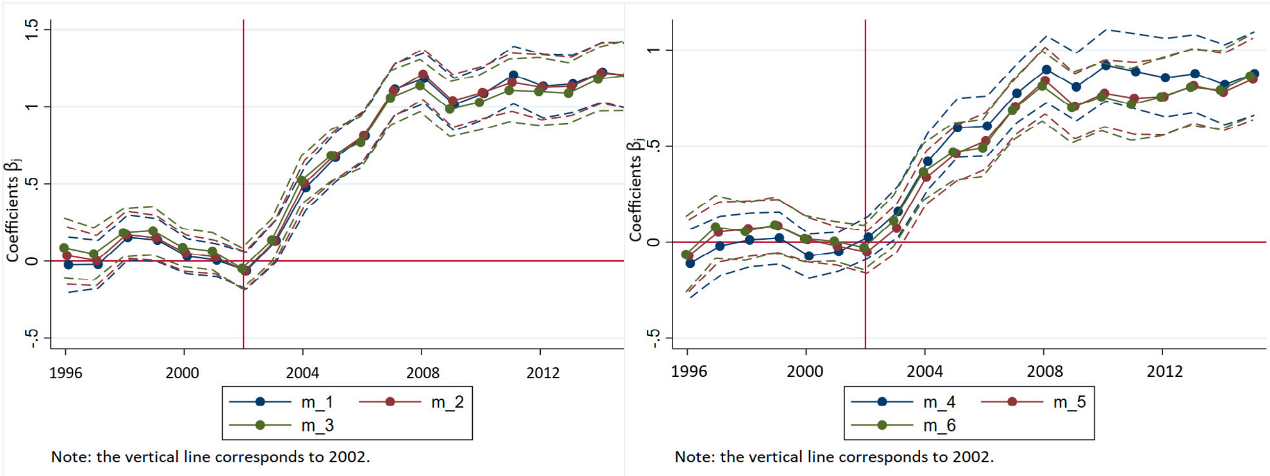
We estimate a flexible model where the sectors that had surges during the 2003–2008[39] period are identified with values 0 or 1, and their export performances are evaluated yearly. The regression equation estimated is the following:

$$y_{i,t} = \sum_{j=1989}^{2015} \beta_j (Surges_i^{2003} Year_t^j) + \sum_{i=n} \alpha_i I_i^n + \sum_{j=1989}^{2015} \lambda_j Year_t^j + M_{i,t}' \Omega + \sum_{j=1989}^{2015} X_i' Year_t^j \Gamma_j + \epsilon_{i,t} \tag{4}$$

This equation allows us to identify the differential performance of those sectors with surges over the years. The coefficient of interest is β_j, which reflects the differential behavior of exports in the sectors that had surges during 2003–2008. I_i^n is a 4-digit sectoral fixed effect, while $Year_t^j$ is the year fixed effect. M refers to macroeconomic controls by sectors that include trade partners' GDP, the real effective exchange rate by sector, and the simple average of import tariffs of Latin America, the European Union, and the United States. Finally, following Lane (2022) we include a series of cross-section controls by sector (X_i'), multiplied by the fixed effect per year to strengthen the control on previous trends. We seek to ensure that the effects come from fulfilling the condition of export surge episodes but are not related to sector characteristics. Robust errors are used.

We estimate six regression models, where the first three columns (1–3) use the logarithm of exports in constant values as the dependent variable, while columns (4–6) use the logarithm of exports in current dollars. The regressions in columns 1 and 4 control only for year and sectoral fixed effects. Columns 2 and 5 present the results with macroeconomic controls by sectors and tariffs. Columns 3 and 6 add controls for Lall's categories, labor intensity, 1996's RCA, and the proximity to sectors with RCAs above the 75th percentile, all interacted with the year-fixed effect. The data correspond to the period 1989–2015, as tariff data before 1989 are not available.

[39] This condition is fixed across all years and identifies cross-sectional way those sectors with surges during 2003–2008.



(a) Constant values (b) Current values

Fig. 3. Hysteresis? Evidence from export surge episodes. Estimated coefficient.
Source: Own elaboration

Figs. 3(a) and 3(b) plot the estimated coefficient of the interaction between the year-fixed effect and the export surges dummy during 2003–2008 (β_j) when the dependent variable is at constant values (a) as well as current values (b). We plot the coefficients of the three regression models (see Table 18 in the appendix). As expected, during the period 2003–2008 there was a significant increase in the export level of these sectors. This dynamic is not interesting but tautological because of the definition of an export surge episode. From 2010 onwards, however, we do not observe a continuous export decrease, and the export gap between sectors holds, despite the real exchange rate appreciation from that year onwards.

This finding suggests that export surge sectors are, on average, successful examples of international integration or acquired productive capabilities that imply the payment of sunk costs. In other words, it suggests that the dynamic margin of Eq. (1) played a relevant role in their export performances. Once their exports have taken off, the new level is maintained relative to the rest of the sectors when controlling for relevant explanatory variables. We should highlight that this finding holds even though Argentina 2010 started a process of fast currency appreciation, imposed capital controls, foreign exchange rate controls, and import restrictions that ended with another large devaluation in 2015.

It can be argued that the observed effect is because, even though there is a trend towards currency appreciation, the real exchange rate remains more depreciated than the levels seen before 2002. This argument would suggest that there is no hysteresis effect, and that the exchange rate increased exports without leading to new investment or capability gains. In other words, the RER would have only impacted export performance through the static margin of Eq. (1). However, if this were the case, we would expect to see a decrease in the gap between exports of sectors experiencing export surges and those that do not when the real exchange rate start appreciating: if there is a linear effect between the exchange rate level and the exports of these sectors, we should also observe a decline in their exports with the continuous RER appreciation. Therefore, in 2015, when the real exchange rate reaches the 2002 level, the gap should be 0 or negligible. We do not observe that, and the fact that the gap remains stable despite continuous appreciation suggests that the new exporting sectors and their gained market shares have demonstrated resilience.

Three main hypotheses are possible explanations for this hysteresis behavior: (1) the payment of sunk costs implies an asymmetry between the expected profitability required to enter a new foreign market and exit. This would explain why these sectors do not reduce their exports once the RER starts appreciating. (2) The high tradable profitability favored by the stable and competitive RER encouraged the self-discovery of pioneer exporters, which then revealed costs and profitability to other firms in their sectors (Hausmann and Rodrik, 2003). Finally, (3) the already exporting firms increased their investments in capital goods, adopted technology, or experienced a learning-by-exporting process (De Loecker, 2013; Atkin et al., 2017), managing to increase their international competitiveness. These hypotheses are not mutually exclusive. With the data and evidence presented here, we cannot rule out or favor any of them over the others.

7. Conclusions

This paper aims to unpack the connection between RER levels and the take-off or development of new export sectors in a developing economy. To this end, we studied the main characteristics of the sectors that take advantage of the exchange rate stimulus using an interesting case study of a long-lasting RER depreciation in Argentina (2003–2008). After a large devaluation occurred in 2002, the next six-year period showed a stable and competitive real exchange rate. During these six years, Argentina showed the maximum peak of export surges episodes from 1980 to 2015 (Palazzo and Rapetti, 2017).

We were able to identify a positive effect of RER on the probability of export surge episodes by taking advantage of the theoretical channel through which the RER should affect export performance. Since export prices are invoiced in dollars (Gopinath, 2015), a more competitive RER level increases the profitability rate by decreasing relative non-tradable costs (mainly labor), and fostering investment in tradable sectors. Then, the more labor-intensive the sectors are, the higher should be the impact of RER on their probability of an export surge episode. Our results support this channel. Labor-intensive sectors showed a higher probability of an export surge episode during the stable and competitive RER period (2003–2008). The opposite was true during 1994–1999, a period of clear currency overvaluation (Aromí et al., 2014). The coefficient estimated of interaction between RER levels and labor intensity by sector was always positive and statically significant.

Furthermore, we were also able to establish the relevance of productive linkages to already competitive sectors on the probability of an export surge episode during the RER stimulus. We show that sectors related to already competitive ones increased their likelihood of an export surge episode during 2003–2008. When we investigated the particular linkages, we found evidence that the upstream channel is the only one that shows statistical and economic significance, implying that sectors supplying inputs to already competitive industries are more likely to achieve export surges. This finding is compatible with the hypothesis of Hirschman (1958, 1977) and in line with the results of Bahar et al. (2019).

Last but not least, we evaluated the subsequent performance of the sectors that had an export surge episode during 2003–2008 once the exchange rate stimulus ended. We find evidence of persistence in their export levels compared to the rest of the export sectors, favoring the hypothesis of sunk costs or learning by exporting effects that generate hysteresis in trade. This fact is relevant for those who support currency undervaluation policy as a driver of tradable-led growth since it would undermine the criticism that denies the possibility of keeping for long periods an undervalued currency. With these findings, only transitory periods of some length would be needed to achieve permanent effects on export development (Rapetti, 2013).

To conclude, Argentina's export performance did not reach the dimension of structural change during this period as it is usually defined. However, promoting structural change requires more than an adequate macroeconomic policy. The latter is mainly an enabler of a more ambitious productive development policy.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Appendix A. Supplementary material

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.strueco.2023.11.009.

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