Persistent Effects of Autonomous Demand Expansions

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Abstract

The prevailing wisdom that aggregate demand shocks determine short-run cyclical fluctuations around a supply-determined equilibrium growth rate and an associated equilibrium unemployment rate (or NAIRU) has been called into question by various strands of literature over the last few decades. Specifically, a recently revived literature on hysteresis finds significant persistence in the effects of recessions and negative aggregate demand shocks (Blanchard *et al.* 2015; Martin *et al.* 2015).

This paper aims to assess this tendency to return to a supply-determined potential output, independent of aggregate demand, after episodes of demand *expansion*. In line with the hysteresis literature, we assess the persistence of aggregate demand effects on key macroeconomic outcomes. However, in contrast with much of that literature, we assess whether persistence is detected also in instances of demand *expansion*.

We study 94 episodes of demand expansion in 34 OECD countries between 1960 and 2015. We look at the sum of primary public expenditure and exports, a variable we call 'autonomous demand'. We define an expansion as a large yearly percentage increase in autonomous demand, 'large' meaning greater than a standard deviation above the country mean. We analyze the impact of these expansions on key macroeconomic outcomes in the subsequent decade, using various techniques to deal with endogeneity. We employ two main approaches: a dynamic two-way fixed-effects model, analogous to a standard difference-in-differences estimation; and a propensity score-based specification which explicitly models selection bias.

We find a highly significant persistent effect on the GDP level: a one-off expansion in our autonomous demand variable by (an average of) 5% is associated 10 years later with a GDP level around 3% higher than in the control group, with no sign of mean reversion. We also document strong persistent effects on capital stock, employment and participation rates. Effects on productivity and the unemployment rate are also strong and quite persistent, but evidence regarding their permanence is more mixed. We do not find that expansions, on average, cause high or accelerating inflation.

Our results lead us to ask whether hysteresis should be considered a distortion in the working of market economies that holds only in specific circumstances – as the mainstream literature has generally suggested – or whether it is, in fact, a pervasive phenomenon which holds most of the time.

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Real output in most advanced capitalist economies fluctuates around a rising trend […] it is part of the usable common core of macroeconomics that the trend movement is predominantly driven by the supply side of the economy (the supply of factors of production and total factor productivity) […] fluctuations are predominantly driven by aggregate demand impulses […] (Solow 1997, p. 230)

1. Introduction

The prevailing macroeconomic textbook wisdom is that aggregate demand shocks determine short-run cyclical fluctuations around an equilibrium GDP (potential output) and an associated equilibrium unemployment rate or NAIRU. These are determined by supply factors and, in New-Keynesian models, by the institutional setting causing some real rigidities; they are independent from aggregate demand fluctuations, and are viewed as 'attractors' towards which the economy tends to return (Solow 1997; Taylor 2000; Blinder 2004). The main focus of our research is on assessing such tendency to *return* to a supply-determined potential output independent of aggregate demand after an autonomous demand expansion.

In recent decades the traditional wisdom has been called into question by various strands of literature.

One such strand, stemming from Nelson and Plosser (1982), is the literature on unit roots in GDP series. Empirical testing has proved controversial and to some extent inconclusive (Cushman 2016), but econometric research along these lines appears on the whole to conclude that fluctuations tend to be associated with rather persistent changes in GDP trajectories, and that the return to an independently determined GDP trend, *if any*, must be extremely slow, much beyond the commonly assumed horizon for cyclical fluctuations and economic policy (Diebold and Rudebush 1989; Martin *et al.* 2015, p. 3). The 'real business cycle' literature has interpreted this as evidence that cycle and trend are determined by the same factors, i.e., *supply* determined. However, this evidence could be interpreted the opposite way: if aggregate demand drives (most) fluctuations, as many economists believe and as pointed out by empirical evidence (see for example Gali 1999), then both cycle and trend would be driven by aggregate demand (Fatàs and Summers 2016, p. 16).

A recently revived strand of literature on hysteresis points to the existence of significant persistence in the effects of negative aggregate demand shocks (Ball *et al.* 1999; Cerra and Saxena 2009; Blanchard *et al.* 2015; Martin *et al.* 2015; Ball 2009; 2014). To some extent, this is a phenomenon in search of explanations (Ball 2009, p. 3; 2014, p. 8). The most common in the literature are: i) insider–outsider models (Blanchard and Summers 1986; Lindbek and Snower 1985); ii) the increase in long-term unemployed, who then lose their skills and/or become detached from the labour market and hence do not exert a competitive pressure on wages (Blanchard and Diamond 1994; Ball *et al.* 1999; Ball 2009); and iii) the effects of aggregate demand on capital formation (Rowthorn 1995; and more recently Haltmaier 2012, p. 1; Ball 2014, p. 1; Fatàs and Summers 2016, p. 16; Martin *et al.* 2015, p. 8). This third explanation is the most consistent with the empirical evidence that will be presented in this paper; we will argue that it is also the most persuasive on more general analytical and empirical grounds.

The relation between our work and the literature on hysteresis is two-sided. While we assess the persistence of aggregate demand effects on GDP (and other variables) in line with the literature above, in contrast with much of that literature, our main purpose in this paper is to test whether 'persistence' is also detected in instances of expansion of aggregate demand, and specifically of its autonomous components. Our results also lead us to ask whether hysteresis should be considered a 'distortion' in the working of market economies that holds only in specific circumstances – as the mainstream literature has generally suggested – or whether it is, in fact, a pervasive phenomenon which holds most of the time.

In order to investigate the effects of positive demand shocks, we detect 94 episodes of demand expansion in a panel of 34 OECD countries between 1960 and 2015. We identify demand expansions by looking at the sum of primary public expenditure (comprising public consumption, transfers except interest payments and capital formation) and exports, a variable we call 'autonomous demand'. We define an expansion as a large yearly percentage increase in autonomous demand, 'large' meaning higher than the country mean by more than a standard deviation. We then employ local projections (Jordà 2005) to analyze the impact of these expansions on GDP and other key macroeconomic outcomes in the subsequent ten years. Of course, a key challenge associated with our analysis is that demand expansions are likely to be partly endogenous. Indeed, we find that country-years associated with an expansion are different from the others. However, we show that observable differences between 'treated' and 'non-treated' observations are eliminated by controlling for a full set of country and year fixed effects, which we thus include in all our empirical specifications. We employ two main approaches to estimate our effects of interest: a two-way fixed-effects model, analogous to a standard difference-in-differences estimation, and a propensity score-based specification which explicitly models selection bias.

We find a highly significant and strikingly persistent level effect on GDP. A one-off increase in the level of our autonomous demand variable, relative to the control units, by (an average of) 5% is associated 10 years later with a GDP level 3% higher than in the control group, with no sign of mean reversion. This GDP expansion is associated with a non-statistically significant, small and short-lived rise in the inflation rate. Expansions also persistently affect some labour market variables (participation rate and employment) and the capital stock. Effects on productivity are strong and quite persistent, although evidence regarding their permanence is more mixed. Long-term unemployment diminishes only in the short/medium run (the effect lasting 4 to 5 years after the expansion). Our empirical analysis also makes it clear that these effects are *not* driven by previous productivity increases or real interest rate declines.

In one respect, therefore, our results concerning the persistent effects of aggregate demand expansions run counter to the logic of hysteresis models, given that we do not find that expansions cause, along with a persistent level effect on GDP, accelerating inflation.

These results also have some relevance in connection with the recent debate on secular stagnation. One of the issues addressed by the literature is why recovery has been very slow since the 2008 crisis, and there is no sign of a return to the GDP forecasts made prior to 2008 (despite the expansionary stance of monetary policy). The literature has attributed this to three (separate or interlinked) factors: i) a negative equilibrium real interest rate; ii) slow (or even negative) growth due to structural factors, such as demographic and technological trends; and iii) hysteresis. A number of recent papers, such as Blanchard *et al.* (2015), Martin *et al.* (2015), Cerra and Saxena (2009), Guajardo *et al.* (2014), Jordà and Taylor (2015), among others, show that persistent effects of recessions or fiscal consolidations are not a peculiarity of the current situation (hence, of supposedly negative equilibrium interest rate, or relatively new structural phenomena) but are very pervasive. Therefore ‘hysteresis’ or, as we would prefer to call it, ‘persistence’ appears to be the best line of interpretation of the current situation within the ‘structural stagnation’ literature. In addition, although we deal with level effects and not with trends and growth rates, our results support the view that stagnation of some major components of aggregate demand explains the slow post-2008 recovery, as well as relatively slow growth in the earlier period. They also support the view that fiscal stimulus would be the most appropriate policy response (Summers 2015; Turner 2015).

The exposition proceeds as follows: after describing sources and methodology we summarize our main results (Sections 2 and 3); in Section 4 we discuss them in connection with the literature on hysteresis; and in Section 5 we explore the analytical framework consistent with the empirical results of this paper and more generally reported in the literature. The concluding section describes some implications for current policy debates.

2. Data and methodology

We build a panel dataset with yearly macroeconomic data for 34 OECD countries for the period 1960–2015. Details on the sources and definitions of all variables in our dataset are provided in Appendix A1, while A2 reports the list of countries in our sample and presents descriptive statistics.

2.1 Autonomous demand variable and identification of episodes of expansion

We build our 'autonomous demand' variable as the sum of primary public expenditure[1] plus exports (in real terms). We then proceed to identify episodes of autonomous demand expansion. In doing this, we face a trade-off: setting a higher bar for classifying an observation as an expansion (i.e., requiring a larger change in demand) would increase the likelihood that each episode really reflects a demand boost, but at the same time it would reduce the number of episodes that we can use in estimation, thus decreasing statistical power. With this trade-off in mind, we identify expansion episodes based on two criteria: (c1) autonomous demand growth must be higher than its country mean by at least one standard deviation in the expansion year; and (c2) autonomous demand growth must be higher than one-half of the country mean in the two years preceding the expansion. The second criterion is meant to avoid capturing episodes in which a high growth rate of autonomous demand represents merely a rebound after a steep fall.

Formally, our two criteria for an autonomous demand expansion in country *i* at time *t* are as follows:

$$\Delta Z_{i,t} > \mu_i(\Delta Z) + \sigma_i(\Delta Z) \qquad \text{(c1)}$$

$$\Delta Z_{i,t-1} > \frac{\mu_i(\Delta Z)}{2} \quad \text{and} \quad \Delta Z_{i,t-2} > \frac{\mu_i(\Delta Z)}{2} \qquad \text{(c2)}$$

[1] Primary public expenditure is defined as government current disbursement net of interest payments plus government gross capital formation. Interest spending, which is not included, is inappropriate to our objectives since we believe that in most circumstances the multiplier effect of interest payments can be considered modest, due to the fact that in many countries a large portion of sovereign debt is held by banks and other financial institutions. By contrast, we include public investment since it is well known that it has a high multiplier effect.

where $\mu_i(\Delta Z)$ represents the average growth rate of autonomous demand in country *i* in our sample period, and $\sigma_i(\Delta Z)$ its standard deviation. When we have two or more years of expansion in a row, we treat them as being part of a single episode.

Our dataset contains 126 country-years of autonomous demand expansion, defined as above. After consolidating consecutive years of expansion, we are left with 94 episodes that can be used in estimation (a complete list is provided in Appendix A2).

Table 1 reports the average growth of autonomous demand and of its components during these episodes of expansion, relative to the rest of the sample. After controlling for country and year fixed effects (as we will do in all our empirical specifications), on average autonomous demand grows 5 percentage points above control units during expansion episodes. Autonomous demand expansions appear to be mainly driven by export growth (which is on average 8.4 percentage points higher in the expansion episodes) and to a lesser extent by government investment (+3.7 p.p.) and current expenditure (1.4 p.p. higher than in the rest of the sample).

Of course, the criteria that we have employed for detecting autonomous demand expansions are to some extent arbitrary. In the robustness analysis section, we will carefully test the robustness of our results to changes in the thresholds adopted (Section 3.7 and Appendix A4).

2.2 Estimation strategy, endogeneity issues and covariate balance tests

We employ local projections (Jordà 2005) to estimate the behaviour of key macroeconomic outcomes in the decade following a demand expansion. Local projections (LPs) allow semi-parametric estimation of the ‘average treatment effect’ of demand expansions at different time horizons, without assuming any underlying parametric model for the outcome variable. This approach imposes little structure on the data and is particularly appealing in our setting, given that we are estimating average effects across heterogeneous economies in a long time period, so we prefer to avoid imposing a single parametric model for the determination of each outcome variable (as a VAR model or a dynamic panel estimation would require).

Of course, a key challenge is the fact that autonomous demand expansions are likely to be partly endogenous. Changes in public spending are determined also on the basis of current macroeconomic conditions. Exports are influenced not only by exogenous changes in external demand, but also by changes in wages, prices and productivity in the domestic economy. In other words, the ‘treatment’ represented by an autonomous demand expansion is not randomly assigned. Macroeconomic factors are likely to affect simultaneously the probability of an expansion and the subsequent dynamics of output, investment, productivity and employment. A simple comparison of average subsequent outcomes experienced by ‘treated’ units (country-years with an expansion) and ‘control’ units (country-years without an expansion) would therefore suffer from endogeneity bias.

To assess the extent of endogeneity, we look at differences in initial conditions. We consider a number of key observable factors and compare their initial values in treated and control units. Specifically, for each indicator, we employ linear regression to compare the mean of the variable in the year before an expansion with the mean in the rest of the sample. Formally, we estimate the following regression for each variable of interest:

$$y_{i,t-1} = \alpha_i + \delta_{t-1} + \beta E_{i,t} + \varepsilon_{i,t-1} \quad (1)$$

where y is the variable under analysis; $E_{i,t}$ is a dummy variable which is equal to 1 if there is an episode of autonomous demand expansion in country i at time t, and 0 otherwise; α_i are country-specific fixed effects; and δ_t are year dummies.

The first column of Table 2 reports results from a simple pooled OLS regression which does not control for country and year fixed effects (thus assuming $\alpha_i = \alpha$ for all i, and $\delta_t = 0$ for all t). This is tantamount to performing a simple comparison of averages between treated and non-treated countries. This exercise reveals that expansions are more likely to happen in country-years that are experiencing a higher growth rate, stronger productivity growth, lower unemployment, lower real long-term interest rates and a lower public debt-to-GDP ratio than in the rest of the sample.

These differences are attenuated by performing a within-countries transformation, that is, allowing for country-specific intercepts (α_i) in Equation 1. This is shown in the second column of Table 2, which controls for country fixed effects but not for year effects ($\delta_t = 0$ is still assumed for all t). Controlling for time-invariant country-specific factors appears to reduce but not eliminate endogeneity bias: differences in initial condition remain statistically significant and relevant.

Finally, the third column of Table 2 presents results from a regression including a full set of country and year fixed effects. This means that, besides performing the within-countries transformation, we are comparing treated and non-treated countries *within each year*. In this way we control for common time-varying factors, including global long-term trends and those cyclical macroeconomic and financial fluctuations which drive the well-documented phenomenon of business cycle coordination. Results clearly indicate that common time-varying factors account for a very large share of observable differences between treated and control units. After controlling for time (as well as country) fixed effects, observable differences in initial macroeconomic conditions between treated and controls virtually disappear. Coefficients on GDP growth and productivity growth become very small, statistically insignificant and *negative*. Differences in unemployment, inflation and real interest rates become small and positive (and not statistically significant). The negative coefficient on the public debt-to-GDP ratio becomes much smaller and loses statistical significance. The only two factors in which significant differences remain are autonomous demand growth and the real exchange rate. The first is likely to reflect persistence in autonomous demand dynamics (as documented, for example, in Girardi and Pariboni 2015; 2016). The pre-expansion decrease in the real exchange rate is instead likely to be a contributor to the forthcoming increase in exports. Given that it is not accompanied by corresponding changes in prices and productivity (to the contrary, the coefficient on productivity growth is negative and the one on CPI inflation is positive, and both are small and insignificant), we see the decrease in the real exchange rate as a factor which affects autonomous demand by contributing to export expansion, without directly affecting the future dynamics of our dependent variables. In any case, we will present robustness tests in which we control for real exchange rate dynamics. Moreover, in the propensity score-based specifications we will explicitly account for the influence of the real exchange rate (and other variables) on the probability of an expansion.

In conclusion, we find that controlling for a full set of country and year fixed effects is necessary in order to make the treated and control units in our sample comparable. In addition to this, we will control in all specifications for initial (pre-expansion) values of the dependent variable, and we will present robustness tests with additional controls. Moreover, we will use propensity score-based methods in order to further address endogeneity issues, explicitly addressing the problem that expansions are not randomly assigned.

In the remainder of this section we discuss the two main approaches that we employ to estimate the effects of autonomous demand expansions on macroeconomic outcomes: a two-way fixed-effects specification and a propensity score-based specification.

2.3 Two-way fixed-effects specification

Our first specification uses a dynamic fixed-effects model to estimate LPs for the effect of a demand expansion at different time horizons. It has the following form:

$$\Delta y_{i,t+h} = \alpha_i^h + \delta_t^h + \beta^h E_{i,t} + \sum_{j=1}^{p} \theta_j^h \, \Delta y_{t-j} + \sum_{j=1}^{p} \varphi_j^h \, x_{t-j} + \varepsilon_{i,t+h}$$

for h = 1, …, n (2)

where $\Delta y_{i,t+h}$ represents the percent change in the outcome of interest between time *t-1* and time *t+h* [equal to $\log(y_{t+h}) - \log(y_{t-1})$]; Δy_{t-j} is the growth rate of the outcome variable at time *t-j* [equal to $\log(y_{t-j}) - \log(y_{t-j-1})$]; and *x* is a vector of additional control variables (on top of two-way fixed-effects and lagged values of the dependent variable) that we will add in a series of robustness tests.[2] For variables that are stationary (such as the unemployment rate and the labour force participation rate), we take the absolute value of the outcome at time *t+h* instead of the change. In our baseline results, we control for two pre-treatment lags of the dependent variable (*p=2*), but we then check robustness to include more lags.

In the rest of the paper, we will refer to $\Delta y_{i,t+h}$ as the *h*-years *change* in y, and to the estimated coefficient β^h as the *h*-years *effect* of an expansion on *y*. The sum of coefficients $\sum_{h=0}^{s} \beta^h$ (a measure often reported in the literature) is the s-years *cumulated* effect.

This two-way fixed-effects specification is analogous to a difference-in-differences estimator. We are assessing the effects of demand expansions by measuring the average variation in the outcome variable after an expansion, relative to a control group of countries that in the same year have not had an expansion, including a set of control variables.

2.4 Propensity score-based specification

We also estimate the same effects using a more sophisticated approach, which combines the LP specification of Equation 2 with propensity score-based methods. This approach explicitly accounts for the fact that expansions are not randomly distributed. It could be seen as consisting of two steps.

[2] As is well known, the inclusion of both individual fixed effects and autoregressive dynamics can generate 'Nickell bias' (Nickell 1981). This bias is however of order 1/T, and should thus be negligible in our large-T panel (we have up to 55 observations for each country, with an average of 34.3). Evidence from Monte Carlo simulations provided by Judson and Owen (1999) suggests that when estimating dynamic panel models on macroeconomic datasets, the fixed-effects model is superior to the alternatives as long as T≥30.

First, we estimate a discrete-choice model, which we call the ‘treatment model’, to explain the probability of experiencing an expansion on the basis of pre-expansion economic conditions (the propensity score). We then re-weigh observations in the control group, assigning greater weight to those observations with a high propensity score.[3] In this way, we compare ‘treated’ countries to a control group which exhibits similar dynamics. This approach is of course based on the assumption of ‘selection on observables’, according to which selection into the ‘treatment’ (i.e., the probability of experiencing an autonomous demand expansion) depends on observable variables.[4]

Specifically, we employ an IPWRA estimator (inverse-probability weighted regression adjustment) (Imbens and Wooldridge 2009, pp.38–40; Wooldridge 2007). This combines the propensity scores weighting described above with a regression-adjustment method, which employs linear regression analysis to obtain estimates of counterfactual outcomes. Regression adjustment consists in estimating a linear regression of the outcome on a number of covariates in the non-treated subsample (we call this the ‘outcome model’) and then using the estimated parameters to estimate the predicted value in the absence of treatment for all units, included those which did receive treatment. The outcomes experienced by treated units are then compared with their predicted values in the absence of treatment, thus providing an estimate of the ‘treatment effect on the treated’ (ATET). The IPWRA estimator combines regression adjustment with propensity score weighting: it estimates counterfactuals following the regression-adjustment approach, but using weighted regressions, with weights based on propensity scores. Therefore, the IPWRA estimator controls both for selection into treatment (through the ‘treatment model’) *and* for the influence of covariates on the outcome variables (through the ‘outcome model’). We choose to employ IPWRA because it is a doubly robust estimator: it needs either the treatment model or the outcome model to be correctly specified, not necessarily both. In other words, it is robust to mis-specification in either the outcome model or the treatment model (Wooldridge 2007).[5]

The outcome model that we employ for estimating counterfactuals is analogous to our baseline fixed-effects specification (Equation 2). It includes two lags of the outcome variable and of the REER, plus a full set of country and year fixed effects. In order to select the pre-determined variables to be included in the treatment model for estimating propensity scores, we estimate a

[3] This amounts to estimating the ‘treatment effect on the treated’ (ATET).
[4] See Jordà and Taylor (2016), Angrist and Kuersteiner (2011), Angrist, Jordà and Kuersteiner (2016) and Acemoglu *et al*. (2014) for similar applications of these methods in macroeconomics.
[5] We estimate the IPWRA model using the command ‘teffects ipwra’ in the STATA software. We use the ATET option (average treatment effect on the treated). Because the presence of many missing values would not allow the estimation algorithm to converge, when estimating the IPWRA model we do not consolidate consecutive years of expansion by setting equal to missing values the expansion dummy for the first years of a multi-year expansion, as we have done for the two-way fixed-effects model. This is likely to have, if anything, a small conservative effect: when estimating the fixed-effects specification without consolidating multi-year expansions, we find slightly lower output effects.

probit model. We start by including country and year fixed effects plus two lags of the following variables: GDP growth, productivity growth, public debt as a share of GDP, change in the REER and real interest rate. We perform Wald tests for the null hypothesis that both lags of each variable are jointly equal to zero, and iteratively exclude the variables for which lags are both individually *and* jointly insignificant. Results are reported in Table 3. Following this procedure, we end up with a treatment model that includes, besides country and year effects, two lags of GDP growth and two lags of the change in the REER.

3. Main results

Our expansionary episodes are large one-off increases in autonomous demand. Figure 1, which displays the average behaviour of autonomous demand around expansion episodes, controlling for country and year fixed effects, clarifies that expansion episodes constitute, on average, permanent increases in the level (but not in the growth rate) of autonomous demand relative to the control group.

As explained in the previous section, we obtain our results using both a dynamic panel model that controls for country and year fixed effects and two lags of the dependent variable (equivalent to a difference-in-differences specification) and a propensity score-based model (IPWRA). Baseline results using these two models are reported in Figures 2 and 3 and in Tables 4 and 5.

3.1 Output

After controlling for time and country fixed effects, our average demand expansion episode implies a 5 percentage point increase in autonomous demand growth, relative to ‘non-treated’ observations (Figure 1). The effect on real GDP is highly statistically significant (at the 1% significance level) at all time horizons. It reaches a peak of 3.4% in the sixth year and then stabilizes around 3%. The 10-year effect is around 3% both in the fixed-effects specification and in the propensity scores-based (IPWRA) specification (Figures 2 and 3, respectively). The 10-year *cumulated* effect is 28.7 in the fixed-effects specification and 28.4 in the propensity scores-based specification.[6]

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[6] On the basis of the 10-year effect, we can calculate an average long-run elasticity of output to our autonomous demand variable, and dividing by the ratio of autonomous demand to GDP in our expansion episodes, we obtain an average ‘10-year multiplier’ around 0.85. The cumulated multiplier, derived from the 10-year cumulated effect of the initial expansion, is around 7.5. In other words, a 10-dollar increase in autonomous demand at ‘time zero’ causes GDP ten years later to be 8.5 dollars higher, and the total production in the eleven years from year 0 to year 10 to be 75 dollars higher. In considering our 0.85 ten-year multiplier, it must be taken into account that it refers to open economies, some of them small, and that it is measured during a ‘boom’ period. Notwithstanding this, this multiplier is relatively high and within the bounds of estimates produced by previous studies (Batini *et al.* 2014) – although the previous literature

This pattern indicates that ten years after an expansion, GDP (which is taken in natural logs) tends to grow at the same *rate* as in non-treated units, but with a permanent shift in its trajectory (see non-technical annex for an example). In other words, we detect an economically relevant long-term level effect on GDP of a one-off autonomous demand expansion. This suggests that hysteresis or, rather, persistence is not limited to fiscal contractions or recessions.

3.2 Capital stock

The capital stock begins to increase above the control group in the second year after the expansion. The 10-year level effect is 2.7% and statistically significant in the fixed-effects specification, 1.3% and more imprecisely estimated in the propensity scores-based specification. This estimated positive effect suggests that the effect of aggregate demand on the evolution of the economy's capital stock might be an important part of the explanation of hysteresis (or persistence) in output.

To further investigate the sizeable effect that we have found on the evolution of the overall capital stock, we disaggregate the latter by component. Baseline results using the fixed-effects specification are reported in Figure 4 and Table 6, while Figure 5 and Table 7 refer to the propensity score-based specification. The strongest and more precisely estimated effect is found on (residential and non-residential) structures, with a 10-year effect of 3.3% in the fixed-effects specification and 2.5% in the propensity score-based specification, both statistically significant. The effect on machinery and (non-transport) equipment is large but less precisely estimated in the fixed-effects model: the 10-year effect is 2.5%, but the effect is statistically significant only between the third and the fifth year. It is smaller and temporary in the IPWRA specification, in which the effect is around 1% and significant in the first two years, but then declines towards zero. The impact on transport equipment is practically non-existent, while the effect on the residual category "other assets" is sizeable but not statistically significant in both specifications.[7]

3.3 Labour market variables

Employment. We measure employment both in hours and in headcount. The hours measure is more rigorous (since changes in the headcount may reflect changes in the weight of part-time contracts, for example) but we employ both for robustness. Results from both the fixed-effects and the

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usually refers to public spending only, or to the fiscal budget, so our estimates are not directly comparable to those. Moreover, the literature generally looks only at short-term effects, while ours is a 'long-term multiplier'. In calculating the cumulated multiplier, we take the ratio between the cumulated effect and the initial increase in autonomous demand (at time 0), and then divide by the ratio of autonomous demand to GDP. We thus take into account only the initial exogenous increase in autonomous demand, not its subsequent behaviour (which might be to some extent endogenous).

[7] Unfortunately, because of data availability we are not able to distinguish between private and public capital stock, nor between residential and non-residential structures.

propensity score-based models point to a permanent level effect on both hours worked and persons employed. The estimated 10-year effect on hours worked is around 2% in both models (2.2% in the fixed-effects specification and 1.9% in the IPWRA model). The 10-year effect is slightly less strong (between 1% and 1.5%) for the number of persons employed. The gap between the increase in hours and the increase in the headcount is much larger in the first 2 to 3 years after an expansion (Figures 2 and 3). This is what one would expect: initially firms tend to demand extra working hours from their employees and only gradually, if the expansion continues, do they hire new workers.

Labour force participation. In both specifications, from the fifth year onwards the effect on labour force participation is positive and statistically significant; it stabilizes just above 0.5% in the fixed-effects model and 0.75% in the propensity score-based model. Viewed along with the results presented in the literature concerning participation in the aftermath of recessions (Duval *et al.* 2011; Reifschneider *et al.* 2015), our result suggests that labour supply is to some extent endogenous with respect to changes in aggregate demand, output and employment. The increase in labour supply owing to increased participation amounts, according to our data, to between one-third and half of the additional employment measured in heads.

Unemployment and long-term unemployment. The effect on the unemployment rate is always negative, and is still statistically significant in the last two years at -0.66% in the fixed-effect model. Also in the propensity score-based model the effect is always negative, is somewhat larger, close to -1% at its peak, and loses statistical significance in the last 3 years.

Of particular interest, especially in connection with the results concerning inflation (see below), is the negative and statistically significant impact on long-term unemployment (measured as a percentage of the labour force) which falls in the expansion year and for four years afterwards, with a maximum of -0.57% three years after the expansion in the fixed-effects model (in the propensity score-based model the size of the negative effect is slightly higher and statistically significant until year 5). This suggests that long-term unemployment is (at least partially) reversible when an expansion occurs, with no significant impact on inflation, in contrast with some explanations of hysteresis (Section 4.2).

The medium-run horizon of the effects on long-term unemployment might reflect the increase, from the fifth year onwards, of participation (see above).

3.4 Inflation

The expansionary episodes and ensuing GDP growth do not cause accelerating inflation and a very modest and short-lived higher rate of inflation. Our examination of the effects on CPI (which includes imported items) and GDP deflator found very similar results: the effects are not statistically significant except for two years and the extra inflation amounts at its peaks to about half a percentage point. With the propensity score-based model the effect is close to 1% and statistically significant in the eighth and ninth years and then diminishes, while it is small and non-significant in previous years.[8]

The importance of these results is clear: autonomous demand expansions and the ensuing expansionary effects on GDP do not cause accelerating inflation, and the costs in terms of higher inflation appear very small and very uncertain (dispersed), consistently with what is found in recent empirical estimates of the Phillips curve (Blanchard *et al.* 2015).

3.5 Productivity

Productivity is measured as GDP at constant prices per hour worked. In both specifications, it increases immediately in the expansion year and the effect reaches a peak around the seventh year after the expansion (of 1.6 percentage points in the fixed-effects model and 2.3 in the propensity score-based model). The short-to-medium-run effect on productivity is thus strong and significant. Regarding the longer term, results are more mixed. Both models (fixed-effects and IPWRA) indicate a substantial but not statistically significant 10-year effect (0.78% with standard error 0.85 in the fixed effects model; 0.57% with s.e. of 0.86 in the IPWRA specification). As we will see in Section 3.7, however, when controlling for potential differential trends between mature and emerging economies, the effect on productivity appears to become permanent. We thus conclude that our estimates provide evidence of a strong productivity effect in the short-to-medium term, and mixed evidence for the longer term.

Of particular relevance for economic interpretation is the fact that in the year preceding the expansions we find no difference in productivity growth between the two sets of countries (see Table 2) – this begins to manifest itself *only* in the expansion year – so that our episodes and the subsequent GDP growth cannot be interpreted as a result of an independent productivity burst:

[8] Somewhat strikingly with the propensity score model we find a statistically significant negative impact on inflation in the expansion year. This might be due to the fact that on the one hand this model controls for lags of REER and autonomous demand, thus eliminating the possible impact of those variable on year 0 inflation, and on the other hand we have a sudden significant increase in productivity in the year of expansion, while higher employment and hence potentially higher inflationary pressures manifest themselves only with a lag.

productivity growth does not lead but follows the expansion. The results concerning productivity are very similar if we look at value added per hour in the *business sector* alone, and of comparable dimension (though the data are available for a small subset of episodes only – results not reported here for reasons of space).

The pattern emerging from the data can be explained by two, potentially complementary, factors. The first has been well known since Okun's 1962 contribution: at the outset of an expansion labour is used more intensively; along with the existence of overhead labour, this causes an increase in productivity. The other factor is the effect of demand expansion on investment (Section 4.3) – if the accumulation rate is higher after the expansions, as confirmed by our capital stock data, this also means that last-generation equipment will represent a higher proportion of the capital stock than in the control group – and this is likely to entail higher productivity.

3.6 Robustness to additional controls, alternative specifications and different criteria for identifying expansions

Table 8 displays the robustness of our results to the inclusion of additional controls. Specifically, we re-estimate the effect of a demand expansion on all our outcomes of interest, controlling for pre-existing trends in GDP, productivity and the real exchange rate (REER). We do so by adding to our baseline LP specification (Equation 2) two lags of GDP growth, two lags of productivity growth and two lags of the percentage change in the REER. As in the baseline specification, we continue to include a full set of two-way fixed effects and (when not coinciding with one of the three variables just mentioned) two lags of the dependent variable. Controlling for pre-existing trends in the REER is particularly meaningful, given our finding that the real exchange rate is the only variable for which pre-treatment differences between treated and non-treated countries persists after controlling for country and year fixed effects (Table 2). In that sense, this exercise tests empirically our claim that the REER is likely to affect our outcomes of interest only through its effect on autonomous demand (and in particular exports). The inclusion of pre-treatment productivity growth as an additional control is also important, because robustness of results to its inclusion would indicate that the higher growth rate observed after a demand expansion is unlikely to just reflect pre-existing trends in supply-side conditions.

Our main findings are robust to the inclusion of these additional controls, as shown in Table 8. Most importantly, the effects on real GDP and on the capital stock remain statistically significant, highly persistent and roughly of the same size. Effects on labour market outcomes remain of a similar size and statistically significant. Also in this case, we find a generally slightly higher inflation rate, but little evidence of *accelerating* inflation.

A possible concern with our estimates arises from the fact that we have both mature and emerging countries in our sample. Of course, the country fixed effects that we include in all specifications absorb any time-invariant country-specific factor, so the fact that some countries may have a structurally higher growth rate because of their initial level of industrialization does not affect our estimates. However, if the growth differential between mature and emerging economies displayed systematic time-varying trends, this could potentially introduce a confounding factor in our analysis. We test robustness to this potential confounder by including in our baseline two-way fixed-effects model a full set of interactions between a dummy for advanced (as opposed to emerging) economies and year dummies.[9] In this way, we control for any potential time-varying trend in the growth differential between advanced and emerging economies. In other words, in this specification, mature (emerging) economies subject to an expansion are compared to a control group including only mature (advanced) economies that in the same year did not experience an expansion. As shown in Appendix A3, our results are robust to this additional control. The only noticeable difference with respect to the baseline results is that, when this additional control is included, the estimated effects of productivity and unemployment become permanent.

We also check robustness to changes in the criteria employed for identifying expansions. In addition to the baseline criterion described in Section 2.1, we try four alternative criteria: (1) autonomous demand growth one standard deviation above the country mean, without any restriction on previous years; (2) autonomous demand growth one s.d. above the country mean, and not lower than 0.25 times the country mean in the previous two years; (3) autonomous demand growth higher than 1.5 times the country mean, and not lower than 0.5 times the country mean in the previous two years; and (4) autonomous demand growth 0.85 s.d. above the country mean, and not lower than 0.5 times the country mean in the previous two years. Our results are robust to these changes in the way expansions are detected. The graphs in Appendix A4 display the effect of expansions on real GDP using these four alternative criteria, showing that they are very similar to the baseline results.[10]

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[9] The dummy variable for mature (as opposed to emerging) economies is based on OECD membership in 1973. Table A2 shows which economies were OECD members in 1973, and thus classified as ‘mature’ by our dummy variable.

[10] The effects on other macroeconomic outcomes using these four alternative criteria are not reported for reasons of space, but are available upon request.

While our baseline specifications control for two lags of the rate of growth of the outcome variable (the level is taken instead for stationary variables like unemployment rates), our results are robust to changes in the number of lags. This is shown in the figures in Appendix A5, which display the effect on real GDP controlling for 1, 3, 4 and 8 lags of real GDP growth, using both the two-way fixed-effects model and the IPWRA specification. As the figures demonstrate, results remain virtually identical to those obtained in the baseline specification with two lags of the dependent.

To summarize our results, we find that aggregate demand expansions have a permanent level effect on GDP, employment, participation rate and capital stock. 'Factor supply', both of labour and capital, does not appear to be independent of aggregate demand, and productivity too is affected (at least in the short to medium run).

4. Discussion: our empirical results and hysteresis

Below we survey interpretations of hysteresis provided in the literature and some of their weaknesses, both with respect to the phenomenon they are generally meant to explain, that is, the effects of recessions on potential output and the NAIRU, and with regard to our results, that is, the relevance of such interpretations for the explanation of persistent effects of expansions.

By hysteresis is broadly meant a tendency for changes in output and employment to persist beyond the time-span required for adjustment to (previously established) equilibrium (i.e., supply-cum-institution-determined potential output) without causing accelerating deflation or inflation. This in turn means that the new persistent level of GDP or unemployment is re-interpreted, by definition, as the new equilibrium. Such persistence has most often been analyzed and discussed in connection with a worsening of macroeconomic conditions – typically how increases in actual unemployment may cause an increase in equilibrium unemployment or, more recently, how a fall in actual GDP may cause a loss in potential output. Note that the consequence usually drawn is that, once this has happened, increasing output and lowering unemployment by means of aggregate demand expansion will cause accelerating inflation.

In the literature three main orders of explanation have been advanced. The first is based on insider–outsider models or, more broadly, on the role of the interaction of labour market institutions and shocks in causing unemployment persistence. The other two mechanisms are the non-employability of long-term unemployed and the impact of aggregate demand on capital formation.

4.1 Labour market institutions

According to insider–outsider models, advanced in the 1980s and stimulated by the rise in European unemployment, the insiders, favoured by employment protection legislation and union power, can artificially increase the costs of hiring and firing, and thus after a reduction in employment establish wages at a level that would prevent re-hiring (Lindbek and Snower 1985; Blanchard and Summers 1986). Another set of explanations that belongs to this same group, argues that hysteresis is the result of the interaction of shocks (technological change, international trade) and labour market rigidities. The typical story (Krugman 1994; Mankiw 2006) is that the shocks have decreased the equilibrium wage for unskilled workers, while labour market rigidities have prevented, particularly in Europe, the required adjustments.

Leaving analytical problems aside, these explanations of hysteresis have not found strong empirical support. Much research has shown very little impact of EPL or other labour market institutions, including the generosity of unemployment benefits or union density, on labour market performances (see Baker *et al.* 2005; Ball 1997; 2009; Ball *et al.* 1999; Stockhammer and Sturn 2012 among others). All in all this approach appears to be most often treated with much caution, even by earlier supporters (see Ball 2009; Blanchard and Katz 1997, pp. 67–69). In connection with our results, this approach would appear particularly ill-suited to explain persistent positive effects of autonomous demand expansion on GDP and employment with no accelerating inflation.

4.2 Long-term unemployment

Concerning long-term unemployment, the argument is that once a recession has generated an increased number of long-term unemployed, these individuals tend to become detached from the labour market and/or lose employability. Accordingly, they do not exert a downward pressure on wages and inflation, hence the increase in equilibrium (non-inflationary) unemployment. The role of long-term unemployment in increasing the NAIRU and causing hysteresis is most often referred to (along with the effects on capital formation) in recent works on persistent effects of recessions and fiscal consolidations (for example, Ball 2009; 2014; Haltmaier 2012; Blanchard *et al.* 2015, p. 12). The reasons advanced in the literature for the impact of long-term unemployment on the NAIRU are on the one hand the atrophy and obsolescence of their human capital (for a critical survey see Bean 1994, p. 609) that makes them less appealing for the employers, and on the other hand discouragement, which may lead to decreased intensity of job search – deemed favoured by the generosity of unemployment benefits.

This last explanation, however, finds little support in evidence that the role of unemployment benefits in explaining labour market performances is (at best) very uncertain (see the papers quoted in the previous paragraph, and also Devine and Kiefer 1991, p. 304; Boone *et al.* 2016). Discouragement may not only affect search behaviour, but can also cause irreversible exit from the labour force in the form of early retirement or access to disability entitlements (Duval *et al.* 2011; Reifschneider *et al.* 2015). The latter, however, would not give rise to an increase in the measured NAIRU (in contrast with its measured increase in countries affected by recessions) but only to a reduction in participation rates and hence, in principle, in supply-determined potential output. While some degree of irreversibility in the reduction in the labour force as a consequence of recessions is likely, our results indicate that expansions too cause a statistically significant and persistent increase in labour force participation, suggesting that labour supply tends to be endogenous with respect to changes in aggregate demand in both directions, although the intensity of the effect might be asymmetric.[11]

The empirical evidence in support of the interpretation of hysteresis based on irreversibility of long-term unemployment owing to the loss in employability consists in general of an increased proportion over time of the long-term unemployment to total unemployment, particularly in Europe; of evidence that exit probability is lower for long-term unemployed vis-à-vis new entrants (e.g., Shimer 2008; Kroft *et al.* 2013); and of an increase in the ratio of vacancies to unemployment, i.e., the outward shift of the Beveridge curve (Layard *et al.* 1991; Budd *et al.* 1988; Bean 1994, p. 610). The evidence concerning the deterioration of human capital and employability is often mixed and controversial, owing to the difficulty in disentangling the role of individuals' characteristics from that of the permanence in the unemployed status (Ljungqvist and Sargent 1998, p. 547; Machin and Manning 1999). However, recent innovative work using US microdata from different sources finds that there is a significant duration effect after controlling for personal characteristics (Abraham *et al.* 2016). Experimental results have also shown that callback rates from employers receiving applications and curricula reduce sharply with the duration of declared unemployment, although this is much truer of *tight* labour markets than slack ones (Kroft *et al.* 2013; Imbens and Lynch 2006). This behaviour appears to be a rational screening device on the part of employers, since in tight labour markets the long-term unemployed tend to be fewer, and in a larger proportion than new entrants are individuals with undesired – from employers' point of view – personal characteristics, such as disabilities, addictions, criminal records, etc. (see Webster 2005), while in

[11] Duval *et al.* (2011) use the same method of impulse-response function based on Jordà (2005). Using a panel of 30 countries they identify 20 severe and 20 very severe downturns. The effect on aggregate participation is between 1.5 and 2.5 percentage points after controlling for country (*but not year*) fixed effects.

slack labour markets long-term unemployment is large and much more likely to result from labour market conditions rather than personal characteristics. However, for employers' behaviour to be an explanation of hysteresis, things should be the other way round.

The fact that individuals with longer spells of unemployment have greater difficulty in finding jobs, however, does not *necessarily* entail long-term unemployment hysteresis at a macro level. The claim of an asymmetric relationship between long-term and total unemployment is controversial. Synthesizing a very articulated work on long-term unemployment in OECD countries, Machin and Manning (1999) stated that 'there is no evidence that, for a given level of unemployment, the incidence of long-term unemployment has been ratcheting up over time' and maintained that the increase of long-term unemployment in Europe had been associated with a 'collapse' of exit flows from unemployment at all durations (p. 3085). Evidence against an asymmetric relationship, implying that once long-term unemployment has been created, it tends to persist even when unemployment declines, is also found in Webster (2005), who analyzes UK data between 1940 and 2004 and shows there has been a constant and symmetric relationship between those two variables when the appropriate measure and time-lag is considered.[12] A similar conclusion in a different context is reached by Ball (Ball *et al.* 1999; Ball 2009), who finds that expansions in OECD countries have caused *temporary* run-ups in inflation but *persistent* reductions in long-term unemployment. The latter is therefore regarded as reversible, albeit at a cost of some inflation.[13] These conclusions are close to our result of a medium-run reduction in long-term unemployment in the aftermath of an expansion, along with a statistically non-significant, small and short-lived increase in inflation.

[12] The author also argues that much of the evidence regarded as supporting hysteresis is due to other factors affecting the proportion between short-term and long-term unemployment, such as increased spatial (regional) dispersion in unemployment rates and changes in labour markets, which increase the number of vacancies for any given level of labour demand (for example the increase in short-term contracts) and disregard for the time-lag normally elapsing between changes in the two variables.

[13] Several studies (including the one just quoted) argue that separation of short-term and long-term components of unemployment improves the estimates of the Phillips curve. That is, long-term unemployment exerts less pressure on (nominal) wages; however, Bean (1994, p. 610) and Rusticelli (2014) report mixed evidence on this. Interestingly, Shaikh (2016, ch. 14) finds that the real wage (the wage share) dynamics are better explained if instead of using the unemployment rate, the latter figure is corrected to take into account the 'intensity', i.e., the duration of unemployment. Hence, in this context, a high proportion of long-term unemployed is found to *intensify* the downward pressure on the wage share and to explain better its long-term changes. The logic behind this is that the long-term unemployed will be more inclined to accept inferior wages and working conditions because they will be under greater pressure to find a job than individuals who have been unemployed only for a short spell. Although the two types of analyses are not directly comparable, the results and the underlying logic are clearly in conflict with one another. It might indeed be the case, as suggested for example by the work of Daly and Hobijn (2013) that taking into account the long-term unemployment in Phillips curve estimates in fact captures non-linearities in nominal wage behaviour that are due to other factors, such as downward nominal rigidities; see also Blanchflower and Oswald (1990), quoted in Bean (1994, p. 610).

4.3 Hysteresis and capital formation

The other channel of hysteresis much referred to in recent works concerning the persistence of aggregate demand effects on GDP is reduced investment affecting capital stock and productivity. A very clear statement is in Haltmaier: ‘There are a number of reasons why growth rates of potential output, and possibly even the level, might fall during a recession. The most obvious is that investment generally contracts, resulting in a permanently lower level of the capital stock even if investment later recovers to its pre-recession level. If technical change is embodied, lower investment may also have a negative effect on the rate of technical progress’ (Haltmaier 2012, p. 1). Here, as in other recent papers, the fall in investment is regarded as a direct consequence of changes in aggregate demand, while whether there will be recovery in the capital stock to the levels it would have reached over the long run had the recession not occurred is often left in the background – although the fact that several papers find that recessions leave scars in GDP after several years (usually 7–8 years) suggests that the effects are persistent enough to leave a longer-run recovery, if any, quite outside the realm of interest for economic policy.

Actually, the view that capital formation is an important channel for hysteresis in unemployment and GDP has already been advanced, and a convergence can be observed among several strands of economic literature. The view that insufficient capital accumulation was at the roots of high European unemployment was advanced by Gordon (1995) and Rowthorn (1995; 1999). Gordon, for example, states: ‘We find that countries with the greatest increase in unemployment had the largest slowdowns in the growth rate of capital per potential labour hour [….]. Europe entered the 1990s with much higher unemployment than in the USA, but with approximately the same rate of capacity utilization, indicating that *there was no longer sufficient capital to equip all the employees that would be at work at the unemployment rates of the late 1970s’* (Gordon 1995, p. 42, italics added). This view, however, is at variance with the traditional approach, according to which wage flexibility combined with factor substitutability should ensure the reduction of unemployment to its equilibrium level even with a reduced or slow-growing capital stock (Layard *et al.* 1991). Even so, however, though employment and the NAIRU would not be affected, some effects on GDP would be in place, owing to reduced output per hour caused by a lower capital endowment per labour unit. Rowthorn (1999) responds to the ‘substitution’ argument by reference to a very large number of econometric studies reporting, or implying, an extremely low (much lower than 1, with median values of between 0.13 and 0.3) elasticity of substitution, and argues accordingly that complementarity of capital and labour prevails. On this ground then, capital scrapping would not only affect potential output but also the employment level, and hence cause an increase in the

NAIRU.[14] However, as is usually the case with models of hysteresis, Rowthorn's contributions suggest an asymmetry: once the capital stock has diminished (or has grown less than it would otherwise), this will impose a stringent constraint on GDP expansion, which will thus cause accelerating inflation owing to pressure on the degree of capacity utilization, which will induce firms to raise output prices. There is no suggestion that increased capital formation stimulated by a positive demand shock might rapidly dampen such inflationary pressures.

More recently, other studies that have empirically tested the relevance of capital accumulation vis-à-vis labour market institutions in affecting unemployment in the medium run or the NAIRU in a set of OECD countries find that only the former is consistently statistically significant across various specifications and has a strong economic impact (Arestis *et al.* 2007; Klär *et al*. 2010; Stockhammer *et al.* 2014). Here, no asymmetry is implied between recessions and expansions. This empirical literature, however, does not aim at enquiring into the determinants of investment and capital accumulation, though they mention the role of aggregate demand. Concerning this last point, however, a large number of empirical analyses have shown that the main determinant of investment is (lagged) GDP growth[15] or autonomous demand growth (Girardi and Pariboni 2015; 2016), consistently with the well-known flexible accelerator principle, while interest rate plays a small role, if any, in determining aggregate investments.

Thus, both the empirical literature on investments and that concerning the effects of accumulation on unemployment suggest that the influence of aggregate demand and GDP growth on investments should be regarded as working in both directions, that is, not only in recessions but also in expansions, in accordance with the evidence presented here.[16]

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[14] Taking a different analytical approach, critical of the traditional view concerning factor substitutability (actually, critical of the possibility of regarding capital as a factor of production), Garegnani (1962 [2015]; 1992) maintained that in the long run both employment and fixed capital tend to adjust to the path of what he called 'final demand', comprising consumption, exports and public expenditure.

[15] See Blanchard (1986), Chirinko (1993), Ford and Poret (1990), Khotari *et al*. (2014), Sharpe and Suarez (2014), Onaran and Galanis (2012), Schoder (2014), Wen (2007). As early as 1986 Blanchard wrote: 'The discrepancy between theory and empirical work is perhaps nowhere in macroeconomics so obvious as in the case of the aggregate investment function. […] The theory from which the neoclassical investment function was initially derived implies that one should be able to specify the model equally well whether using only factor prices or using output and the user cost of capital. We all know that this is not the case. […] It is very hard to make sense of the distributed lag of output on investment. […] Finally, *it is well known that to get the user cost to appear at all in the investment equation, one has to display more than the usual amount of econometric ingenuity, resorting most of the time to choosing a specification that simply forces the effect to be there'* (Blanchard 1986).

[16] Of course the degree of influence may differ in recessions vis-à-vis expansions, in view of evidence that fiscal multipliers are higher during a slump (Jordà and Taylor 2015).

5. An analytical framework

Our empirical results lead to the question of what the economic mechanisms working behind them are, and which analytical framework would be consistent with them. Clearly, a positive link between non-investment autonomous components of aggregate demand, GDP and capital accumulation in the long run is inconsistent with macro models in which an increase in public spending, or any other autonomous components of demand, causes a crowding out of private investment and/or private consumption. More generally this is inconsistent with the view that an increase in the autonomous components of demand will cause rising inflation while only temporarily, if at all, an increase in output, which in the medium to long run must be regarded as determined by factor endowments, technology and institutions – all of them independent of aggregate demand.[17]

However, the main lines of an approach consistent with the findings can be traced by linking and bringing to their logical conclusions a number of observations and analyses that are individually – each separately – shared by many scholars and empirically supported.

The essential interconnected ingredients of a framework consistent with the evidence of persistent effects of aggregate demand changes on GDP and capital stock appear to be the following:

a) in any given period, with given equipment, aggregate demand can differ in a sufficiently persistent way from the aggregate output that would be forthcoming if the existing fixed capital was normally utilized (that is, was utilized in the degree planned by firms when installing the equipment);
b) underutilization or overutilization of plants can be persistent enough to induce firms to adjust their capital equipment; this in turn entails that existing capital equipment is not necessarily of a size capable of employing the entire existing labour force,[18] and hence labour reserves can be available, either in the form of involuntary unemployment or discouraged labour even when the planned degree of capacity utilization prevails – quite independently of institutional 'rigidities';
c) it must generally be possible, even when fixed capital is used to the degree initially planned by firms, to increase output simultaneously in the investment goods and consumption goods sectors.

[17] We do not address here real business cycle versions of macroeconomic theory – however, our findings that increases in productivity follow and do not lead our expansionary episodes is clearly at variance with that approach.

[18] As was for example the case in Europe in the 1990s, according to Gordon and Rowthorn among others (see Section 4.3).

The analytical premises and consequences of these propositions for the analysis of accumulation were discussed in pioneering research carried out by Garegnani at SVIMEZ (an institution for economic analysis of southern Italy) in the early 1960s (Garegnani 1962 [2015]; see also Garegnani 1978–79), and have since then stimulated research on the role of demand in accumulation processes.[19] Let us now look more closely at each of these propositions to see how they are analytically founded and whether they are empirically supported.

The first proposition is that in any given period (that is, given the fixed capacity installed) aggregate demand can differ from potential output. If this is so, macroeconomic equilibrium will be brought about by output adjusting to demand. This is the Keynesian theory of output normally laid out in textbooks. Now the ordinary textbook story is that in response to underutilization or overutilization of capacity, changes in interest rate (via central bank policy or changes in the price level vis-à-vis money supply) will bring aggregate private investment back to its full employment level.[20] We know, however, that this may not be the case, since although the interest rate may affect aggregate demand in various ways, it has little impact (if any) on aggregate investments, and therefore may not succeed in closing the gap between aggregate demand and the output that would be forthcoming at the planned degree of plant utilization.

Second, the dependence of investments on interest rate has not only been proved empirically weak (see above) but has also been rejected on analytical grounds.[21] Leaving aside these deep analytical problems, it should also be recognized that according to traditional theory, the process of changing

[11] Quite interestingly, in the same period and working at the same institution, Ackley developed an econometric model of the Italian economy bearing a strong affinity with Garegnani's approach, as it explained the 'Italian economic miracle' of the post-war period by means of the interaction of autonomous demand growth and induced private investments (Ackley 1963). Garegnani's work has inspired subsequent research on the role of autonomous demand in growth processes. For a survey, see Cesaratto (2015). See also various contributions in Levrero, Palumbo and Stirati (2013, eds, vol. 2) and Cesaratto and Mongiovi (2015, eds). The stability conditions for growth processes with autonomous components of demand and induced investment are discussed in Freitas and Serrano (2015), and essentially rely on the changes in the average propensity to save caused by the existence of autonomous components of demand and on the graduality of the adjustment of capital to changes in demand and expected output. Empirical research explicitly assessing the usefulness of the approach for the understanding of actual accumulation processes has recently begun to develop: see Freitas and Dweck (2013) on Brazil, and Girardi and Pariboni (2016) on the US. In the 1990s a seminal paper by Badhuri and Marglin (1990) also stimulated research on demand-led growth, albeit in a different theoretical framework; recently, however, there has been a degree of convergence between these two streams of research (see Cesaratto 2015; Lavoie 2016).

[20] Changes in real money balances can also stimulate consumption (increase the propensity to consume) via wealth effects, but it is generally agreed that this influence is not such as to ensure a continuous tendency to adjust to full employment (Patinkin 1987).

[21] The capital theory controversy was precisely about the analytical foundations of decreasing factor demand curves, and therefore also of the inverse relation between the interest rate and investment, since the latter is the 'flow' counterpart of the equilibrium between demand and supply of 'capital' as a stock. See Pasinetti (1966) and Garegnani (1970; 2012). Girardi (2017) provides a critical survey of neoclassical investment theory, discussing this and other analytical difficulties in deriving a negative relation between investment and the interest rate.

the techniques used and hence of adjusting the capital–labour ratio (by means of higher investments, given the labour supply) in response to an interest rate fall must be slow, since it entails changing the ‘form’ of capital, that is, substituting the existing ‘machines’ with different ones (Hicks 1932, pp. 19–21; Dvoskin and Petri 2016). Therefore, an underutilization (overutilization) of capacity associated with aggregate investment lower (higher) than that which would close the gap between aggregate demand and the output forthcoming at the planned utilization of equipment, may be rather persistent. It is quite natural then that firms will respond to such a situation with an attempt to adjust their capacity to actual (average) production levels. This of course is the basis for the *flexible* accelerator, whereby there is a gradual adjustment of capacity to changes in aggregate demand that depend on the current degree of capacity utilization.[22]

If aggregate private investment must be regarded as induced by changes in GDP in the long run, this means that while in Keynes it is the output produced out of a given capacity that adjusts to aggregate demand, in the longer run, with induced investments, fixed capital adjusts to (sufficiently persistent changes of) aggregate demand, consistently with empirical evidence showing that capacity utilization fluctuates but does not exhibit persistent trends.

The third point to be clarified is how both autonomous demand and investments can increase together – i.e., why we do not observe ‘crowding out’, but ‘crowding in’. If in any given period we have given equipment, how is it possible that production of consumption goods, public goods and investment goods all increase at the same time? First, we may observe that in any given period fixed capital could be underutilized owing to lack of aggregate demand – thus in such a situation production could be increased simply by using existing spare capacity. Second, even when firms are operating at or close to the planned degree of utilization, such degree does not generally correspond to the maximum achievable production level. It is generally recognized that firms normally have some margin allowing for increasing production, by adding extra working hours to normal shifts, increasing the number of shifts on given plant (e.g., night shifts) or by intensifying the use of a given number of working hours. The reasons for carrying such margins have been discussed widely in the literature, with a range of explanations: indivisibilities and scale economies, increasing wage costs; increasing capital maintenance costs; imperfect competition and short-run increasing returns; and firms’ willingness to satisfy clients even at cyclical peaks (Chenery 1952; Corrado and Mattey 1997; Steindl 1952; Ciccone 1986). At any rate, statistical surveys clearly show that normally – on average – capacity utilization remains below the maximum (Corrado and Mattey 1997, p. 155, for example, report a stable 82% long-run normal capacity utilization in the USA according to survey

[22] A founding contribution is Chenery (1952).

data time-series). Third, as the increase in demand persists, investments will create additional capacity, so that the elasticity of production to changes in aggregate demand actually increases over longer time spans. This of course does not imply that *any* amount of additional demand can be immediately accommodated, but that unless the economy is already overheated and available labour force (including discouraged and 'hidden' unemployed or underemployed) entirely absorbed, there is a good deal of flexibility in the economic system for increasing both private and public consumption and investment. The experiences of several emerging economies that have grown at rates of 7% and more for many consecutive years seem to provide a rough, but striking illustration of such long-run flexibility of output.

As capital and employment adjust, inflationary pressures that might come from increasing costs associated with *overutilization* of fixed capital and/or labour (overtime, night shifts, increased maintenance costs, etc.) would tend to disappear. The only remaining inflationary tensions would be those that *may* be brought about by an intensification of wage pressure resulting from lower unemployment and faster employment growth (Stirati 2001; 2011; 2016). Our results (along with those of the literature cited in the previous section, and particularly Blanchard *et al.* 2015; Ball *et al.* 1999; Ball 2009), however, suggest that this is not *necessarily* the case.

As a consequence of the above, autonomous demand changes can be said to have long-run effects on GDP in two senses. First, with given equipment, as long as the change in autonomous demand persists, there are no feed-back mechanisms (i.e., offsetting changes in private investments or consumption) that will drive total aggregate demand back to the output associated with the planned degree of utilization of the existing equipment – that is to say, the Keynesian multiplier works out without necessarily setting in motion feed-back effects. Second, the changes in autonomous demand and capacity utilization will affect aggregate private investment and hence installed productive capacity, i.e., they will affect 'potential output', redefined here as the output forthcoming at the planned degree of utilization of the existing fixed capital stock. Employment will tend to vary in the same direction, and may accordingly stimulate changes in labour force participation. Overall, this broad framework of analysis is consistent with our empirical results as well as those recently shown in several papers concerned with persistent effects of recessions and fiscal consolidations.

6. Conclusions

After identifying 94 large episodes of autonomous demand expansion in OECD countries (from 1960 to 2015) looking at the sum of primary public expenditure and exports, in this paper we investigate the impact of these expansions on key macroeconomic outcomes in the subsequent decade. To this end, we exploit various techniques to deal with endogeneity (specifically, two-way fixed-effects and propensity score-based specifications). We find a highly significant persistent effect on the GDP level. We also document strong persistent effects on capital stock, employment and participation rates. Effects on productivity and unemployment rate are also strong and quite persistent, but evidence regarding their permanency is more mixed. We do not find that autonomous demand expansions, on average, cause high or accelerating inflation.

The mechanism linking expansions and recessions to aggregate private investment and hence to long-term GDP trajectories appears to be the most convincing and empirically supported explanation of the persistent level effects on GDP resulting from changes in aggregate demand.

The policy implications of our results (along with those concerning the persistent effects of recessions and fiscal consolidations, and the weakness of the relationship between unemployment and inflation) are rather interesting and at variance with prevailing official wisdom, particularly in European institutions. The trade-off in macroeconomic policy is overturned: aggregate demand expansions bring about *persistent* effects on GDP, the capital stock, participation and employment at the cost of an extremely short-ived and moderate increase in inflation. Accordingly, neither productivity nor factor endowments can be regarded as entirely independent of aggregate demand.

As noted, to some extent similar conclusions had been reached by recent literature on hysteresis; but while hysteresis conveys the idea of a distortion in the normal functioning of the system caused by some obstacle to the return to what would have been in some sense the normal outcome of free market forces, our data, covering a long period of time and many countries, and the underlying process described above, suggests that the persistence of the effects of aggregate demand changes are indeed the results of the normal functioning of market forces.

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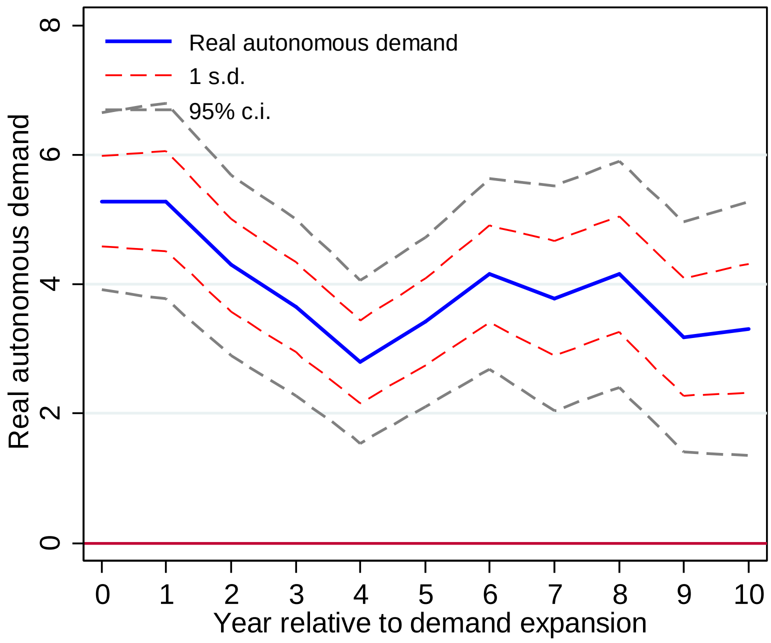
Figure 1 – Average behaviour of autonomous demand during and after an expansion episode



The graphs display the impulse-response function for the effect of an autonomous demand expansion on autonomous demand itself. It is obtained through local projections, controlling for a full set of country and year fixed effects and two lags of the dependent variable. Years relative to the demand expansion on the horizontal axis. Percentage points on the vertical axis.

Figure 2 – Estimated effect of an autonomous demand expansion on key macroeconomic outcomes (two-way FE model)

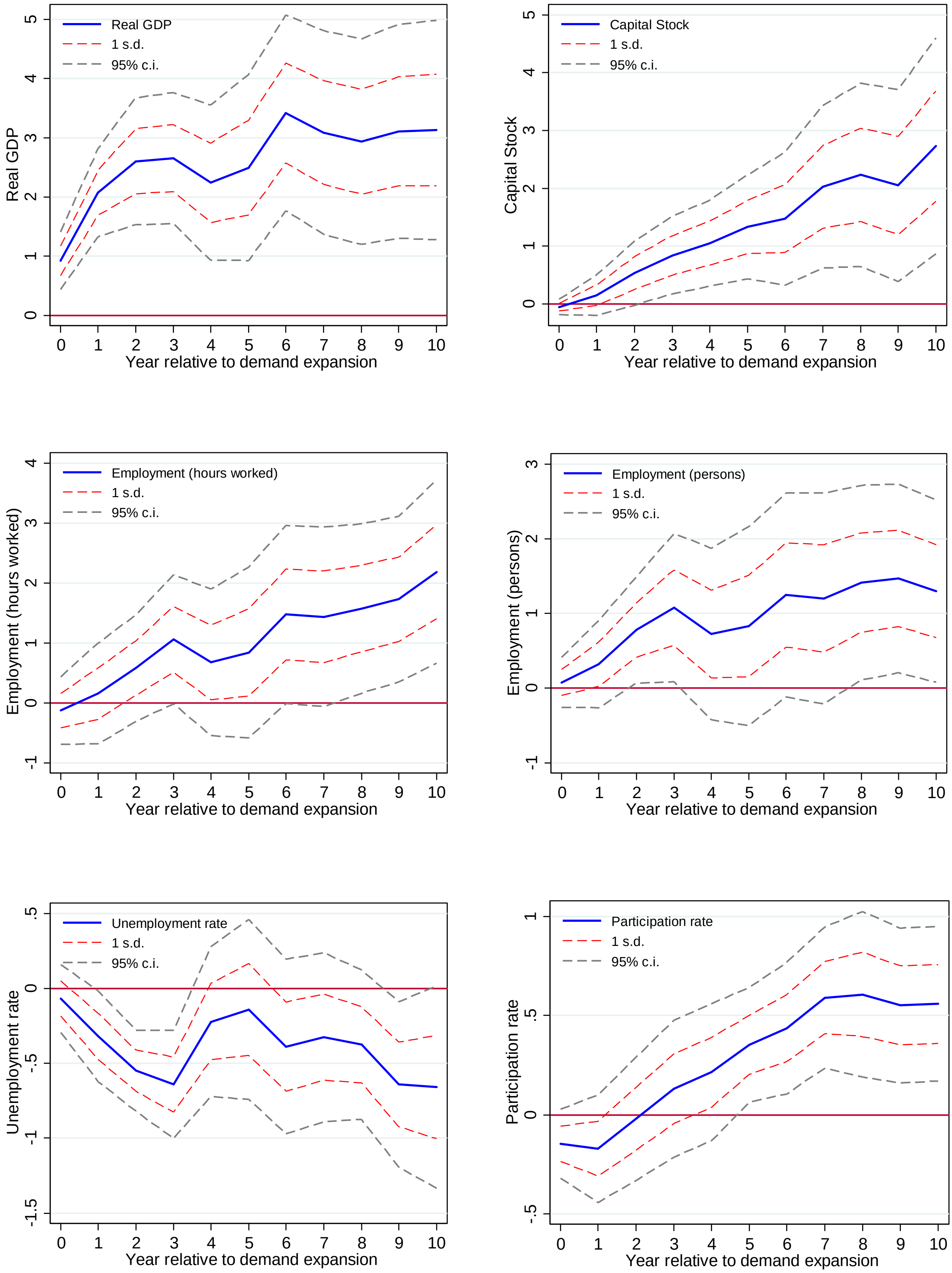


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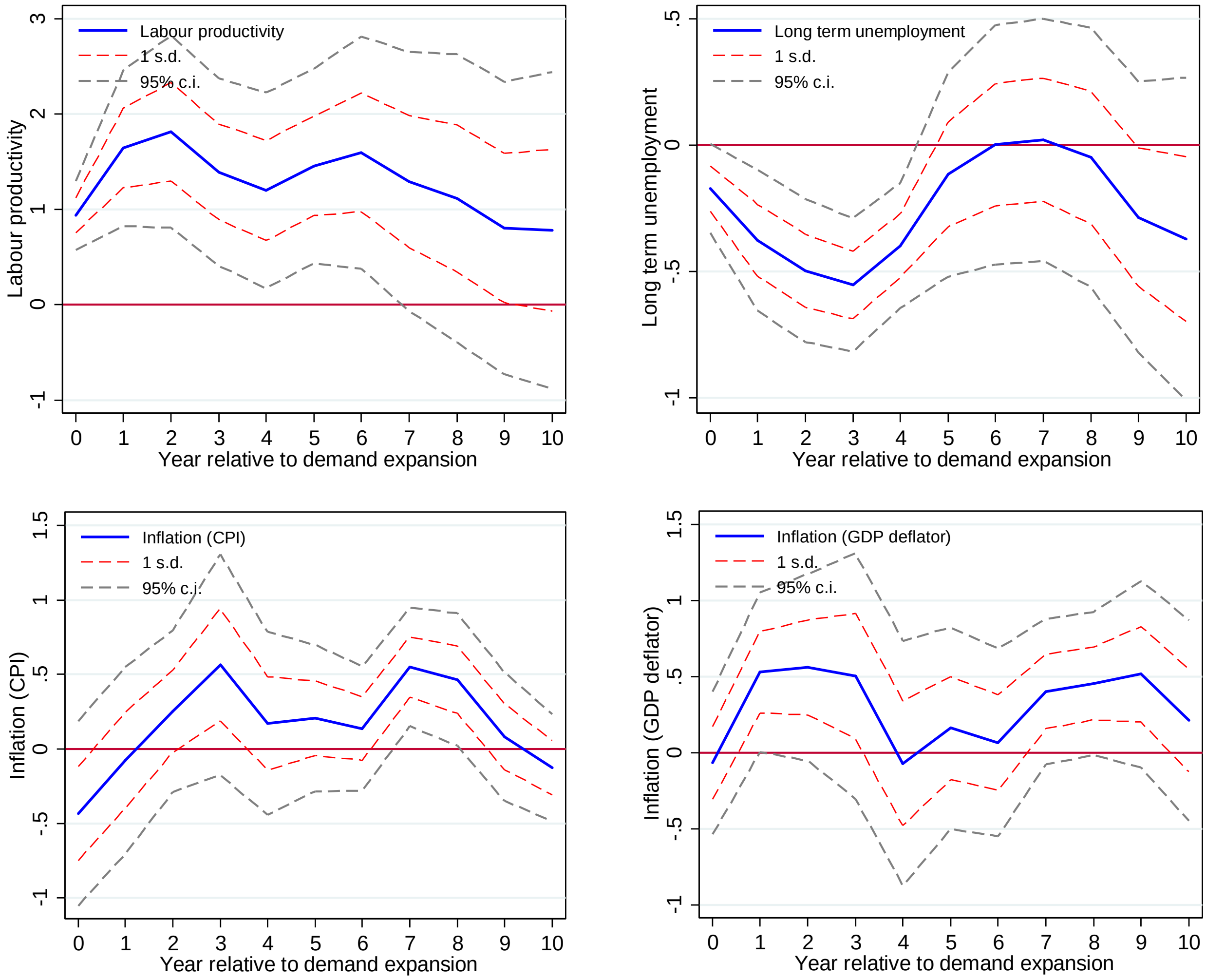
Figure 2 (cont.) – Estimated effect of an autonomous demand expansion on key macroeconomic outcomes (two-way FE model)



The graphs display impulse-response functions for the effect of an autonomous demand expansion on various macroeconomic outcomes. They are obtained through local projections, controlling for a full set of country and year fixed effects and two lags of the dependent variable. Years relative to the demand expansion on the horizontal axis. Percentage points on the vertical axis.

Figure 3 – Estimated effect of an autonomous demand expansion on key macroeconomic outcomes (propensity score-based model, IPWRA)

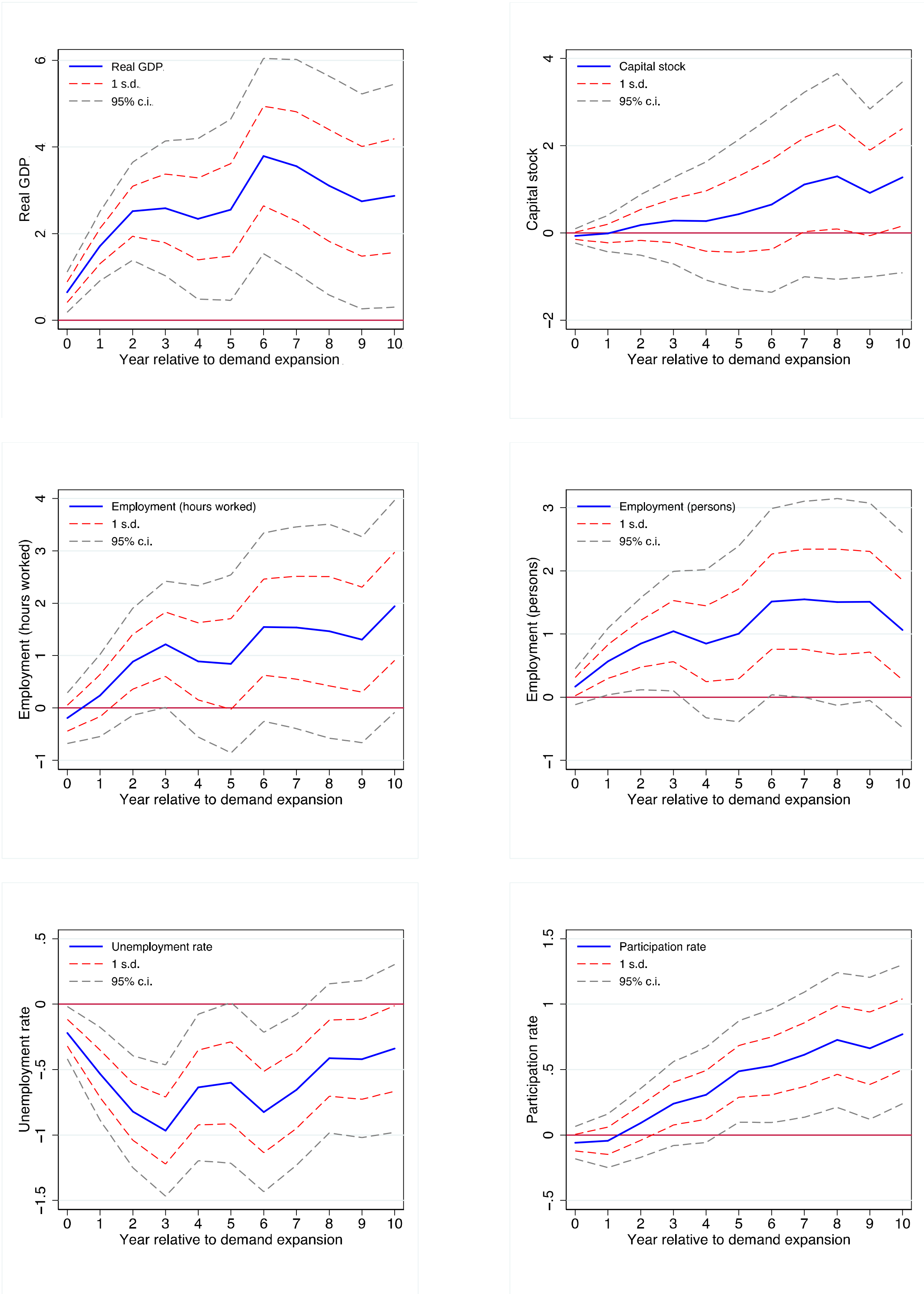


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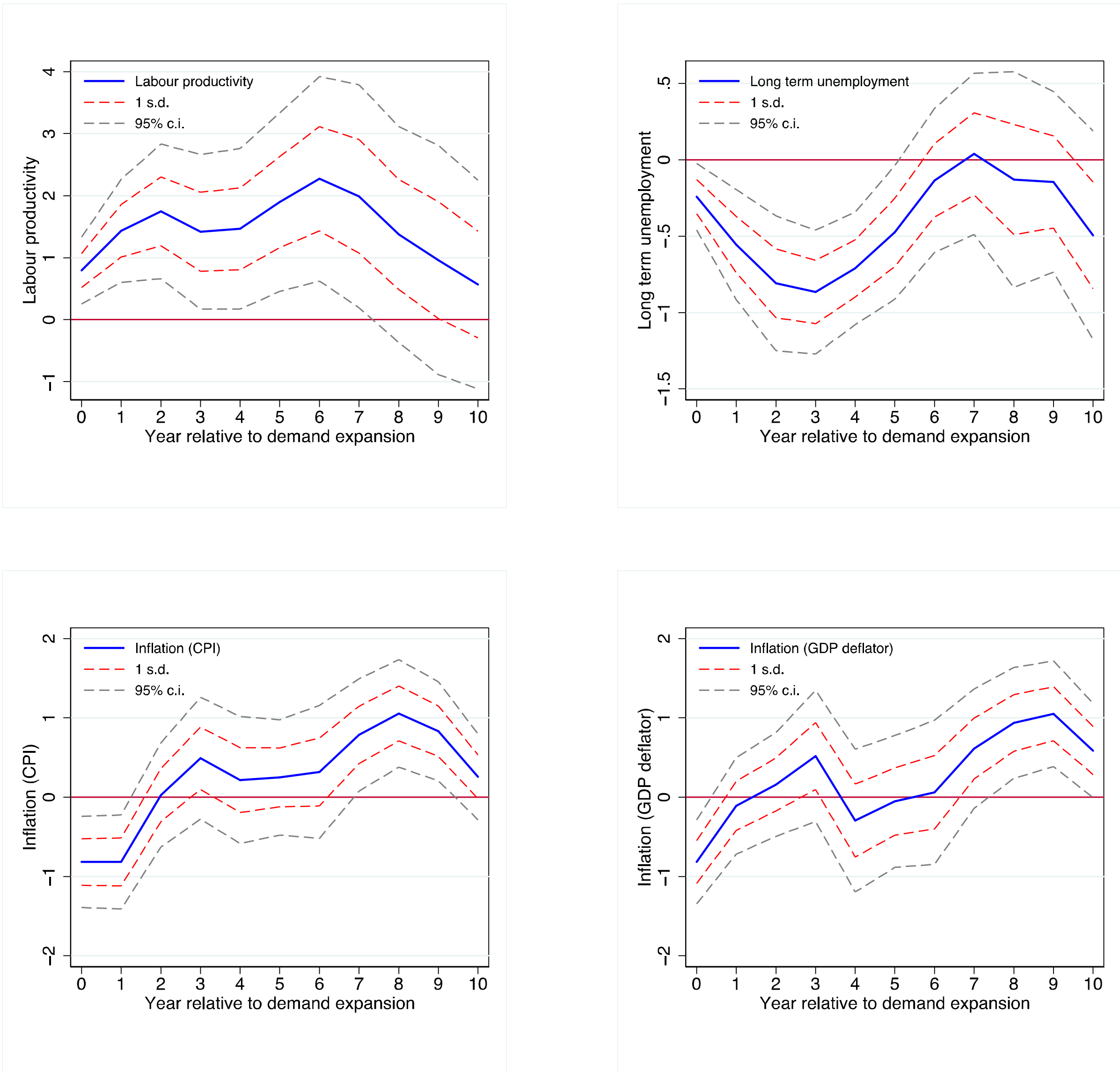
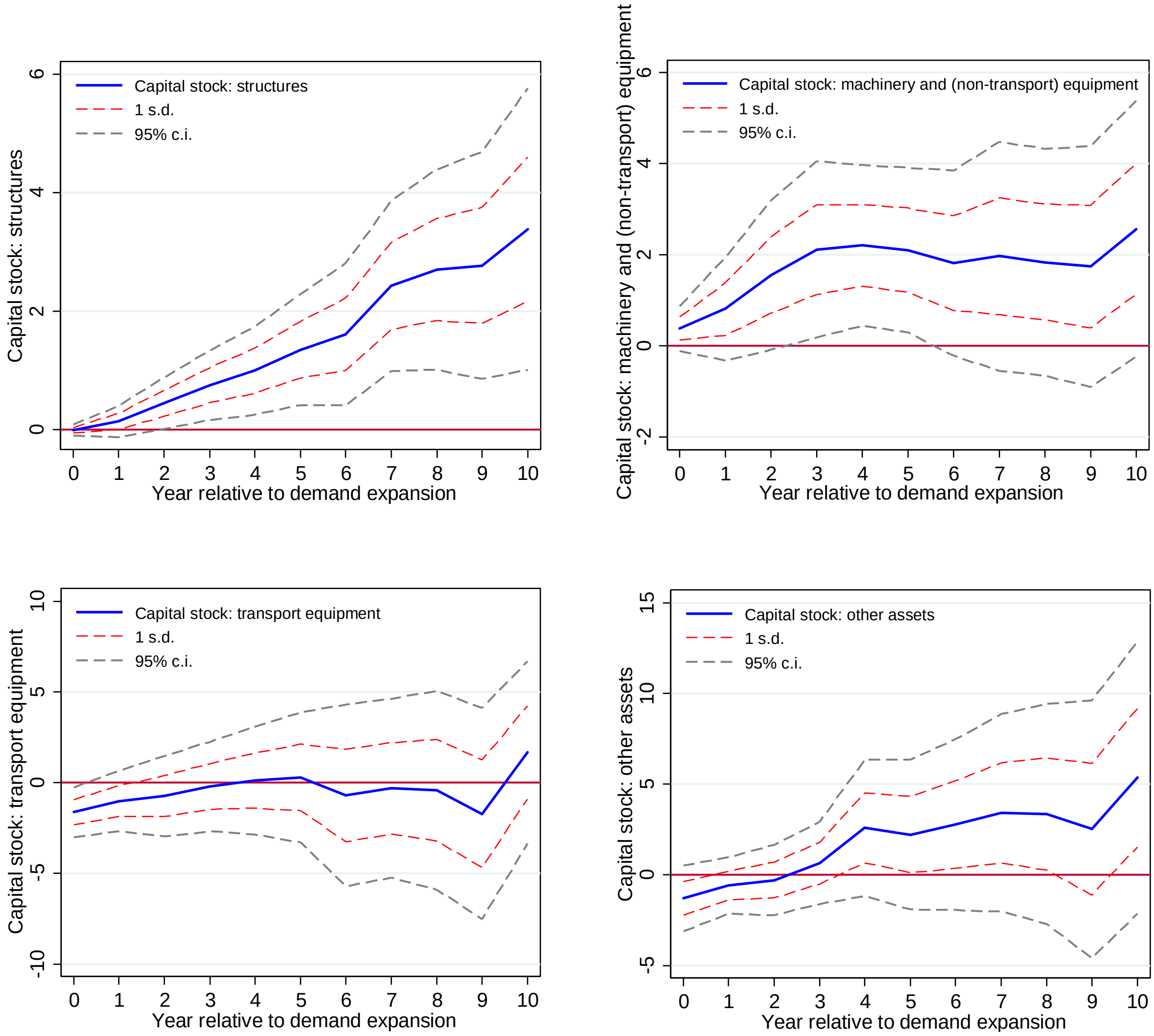
Figure 3 (cont.) – Estimated effect of an autonomous demand expansion on key macroeconomic outcomes (propensity score-based model, IPWRA)



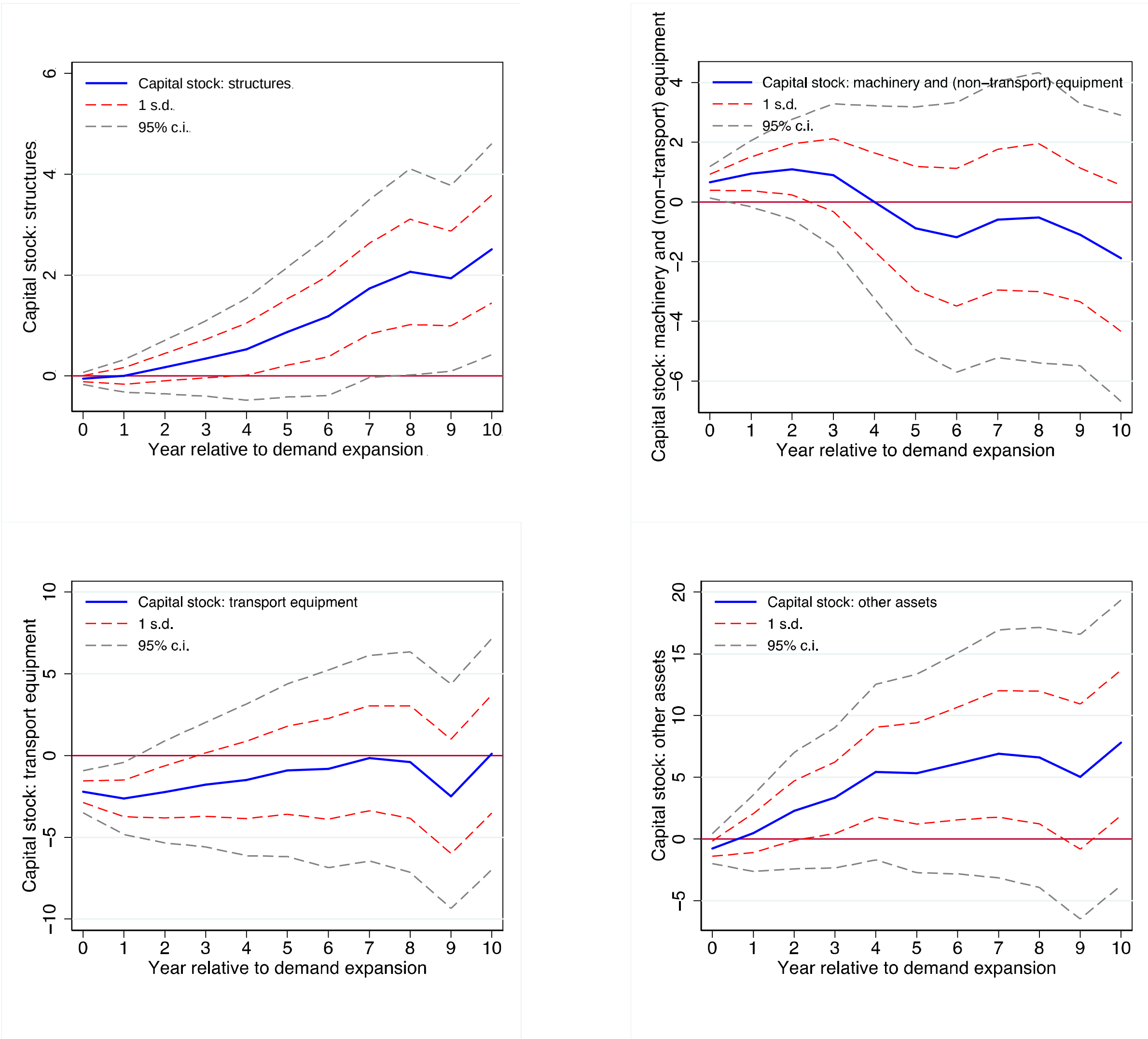
The graphs display impulse-response functions for the effect of an autonomous demand expansion on various macroeconomic outcomes. They are obtained through combining local projections with inverse probability weighting regression adjustment (IPWRA). The outcome model controls for two lags of the outcome variable, two lags of the change in the REER, and a full set of country and year fixed effects. The treatment model includes two lags of GDP growth, two lags of the change in the REER and a full set of country and year fixed effects. Years relative to the demand expansion on the horizontal axis. Percentage points on the vertical axis.

Figure 4 – Estimated effect of an autonomous demand expansion on capital stock components (two-way FE model)



The graphs display impulse-response functions obtained through local projections, controlling for a full set of country and year fixed effects and two lags of the dependent variable. Years relative to the demand expansion on the horizontal axis. Percentage points on the vertical axis.

Figure 5 – Estimated effect of an autonomous demand expansion on capital stock components (propensity score-based model, IPWRA)



Impulse-response functions estimated by combining local projections with inverse probability weighting regression adjustment (IPWRA). The outcome model controls for two lags of the outcome variable, two lags of the change in the REER, and a full set of country and year fixed effects. The treatment model includes two lags of GDP growth, two lags of the change in the REER and a full set of country and year fixed effects. Years relative to the demand expansion on the horizontal axis. Percentage points on the vertical axis.

Table 1 – Average increase in autonomous demand growth and its components during expansions (relative to non-expansion observations)

	Difference (treated – controls)		
	OLS	Country FE	Two-way FE
Autonomous demand	6.24***	6.33***	5.04***
	(0.53)	(0.49)	(0.59)
Exports	12.25***	12.59***	8.43***
	(1.22)	(1.15)	(1.40)
Government primary current expenditure	4.61***	4.69***	1.35*
	(0.68)	(0.66)	(0.68)
Government gross capital formation	5.75***	5.86***	3.70**
	(1.28)	(1.30)	(1.55)

*All variables taken in first differences of natural logs. Coefficients multiplied by 100 for ease of interpretation (so a coefficient of 1 means a 1% difference). For each indicator, we employ a linear regression to compare the mean of the variable in the year of an expansion with the mean in the rest of the sample. The test is applied using three models: a simple OLS model without controls ('OLS' column); a fixed-effects model that only controls for country-specific effects ('Country FE'); and a two-way fixed-effects model which controls for a full set of country and year effects ('Two-way FE'). Robust standard errors clustered by country in parentheses; *** p<0.01, ** p<0.05, * p<0.1.*

Table 2 – Comparison of initial macroeconomic conditions in treated and non-treated observations

	Difference (treated – controls)		
	OLS	Country FE	Two-way FE
Real GDP growth	1.43***	1.34***	-0.07
	(0.38)	(0.38)	(0.34)
Labour productivity growth	1.03***	0.99***	-0.17
	(0.28)	(0.28)	(0.21)
Unemployment rate	-1.44***	-1.05***	0.26
	(0.52)	(0.38)	(0.24)
Real interest rate	-0.79**	-0.84**	0.13
	(0.36)	(0.35)	(0.32)
Participation rate	-0.36	-0.84**	0.06
	(0.59)	(0.34)	(0.20)
Public debt (% of GDP)	-17.07***	-14.56***	-1.06
	(4.85)	(4.47)	(1.21)
CPI Inflation rate	0.78	0.88*	0.59
	(0.50)	(0.46)	(0.36)
REER (% change)	-0.97	-0.96*	-1.28**
	(0.59)	(0.56)	(0.56)
Autonomous demand growth	1.87***	1.76***	0.79**
	(0.31)	(0.27)	(0.36)

For each indicator, we employ a linear regression to compare the mean of the variable in the year before an expansion with the mean in the rest of the sample (Equation 1 in the main text). Growth rates calculated by taking first differences of natural logs, and then multiplying coefficients by 100 for ease of interpretation (so a coefficient of 1 means a 1% difference). The test is applied using three models: a simple OLS model without controls ('OLS' column); a fixed-effects model that only controls for country-specific effects ('Country FE'); and a two-way fixed-effects model which controls for a full set of country and year effects ('Two-way FE'). Robust standard errors clustered by country in parentheses; *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 3 – Probit model for the probability of an autonomous demand expansion

	(1)	(2)	(3)
ΔGDP_{t-1}	-0.070	-0.038	-0.025
	(0.069)	(0.060)	(0.047)
ΔGDP_{t-2}	0.080*	0.096**	0.091***
	(0.044)	(0.042)	(0.032)
$\Delta Productivity_{t-1}$	0.004	-	-
	(0.050)	-	-
$\Delta Productivity_{t-2}$	0.014	-	-
	(0.051)	-	-
Debt/GDP $_{t-1}$	-0.036	-	-
	(0.031)	-	-
Debt/GDP $_{t-2}$	0.026	-	-
	(0.028)	-	-
$\Delta REER_{t-1}$	-0.066***	-0.060***	-0.044***
	(0.015)	(0.013)	(0.013)
$\Delta REER_{t-1}$	-0.015	-0.002	0.003
	(0.021)	(0.020)	(0.018)
Real interest rate $_{t-1}$	0.068*	0.047	-
	(0.037)	(0.038)	-
Real interest rate $_{t-1}$	-0.021	-0.041	-
	(0.034)	(0.036)	-
Observations	616	682	809
Country FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
p-value for the null hypothesis that both lags are jointly equal to 0			
GDP growth	0.159	0.064	0.009
Productivity growth	0.964	-	-
Debt/GDP	0.325	-	-
REER change	5.15e-05	8.15e-06	0.009
Real interest rate	0.180	0.323	-

*Robust standard errors clustered by country in parentheses; *** $p<0.01$, ** $p<0.05$, * $p<0.1$; variables taken in natural logarithms, except for the debt/GDP ratio and the real interest rate.*

Table 4 – Dynamic effect of an autonomous demand expansion on key macroeconomic outcomes (two-way FE model)

	(1) Year 0	(2) Year 1	(3) Year 2	(4) Year 3	(5) Year 4	(6) Year 5	(7) Year 6	(8) Year 7	(9) Year 8	(10) Year 9	(11) Year 10
Real GDP	0.92***	2.07***	2.60***	2.66***	2.24***	2.50***	3.42***	3.09***	2.93***	3.11***	3.13***
	(0.25)	(0.38)	(0.55)	(0.56)	(0.67)	(0.80)	(0.84)	(0.88)	(0.89)	(0.92)	(0.94)
Obs.	1,131	1,130	1,098	1,064	1,030	996	962	928	894	860	826
Countries	34	34	34	34	34	34	34	34	34	34	34
Expansions	94	93	93	93	92	92	92	92	91	87	86
Capital stock	-0.06	0.15	0.53*	0.84**	1.05***	1.33***	1.47**	2.02***	2.23***	2.05**	2.73***
	(0.07)	(0.18)	(0.28)	(0.34)	(0.38)	(0.46)	(0.59)	(0.72)	(0.81)	(0.85)	(0.95)
Obs.	1,100	1,066	1,032	998	964	930	896	862	828	794	760
Countries	34	34	34	34	34	34	34	34	34	34	34
Expansions	94	93	92	92	92	92	91	87	86	77	73
Employment	-0.13	0.16	0.58	1.06*	0.68	0.84	1.48*	1.44*	1.57**	1.73**	2.19***
(hours worked)	(0.29)	(0.43)	(0.45)	(0.55)	(0.62)	(0.73)	(0.76)	(0.76)	(0.72)	(0.71)	(0.78)
Obs.	1,129	1,118	1,084	1,050	1,016	982	948	914	880	846	812
Countries	34	34	34	34	34	34	34	34	34	34	34
Expansions	94	93	93	92	92	92	91	90	87	86	84
Employment	0.08	0.32	0.78**	1.08**	0.73	0.83	1.25*	1.20	1.41**	1.47**	1.30**
(persons)	(0.17)	(0.30)	(0.36)	(0.51)	(0.59)	(0.68)	(0.70)	(0.72)	(0.67)	(0.64)	(0.62)
Obs.	1,131	1,099	1,065	1,031	997	963	929	895	861	827	793
Countries	34	34	34	34	34	34	34	34	34	34	34
Expansions	94	93	93	92	92	92	92	91	87	86	77
Unemployment rate	-0.07	-0.32**	-0.55***	-0.64***	-0.22	-0.14	-0.39	-0.33	-0.37	-0.64**	-0.66*
	(0.12)	(0.15)	(0.14)	(0.18)	(0.26)	(0.31)	(0.30)	(0.29)	(0.25)	(0.28)	(0.34)
Obs.	1,098	1,067	1,034	1,001	968	935	902	869	836	803	770
Countries	33	33	33	33	33	33	33	33	33	33	33
Expansions	87	87	87	86	86	86	86	85	81	80	71

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Table 4 (cont.) – Dynamic effect of an autonomous demand expansion on key macroeconomic outcomes (two-way FE model)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Participation rate	-0.15	-0.17	-0.02	0.13	0.21	0.35**	0.44**	0.59***	0.61***	0.55***	0.56***
	(0.09)	(0.14)	(0.16)	(0.18)	(0.18)	(0.15)	(0.17)	(0.18)	(0.21)	(0.20)	(0.20)
Obs.	1,105	1,073	1,039	1,005	971	937	903	869	835	801	768
Countries	34	34	34	34	34	34	34	34	34	33	33
Expansions	88	87	87	86	86	86	86	85	81	80	71
Labour productivity	0.94***	1.64***	1.82***	1.39***	1.20**	1.46***	1.60**	1.29*	1.12	0.80	0.78
	(0.18)	(0.42)	(0.51)	(0.50)	(0.52)	(0.52)	(0.62)	(0.69)	(0.77)	(0.78)	(0.85)
Obs.	1,131	1,099	1,065	1,031	997	963	929	895	861	827	793
Countries	34	34	34	34	34	34	34	34	34	34	34
Expansions	94	93	93	92	92	92	92	91	87	86	77
Long-term unemployment	-0.17*	-0.38**	-0.50***	-0.55***	-0.40***	-0.12	0.00	0.02	-0.05	-0.28	-0.37
	(0.09)	(0.14)	(0.14)	(0.13)	(0.13)	(0.21)	(0.24)	(0.24)	(0.26)	(0.27)	(0.33)
Obs.	847	818	785	752	718	686	652	620	587	555	522
Countries	33	33	33	33	33	33	33	33	33	33	33
Expansions	50	50	51	50	50	50	50	50	47	44	35
Inflation (CPI)	-0.43	-0.08	0.25	0.56	0.17	0.21	0.14	0.55**	0.47**	0.08	-0.13
	(0.32)	(0.32)	(0.28)	(0.38)	(0.31)	(0.25)	(0.21)	(0.20)	(0.23)	(0.22)	(0.18)
Obs.	1,116	1,115	1,083	1,049	1,015	981	947	913	879	845	811
Countries	34	34	34	34	34	34	34	34	34	34	34
Expansions	94	93	93	93	92	92	92	92	91	87	86
Inflation (GDP deflator)	-0.07	0.53*	0.56*	0.50	-0.07	0.16	0.07	0.40	0.45*	0.52	0.21
	(0.24)	(0.27)	(0.31)	(0.41)	(0.41)	(0.34)	(0.31)	(0.24)	(0.24)	(0.31)	(0.34)
Obs.	1,131	1,130	1,098	1,064	1,030	996	962	928	894	860	826
Countries	34	34	34	34	34	34	34	34	34	34	34
Expansions	94	93	93	93	92	92	92	92	91	87	86

Real GDP = natural log of real gross domestic product; Employment (hours worked) = natural log of total hours worked; Employment (persons) = natural log of total persons employed; Participation rate = labour market participation rate (aged 15-74); Labour productivity = natural log of real GDP per hour worked; Long-term unemployment = long-term unemployment as a share of total labour force.

*Effects estimated through local projections (see Equation 2 in main text). Coefficients are multiplied by 100 for ease of interpretation (so a coefficient of 1 means a 1% increase in the variable). All regressions control for a full set of country and year fixed effects and for two (pre-treatment) lags of the dependent variable. Robust standard errors clustered by country in parentheses; *** $p<0.01$, ** $p<0.05$, * $p<0.1$.*

Table 5 – Dynamic effect of an autonomous demand expansion on key macroeconomic outcomes (propensity score-based model, IPWRA)

	(1) Year 0	(2) Year 1	(3) Year 2	(4) Year 3	(5) Year 4	(6) Year 5	(7) Year 6	(8) Year 7	(9) Year 8	(10) Year 9	(11) Year 10
Real GDP	0.65^{***}	1.71^{***}	2.52^{***}	2.58^{***}	2.34^{***}	2.55^{***}	3.79^{***}	3.56^{***}	3.11^{**}	2.75^{**}	2.87^{**}
	(0.23)	(0.41)	(0.58)	(0.79)	(0.95)	(1.07)	(1.15)	(1.26)	(1.29)	(1.27)	(1.31)
Obs.	1,151	1,150	1,118	1,084	1,050	1,016	982	948	914	880	846
Countries	34	34	34	34	34	34	34	34	34	34	34
Expansions	121	120	120	120	119	119	119	119	118	114	113
Capital stock	-0.07	-0.01	0.18	0.28	0.27	0.43	0.66	1.11	1.30	0.92	1.27
	(0.08)	(0.21)	(0.35)	(0.51)	(0.69)	(0.87)	(1.03)	(1.08)	(1.20)	(0.98)	(1.12)
Obs.	1,120	1,086	1,052	1,018	984	950	916	882	848	641	607
Countries	34	34	34	34	34	34	34	34	34	34	34
Expansions	121	120	119	119	119	119	118	114	113	104	100
Employment	-0.19	0.24	0.88^{*}	1.22^{**}	0.89	0.84	1.54^{*}	1.53	1.47	1.31	1.94^{*}
(hours worked)	(0.25)	(0.40)	(0.52)	(0.61)	(0.73)	(0.87)	(0.92)	(0.98)	(1.04)	(1.00)	(1.03)
Obs.	1,149	1,138	1,104	1,070	1,036	1,002	968	934	900	866	832
Countries	34	34	34	34	34	34	34	34	34	34	34
Expansions	121	120	120	119	119	119	118	117	114	113	111
Employment	0.16	0.56^{**}	0.85^{**}	1.05^{**}	0.84	1.00	1.51^{**}	1.55^{*}	1.50^{*}	1.51^{*}	1.06
(persons)	(0.14)	(0.27)	(0.37)	(0.48)	(0.60)	(0.71)	(0.75)	(0.79)	(0.83)	(0.80)	(0.79)
Obs.	1,151	1,119	1,085	1,051	1,017	983	949	915	881	847	640
Countries	34	34	34	34	34	34	34	34	34	34	34
Expansions	121	120	120	119	119	119	118	114	113	104	104
Unemployment rate	-0.22^{**}	-0.53^{***}	-0.82^{***}	-0.97^{***}	-0.64^{**}	-0.60^{*}	-0.82^{***}	-0.65^{**}	-0.41	-0.42	-0.34
	(0.10)	(0.18)	(0.22)	(0.26)	(0.29)	(0.31)	(0.31)	(0.29)	(0.29)	(0.31)	(0.33)
Obs.	1,121	1,090	1,057	1,024	991	958	925	892	859	826	611
Countries	33	33	33	33	33	33	33	33	33	33	33
Expansions	114	114	114	113	113	113	113	112	108	107	98

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Table 5 (cont.) – Dynamic effect of an autonomous demand expansion on key macroeconomic outcomes (propensity score-based model, IPWRA)

	(1) Year 0	(2) Year 1	(3) Year 2	(4) Year 3	(5) Year 4	(6) Year 5	(7) Year 6	(8) Year 7	(9) Year 8	(10) Year 9	(11) Year 10
Participation rate	-0.06	-0.04	0.09	0.24	0.31	0.49**	0.53**	0.61**	0.73***	0.66**	0.77***
	(0.06)	(0.10)	(0.13)	(0.16)	(0.19)	(0.20)	(0.22)	(0.24)	(0.26)	(0.28)	(0.27)
Obs.	1,151	1,119	1,085	1,051	1,017	983	949	915	881	847	813
Countries	34	34	34	34	34	34	34	34	34	33	34
Expansions	121	120	120	119	119	119	119	118	114	113	104
Labour productivity	0.79***	1.43***	1.74***	1.42***	1.47**	1.90***	2.27**	1.98**	1.37	0.96	0.57
	(0.28)	(0.42)	(0.55)	(0.63)	(0.66)	(0.73)	(0.84)	(0.92)	(0.89)	(0.94)	(0.86)
Obs.	1,151	1,119	1,085	1,051	1,017	983	949	915	881	847	640
Countries	34	34	34	34	34	34	34	34	34	34	34
Expansions	121	120	120	119	119	119	119	118	114	113	104
Long-term unemployment	-0.24*	-0.56**	-0.81***	-0.87***	-0.71***	-0.48	-0.14	0.03	-0.13	-0.14	-0.49
	(0.11)	(0.18)	(0.23)	(0.21)	(0.19)	(0.22)	(0.24)	(0.27)	(0.36)	(0.30)	(0.35)
Obs.	561	560	560	527	527	527	527	497	497	429	396
Countries	33	33	33	33	33	33	33	33	33	33	33
Expansions	56	56	57	56	56	56	56	56	53	50	41
Inflation (CPI)	-0.82***	-0.82***	0.27	0.49	0.22	0.25	0.32	0.79**	1.06**	0.83***	0.26
	(0.29)	(0.30)	(0.33)	(0.39)	(0.41)	(0.37)	(0.42)	(0.36)	(0.35)	(0.32)	(0.28)
Obs.	1,146	1,145	1,113	1,079	1,045	1,011	977	943	909	875	841
Countries	34	34	34	34	34	34	34	34	34	34	34
Expansions	121	120	120	120	119	119	119	119	118	114	113
Inflation (GDP deflator)	-0.82***	-0.11	0.16	0.52	-0.29	-0.05	0.06	0.61	0.94***	1.05***	0.59*
	(0.27)	(0.31)	(0.33)	(0.42)	(0.46)	(0.42)	(0.46)	(0.38)	(0.36)	(0.34)	(0.30)
Obs.	1,151	1,150	1,118	1,084	1,050	1,016	982	948	914	880	846
Countries	34	34	34	34	34	34	34	34	34	34	34
Expansions	121	120	120	120	119	119	119	119	118	114	113

*Local projections estimated through a IPWRA model that combines propensity score weighting and regression adjustment. Coefficients are multiplied by 100 for ease of interpretation (so a coefficient of 1 means a 1% increase in the variable). See main text for description of the outcome and treatment models employed. Year effects were not included in the outcome model for long-term unemployment, due to difficulties in estimation. Robust standard errors clustered by country in parentheses; *** p<0.01, ** p<0.05, * p<0.1.*

Table 6 – Dynamic effect of an autonomous demand expansion on capital stock, by component (two-way FE model)

	(1) Year 0	(2) Year 1	(3) Year 2	(4) Year 3	(5) Year 4	(6) Year 5	(7) Year 6	(8) Year 7	(9) Year 8	(10) Year 9	(11) Year 10
Machinery and non-transport equipment	0.39	0.72	1.47	2.07*	2.19**	2.10**	1.86	2.01	2.17	1.52	2.51
	(0.27)	(0.64)	(0.91)	(1.06)	(0.96)	(1.00)	(1.12)	(1.37)	(1.36)	(1.45)	(1.51)
Obs.	1,100	1,066	1,032	998	964	930	896	862	828	794	760
Countries	34	34	34	34	34	34	34	34	34	34	34
Expansions	94	93	92	92	92	92	91	87	86	77	73
Structures	-0.01	0.14	0.45*	0.76**	1.00**	1.35**	1.61**	2.44***	2.75***	2.71**	3.31**
	(0.05)	(0.13)	(0.23)	(0.31)	(0.40)	(0.51)	(0.65)	(0.78)	(0.89)	(1.03)	(1.28)
Obs.	1,100	1,066	1,032	998	964	930	896	862	828	794	760
Countries	34	34	34	34	34	34	34	34	34	34	34
Expansions	94	93	92	92	92	92	91	87	86	77	73
Transport equipment	-1.44*	-0.80	-0.65	-0.07	0.25	0.52	0.10	0.77	0.46	-0.92	2.58
	(0.74)	(0.94)	(1.19)	(1.34)	(1.59)	(1.92)	(2.72)	(2.81)	(2.88)	(3.24)	(2.89)
Obs.	1,100	1,066	1,032	998	964	930	896	862	828	794	760
Countries	34	34	34	34	34	34	34	34	34	34	34
Expansions	94	93	92	92	92	92	91	87	86	77	73
Other assets	-0.95	-0.00	-0.16	0.71	2.68	2.48	3.36	4.47	3.36	2.61	5.74
	(0.96)	(0.81)	(1.01)	(1.14)	(1.89)	(2.07)	(2.37)	(2.76)	(3.09)	(3.62)	(3.80)
Obs.	1,100	1,066	1,032	998	964	930	896	862	828	794	760
Countries	34	34	34	34	34	34	34	34	34	34	34
Expansions	94	93	92	92	92	92	91	87	86	77	73

Effects estimated through local projections. Coefficients are multiplied by 100 for ease of interpretation (so a coefficient of 1 means a 1% increase in the variable). All regressions control for a full set of country and year fixed effects and for two (pre-treatment) lags of the dependent variable. Robust standard errors clustered by country in parentheses; $^{***}p<0.01$, $^{**}p<0.05$, $^{*}p<0.1$.

Table 7 – Dynamic effect of an autonomous demand expansion on capital stock, by component (propensity score-based model, IPWRA)

	(1) Year 0	(2) Year 1	(3) Year 2	(4) Year 3	(5) Year 4	(6) Year 5	(7) Year 6	(8) Year 7	(9) Year 8	(10) Year 9	(11) Year 10
Machinery and non-transport equipment	0.66**	0.94*	1.09	0.90	0.00	-0.88	-1.18	-0.59	-0.52	-1.10	-1.89
	(0.27)	(0.57)	(0.86)	(1.22)	(1.64)	(2.07)	(2.30)	(2.36)	(2.48)	(2.24)	(2.44)
Obs.	1,120	1,086	1,052	1,018	984	950	916	882	848	641	607
Countries	34	34	34	34	34	34	34	34	34	34	34
Expansions	121	120	119	119	119	119	118	114	113	104	100
Structures	-0.05	0.00	0.18	0.35	0.53	0.87	1.18	1.73*	2.06**	1.93**	2.51**
	(0.06)	(0.16)	(0.27)	(0.38)	(0.52)	(0.66)	(0.80)	(0.90)	(1.04)	(0.94)	(1.07)
Obs.	1,120	1,086	1,052	1,018	984	950	916	882	848	641	607
Countries	34	34	34	34	34	34	34	34	34	34	34
Expansions	121	120	119	119	119	119	118	114	113	104	100
Transport equipment	-2.21***	-2.62**	-2.22	-1.78	-1.49	-0.89	-0.81	-0.16	-0.40	-2.49	0.10
	(0.66)	(1.13)	(1.59)	(1.94)	(2.37)	(2.69)	(3.08)	(3.20)	(3.44)	(3.50)	(3.61)
Obs.	1,120	1,086	1,052	1,018	984	950	916	882	848	641	607
Countries	34	34	34	34	34	34	34	34	34	34	34
Expansions	121	120	119	119	119	119	118	114	113	104	100
Other assets	-0.77	0.48	2.29	3.34	5.42	5.32	6.11	6.89	6.60	5.05	7.80
	(0.62)	(1.58)	(2.41)	(2.90)	(3.63)	(4.10)	(4.56)	(5.11)	(5.37)	(5.88)	(5.89)
Obs.	1,120	1,086	1,052	1,018	984	950	916	882	848	614	607
Countries	34	34	34	34	34	34	34	34	34	34	34
Expansions	121	120	119	119	119	119	118	114	113	104	100

*Local projections estimated through an IPWRA model that combines propensity score weighting and regression adjustment. Coefficients are multiplied by 100 for ease of interpretation (so a coefficient of 1 means a 1% increase in the variable). See main text for description of the outcome and treatment models employed. Robust standard errors clustered by country in parentheses; *** $p<0.01$, ** $p<0.05$, * $p<0.1$.*

Table 8 – Dynamic effect of an autonomous demand expansion on key macroeconomic outcomes, controlling for pre-existing trends in productivity, REER and GDP growth (two-way FE model)

	(1) Year 0	(2) Year 1	(3) Year 2	(4) Year 3	(5) Year 4	(6) Year 5	(7) Year 6	(8) Year 7	(9) Year 8	(10) Year 9	(11) Year 10
Real GDP	0.91***	2.04***	2.60***	2.66***	2.09***	2.19***	3.13***	2.79***	2.61***	2.68***	2.75***
	(0.24)	(0.36)	(0.51)	(0.51)	(0.62)	(0.73)	(0.75)	(0.77)	(0.78)	(0.77)	(0.75)
Obs.	1,121	1,120	1,088	1,054	1,020	986	952	918	884	850	816
Countries	34	34	34	34	34	34	34	34	34	34	34
Expansions	91	90	90	90	89	89	89	89	88	84	83
Capital stock	-0.03	0.18	0.59*	0.94**	1.17***	1.40***	1.50**	2.05***	2.17**	1.90**	2.73***
	(0.07)	(0.20)	(0.31)	(0.37)	(0.40)	(0.49)	(0.63)	(0.72)	(0.81)	(0.87)	(0.93)
Obs.	1,090	1,056	1,022	988	954	920	886	852	818	784	750
Countries	34	34	34	34	34	34	34	34	34	34	34
Expansions	91	90	89	89	89	89	88	84	83	74	70
Employment	-0.04	0.29	0.76*	1.27**	0.86	0.85	1.48**	1.46*	1.55**	1.75**	2.22***
(hours worked)	(0.24)	(0.41)	(0.44)	(0.52)	(0.60)	(0.70)	(0.71)	(0.74)	(0.71)	(0.67)	(0.76)
Obs.	1,119	1,108	1,074	1,040	1,006	972	938	904	870	836	802
Countries	34	34	34	34	34	34	34	34	34	34	34
Expansions	91	90	90	89	89	89	88	87	84	83	81
Employment	0.16	0.47	0.94**	1.23**	0.82	0.83	1.27*	1.25*	1.41**	1.51**	1.31**
(persons)	(0.16)	(0.30)	(0.34)	(0.47)	(0.54)	(0.64)	(0.65)	(0.69)	(0.65)	(0.64)	(0.59)
Obs.	1,121	1,089	1,055	1,021	987	953	919	885	851	817	783
Countries	34	34	34	34	34	34	34	34	34	34	34
Expansions	91	90	90	89	89	89	89	88	84	83	74
Unemployment rate	-0.11	-0.39**	-0.61***	-0.68***	-0.23	-0.11	-0.41	-0.35	-0.37	-0.66**	-0.70*
	(0.12)	(0.17)	(0.15)	(0.17)	(0.24)	(0.32)	(0.30)	(0.29)	(0.26)	(0.31)	(0.39)
Obs.	1,092	1,061	1,028	995	962	929	896	863	830	797	764
Countries	33	33	33	33	33	33	33	33	33	33	33
Expansions	85	85	85	84	84	84	84	83	79	78	69

(continues on the next page)

Table 8 (cont.) – Dynamic effect of an autonomous demand expansion on key macroeconomic outcomes, controlling for pre-existing trends in productivity, REER and GDP growth (two-way FE model)

	(1) Year 0	(2) Year 1	(3) Year 2	(4) Year 3	(5) Year 4	(6) Year 5	(7) Year 6	(8) Year 7	(9) Year 8	(10) Year 9	(11) Year 10
Participation rate	-0.16*	-0.18	-0.04	0.11	0.17	0.28*	0.35*	0.51**	0.53**	0.46*	0.45*
	(0.08)	(0.13)	(0.15)	(0.17)	(0.19)	(0.16)	(0.19)	(0.21)	(0.24)	(0.23)	(0.22)
Obs.	1,099	1,067	1,033	999	965	931	897	863	829	795	762
Countries	34	34	34	34	34	34	34	34	34	33	33
Expansions	86	85	85	84	84	84	84	83	79	78	69
Labour productivity	0.91***	1.61***	1.79***	1.32***	1.06**	1.35***	1.46**	1.07*	0.88	0.64	0.59
	(0.18)	(0.42)	(0.50)	(0.44)	(0.48)	(0.49)	(0.56)	(0.62)	(0.66)	(0.63)	(0.69)
Obs.	1,121	1,089	1,055	1,021	987	953	919	885	851	817	783
Countries	34	34	34	34	34	34	34	34	34	34	34
Expansions	91	90	90	89	89	89	89	88	84	83	74
Long-term unemployment	-0.11	-0.28*	-0.40***	-0.46***	-0.35***	-0.10	-0.00	0.03	-0.03	-0.27	-0.37
	(0.08)	(0.14)	(0.15)	(0.13)	(0.11)	(0.18)	(0.22)	(0.23)	(0.26)	(0.28)	(0.33)
Obs.	846	817	784	751	717	685	651	619	586	554	521
Countries	33	33	33	33	33	33	33	33	33	33	33
Expansions	50	50	51	50	50	50	50	50	47	44	35
Inflation (CPI)	-0.53	-0.14	0.17	0.52	0.15	0.20	0.13	0.51**	0.43*	0.11	-0.09
	(0.31)	(0.29)	(0.25)	(0.37)	(0.31)	(0.25)	(0.19)	(0.20)	(0.24)	(0.22)	(0.20)
Obs.	1,116	1,115	1,083	1,049	1,015	981	947	913	879	845	811
Countries	34	34	34	34	34	34	34	34	34	34	34
Expansions	91	90	90	90	89	89	89	89	88	84	83
Inflation (GDP deflator)	-0.12	0.45*	0.48	0.49	-0.09	0.14	0.11	0.39	0.34	0.58*	0.29
	(0.23)	(0.24)	(0.31)	(0.39)	(0.43)	(0.35)	(0.31)	(0.24)	(0.24)	(0.32)	(0.35)
Obs.	1,121	1,120	1,088	1,054	1,020	986	952	918	884	850	816
Countries	34	34	34	34	34	34	34	34	34	34	34
Expansions	91	90	90	90	89	89	89	89	88	84	83

*See Table 4 and Appendix A1 for variables definitions. Effects estimated through local projections (see Equation 2). Coefficients are multiplied by 100 for ease of interpretation (so a coefficient of 1 means a 1% increase in the variable). All regressions control for a full set of country and year fixed effects, two (pre-treatment) lags of the dependent variable, two lags of output growth, two lags of productivity growth and two lags of the change in the real exchange rate. Robust standard errors clustered by country in parentheses; *** p<0.01, ** p<0.05, * p<0.1.*

Appendices

A1 – Data and sources

Real GDP	Gross domestic product, volume, market prices (GDPV), local currency. *Source:* OECD, *Economic Outlook No 100* (November 2016). For Germany pre-1991 (West Germany) we used GDP (constant LCU). *Source:* World Bank, World Development Indicators (WDI). Where possible, we prolonged the OECD Real GDP series by retropolating them using the World Bank World Development Indicators Real GDP series and the Penn World Tables 9.0, National Accounts Real GDP series.
Public primary expenditure	Current disbursements general government (YPG), value, local currency (the sum of final consumption expenditure (CGAA), social security benefits (SSPG), property income paid (YPEPG), other current outlays (YPOTG)); Government fixed capital formation (IGAA), value, local currency; Gross government interest payments (GGINTP), value, local currency. (Variables converted into volumes by applying the GDP deflator). *Source:* OECD *Economic Outlook No 100* (November 2016). For Germany pre-1991 (West Germany) we used Expenditure (2M), the sum of expense and the net investment in non-financial assets, minus interest expense (24). *Source:* International Monetary Fund, Government Financial Statistics (GFS).
Export	Exports of goods and services, current LCU (converted into volumes by applying GDP deflator). *Source:* World Bank, World Development Indicators (WDI).
GDP deflator	GDP deflator (2011=100). *Source:* Penn World Tables (Version 9.0), National Accounts Data. The PWT 9.0 series end in 2014. Where possible, we prolonged these series until 2015 by using the inflation rate calculated from the GDP deflator series from World Bank, World Development Indicators (WDI).
CPI	Consumer prices, all items (2010=100). *Source:* OECD (dataset: Consumer Prices).
Labour productivity	Real GDP (in constant national 2011 prices) per hour worked, calculated from the Penn World Tables (Version 9.0), National Accounts Data. We calculated total hours worked as the average number of hours worked per person engaged, times the number of persons engaged. Then we divided real GDP by the number of hours worked. The PWT 9.0 series end in 2014. Where possible, we prolonged these series until 2015 by using the productivity growth calculated from the 'GDP per hour worked' series taken from OECD dataset, *Level of GDP per capita and productivity*.
Unemployment rate	Unemployment rate (% of total labour force). *Source:* OECD, *Economic Outlook No 100(*November 2016*).* When possible, we retropolated the series using the unemployment rate series from the World Bank World Development Indicators and the ILO database.

Long-term unemployment	Long-term unemployment (% of the labour force), defined as 1 year or more. We calculated this indicator using data from OECD Labour force statistics dataset, *Incidence of unemployment by duration - 1 year and over*. The dataset provides long-term unemployment as a % of total unemployment. We multiplied this measure by the unemployment rate from the same dataset, in order to obtain long-term unemployment as a share of the labour force. Where possible, we prolonged these series by using the International Labour Organization's long-term unemployment series, retrieved from the ILO website.
Capital stock	Capital stock at constant 2005 national prices (total and components). *Source:* Penn World Tables (Version 9.0).
Reer	CPI-based real effective exchange rate, narrow index (updated 6 June 2017). *Source:* Darvas, Zsolt (2012a). Retrieved from Bruegel (http://bruegel.org/publications/datasets/real-effective-exchange-rates-for-178-countries-a-new-database/).
Employment (persons)	Number of persons engaged. *Source:* Penn World Tables (Version 9.0). The PWT 9.0 series end in 2014. Where possible, we prolonged these series until 2015 by using the series 'Total employment, domestic concept' from the OECD dataset, *Population and employment by main activity*.
Employment (hours worked)	We calculated total hours worked as the average number of hours worked per person engaged, times the number of persons engaged. *Source:* Penn World Tables (Version 9.0), National Accounts Data. The PWT 9.0 series end in 2014. Where possible, we prolonged these series until 2015 by using the series 'Total employment, hours worked, domestic concept' from the OECD dataset, *Population and employment by main activity*.
Participation rate	Labour force participation rate, aged 15–74. *Source:* OECD, *Economic Outlook No 100(*November 2016). Where possible, we prolonged these series by using the labour force participation rate series from ILO (ages 15+), downloaded from ILO website.
Real interest rate	Lending interest rate adjusted for inflation as measured by the GDP deflator. *Source:* World Bank, World Development Indicators (WDI).
Public debt	General government gross debt (% of GDP). *Source:* International Monetary Fund, Government Financial Statistics. Where possible, we prolong the public debt series by retropolating them using the following series: 'General Government consolidated gross debt (% of GDP)' from the AMECO database; 'Gross public debt, Maastricht criterion (% of GDP)' from OECD, *Economic Outlook n.100* (Nov. 2016); '*Public debt (% of GDP)*' from Reinhard and Rogoff (2010) (as processed and coded by Herndon *et al.*, 2013); 'Central Government Debt, total (% of GDP)' from the World Bank World Development Indicators.

Note: all the interpolations mentioned in this table have been performed by chaining the series using their growth rates, after having checked that the yearly growth rates of the series are very closely correlated to each other.

A2 – List of countries and episodes of autonomous demand expansion

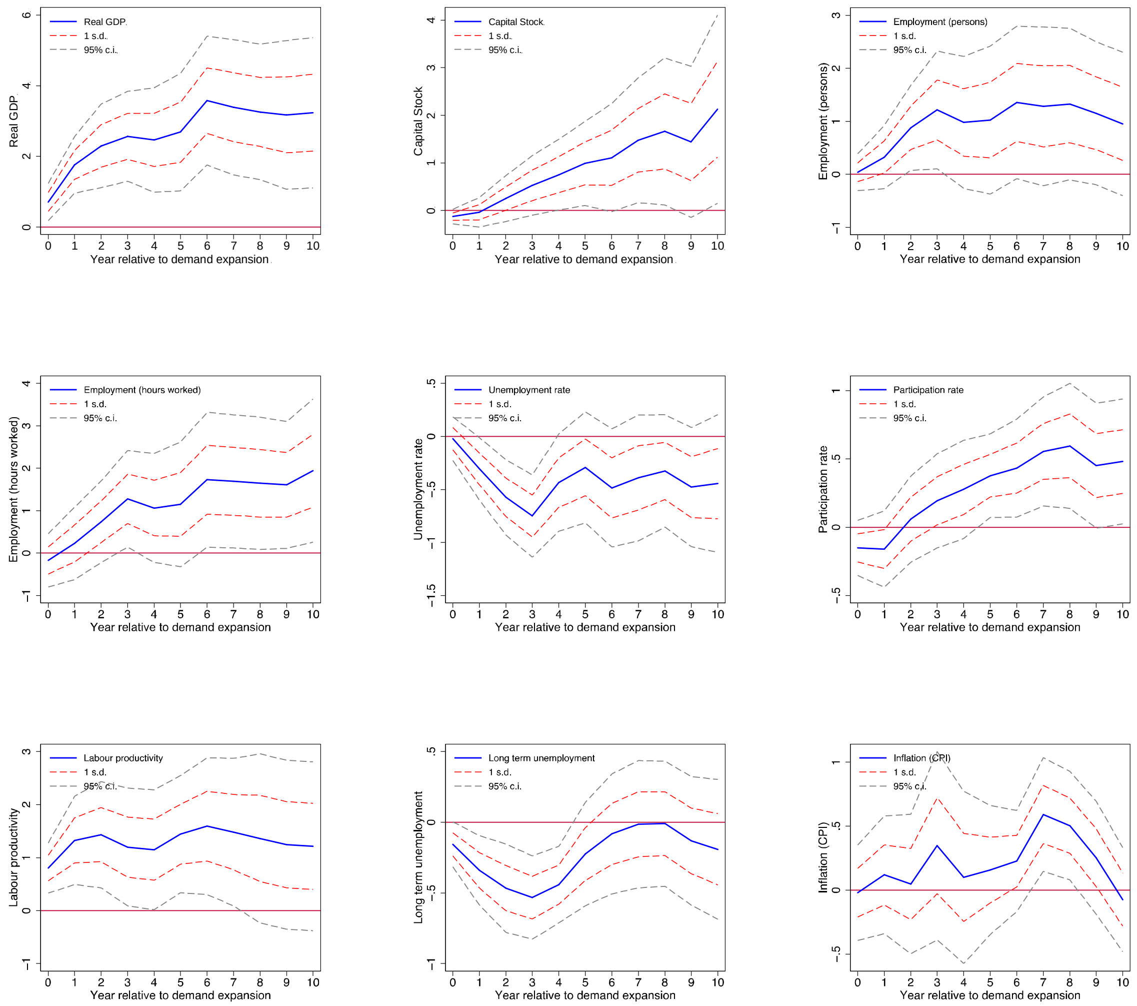
Table A2.1 – Countries in our sample

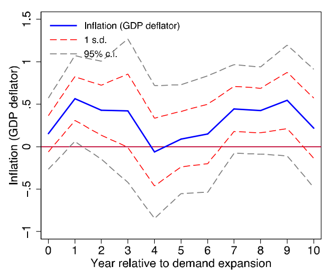
Country	OECD member in 1973	No. of expansion episodes	Non-expansion observations	Country mean of autonomous demand growth (%)	Country std. dev. of autonomous demand growth (%)
Australia	YES	3	22	3.64	2.50
Austria	YES	2	37	2.85	2.71
Belgium	YES	1	42	3.14	3.68
Canada	YES	4	40	3.24	2.63
Czech Rep.		1	19	4.53	4.68
Denmark	YES	5	37	2.74	2.75
Estonia		1	19	4.29	7.42
Finland	YES	7	47	4.00	3.32
France	YES	3	45	3.79	2.49
Germany	YES	2	22	2.52	3.06
Greece	YES	1	18	3.07	5.19
Hungary		2	18	4.65	5.55
Iceland	YES	2	32	3.64	3.92
Ireland	YES	2	23	7.31	6.10
Israel		1	15	3.24	4.00
Italy	YES	5	50	3.45	3.28
Japan	YES	4	48	4.77	4.22
Korea		5	39	8.62	6.54
Latvia		1	18	5.27	4.71
Lithuania		2	18	6.21	7.83
Luxembourg	YES	2	23	5.96	5.68
Netherlands	YES	3	42	3.23	3.41
New Zealand	YES	3	24	2.32	2.58
Norway	YES	3	32	2.75	2.25
Poland		3	17	5.47	2.26
Portugal	YES	2	34	3.80	3.75
Slovak Rep.		1	19	5.49	6.36
Slovenia		2	18	4.10	4.99
Spain	YES	3	47	4.84	3.11
Sweden	YES	3	50	3.40	3.08
Switzerland	YES	3	22	2.78	3.95
UK	YES	2	42	2.60	2.97
USA	YES	7	47	3.70	2.09
West Germany	YES	3	13	2.90	2.21
Total		**94**	**1039**		

Table A2.2 – Episodes of autonomous demand expansion in our sample

Country	**Year**	**Autonomous demand growth (%)**
Australia	1993	6.36
Australia	2000–2001	7.10–6.86
Australia	2009	8.00
Austria	1979	6.23
Austria	2000	6.41
Belgium	1972–1974	7.03–10.11–8.87
Canada	1973–1974	6.33–7.57
Canada	1978	6.17
Canada	1994	6.26
Canada	2000	7.13
Czech Republic	2005	10.53
Denmark	1974	8.88
Denmark	1979-1981	7.87–6.58–5.56
Denmark	1994	6.22
Denmark	2000	7.90
Denmark	2006	5.65
Estonia	2005	12.86
Finland	1964	7.85
Finland	1968–1969	7.44–9.04
Finland	1972	10.50
Finland	1974	8.79
Finland	1977	8.14
Finland	1979	7.67
Finland	1992	7.48
France	1961–1965	6.74–6.75–6.60–7.43–7.31
France	1970	6.82–7.95–7.33
France	1973–1974	8.20–10.26
Germany	2000	6.96
Germany	2006	6.31
Greece	1999–2000	10.84–11.87
Hungary	2000	14.14
Hungary	2006	15.27
Iceland	2001	10.84
Iceland	2008	13.87
Ireland	1995	13.58
Ireland	2000	15.03
Israel	1999–2000	7.89–10.01
Italy	1962	8.01
Italy	1965	10.37
Italy	1968	10.75
Italy	1974	7.66
Italy	1976	6.99
Japan	1962	12.83
Japan	1964–1966	11.41–10.79–10.65
Japan	1968–1969	13.44–12.39
Japan	1974	14.12
Korea	1972-1973	17.33–29.77
Korea	1976	17.19
Korea	1986	15.93
Korea	1998	19.42
Korea	2008	19.91
Latvia	2004-2005	12.90–14.91
Lithuania	1997	15.55
Lithuania	2005	15.33
Luxembourg	1998	11.73
Luxembourg	2000	17.32
Netherlands	1973-1974	7.33–9.44
Netherlands	2000	9.49
Netherlands	2006	6.75
New Zealand	1999-2000	6.91–7.43
New Zealand	2006	6.63
New Zealand	2008	6.79
Norway	1979-1980	6.71–6.81
Norway	1989-1990	5.99–6.07
Norway	1996	5.84
Poland	1997	7.77
Poland	2003	9.28
Poland	2006	10.60
Portugal	1978-1980	9.50–15.69–9.90
Portugal	1989	9.54
Slovak Republic	2006	15.76
Slovenia	2000	11.17
Slovenia	2006	10.01
Spain	1966	10.79
Spain	1968–1969	12.01–11.51
Spain	1971	11.07
Sweden	1963-1964	9.66–8.19
Sweden	1968-1969	8.28–7.33
Sweden	1974	11.99
Switzerland	2000	8.15
Switzerland	2007	8.10
Switzerland	2013	6.75
United Kingdom	1973–1974	9.74–11.54
United Kingdom	2006	7.36
United States	1961	6.02
United States	1966–1967	8.63–7.78
United States	1970	6.81
United States	1974	6.52
United States	1980	6.31
United States	1992	5.87
United States	2008	6.86
West Germany	1976	5.14
West Germany	1980	5.42
West Germany	1990	6.06

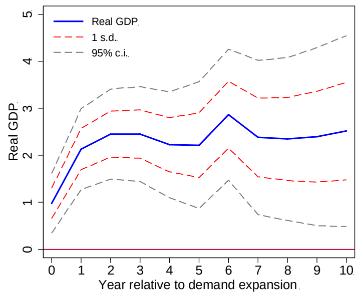
A3 – Dynamic effect of an autonomous demand expansion on key macroeconomic outcomes, controlling for time-varying differential trends between mature and emerging economies (two-way FE model)



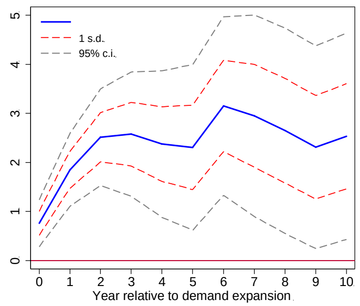


The graphs display impulse-response functions for the effect of an autonomous demand expansion on various macroeconomic outcomes. They are obtained through local projections, controlling for a full set of country and year fixed effects, two lags of the dependent variable, and a full set of interaction terms between year dummies and a dummy that identifies mature (as opposed to emerging) economies on the basis of OECD membership in 1973. Years relative to the demand expansion on the horizontal axis. Percentage points on the vertical axis.

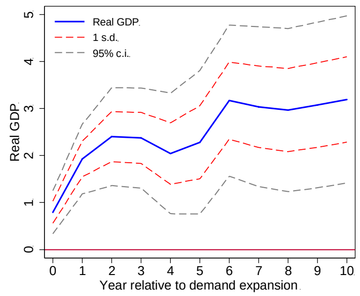
A4 – Dynamic effect of an autonomous demand expansion on output, robustness to different criteria for defining expansions



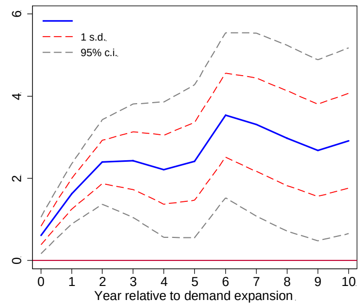
(a) alternative criterion 1 (FE model)



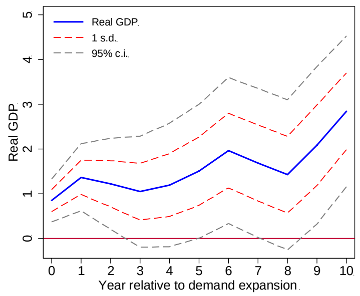
(b) alternative criterion 1 (IPWRA model)



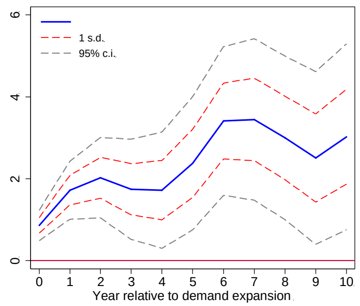
(c) alternative criterion 2 (FE model)



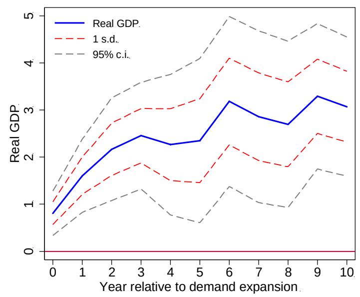
(d) alternative criterion 2 (IPWRA model)



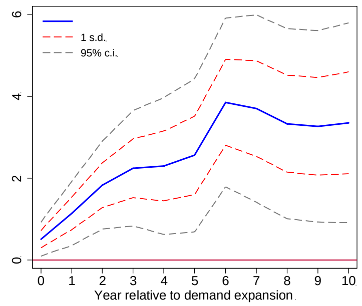
(e) alternative criterion 3 (FE model)



(f) alternative criterion 3 (IPWRA model)



(g) alternative criterion 4 (FE model)



(h) alternative criterion 4 (IPWRA model)

IRFs obtained through local projections. Years relative to the demand expansion on the horizontal axis. Percentage points on the vertical axis. FE model = two-way fixed-effects model; IPWRA model = inverse propensity score-weighted regression adjustment.

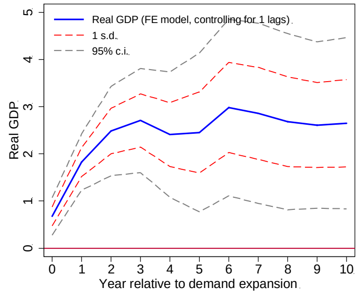
Alternative criterion 1: autonomous demand growth 1sd above country mean; no restriction on previous years.

Alternative criterion 2: autonomous demand growth 1sd above country mean; not lower than 0.25 times the country mean in the previous two years.

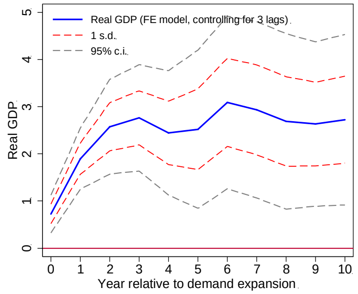
Alternative criterion 3: autonomous demand growth higher than 1.5 times the country mean; not lower than 0.5 times the country mean in the previous two years.

Alternative criterion 4: autonomous demand growth 0.85sd above the country mean; not lower than 0.5 times the country mean in the previous two years.

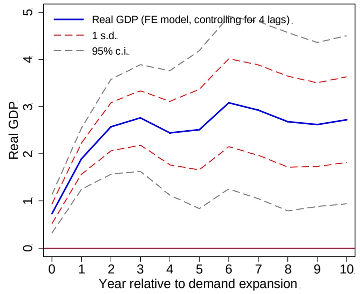
A5 – Dynamic effect of an autonomous demand expansion on output, robustness to different lag lengths



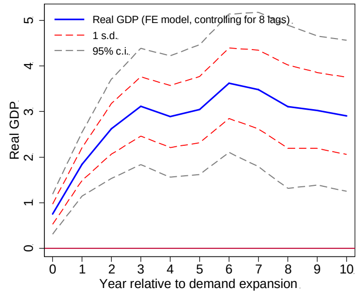
(a) controlling for 1 lag of GDP growth (FE model)



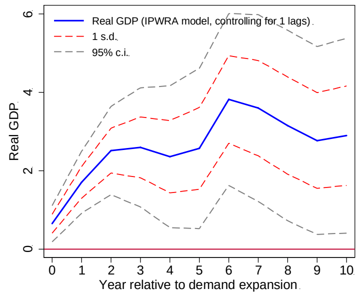
(b) controlling for 3 lags of GDP growth (FE model)



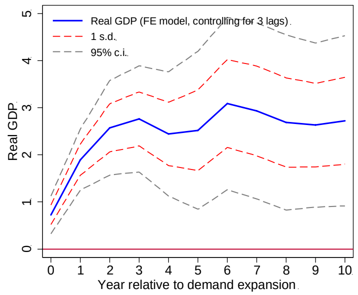
(c) controlling for 4 lags of GDP growth (FE model)



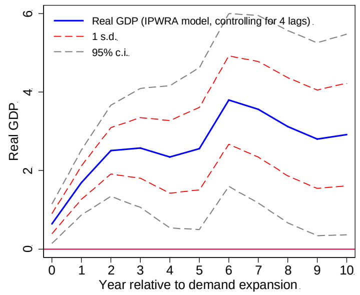
(d) controlling for 8 lags of GDP growth (FE model)



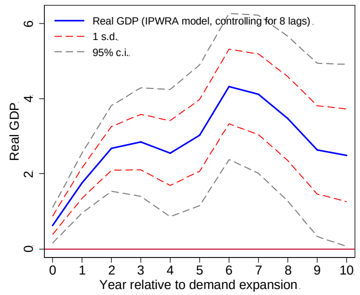
(a) controlling for 1 lag of GDP growth (IPWRA model)



(b) controlling for 3 lags of GDP growth (IPWRA model)



(c) controlling for 4 lags of GDP growth (IPWRA model)



(d) controlling for 8 lags of GDP growth (IPWRA model)

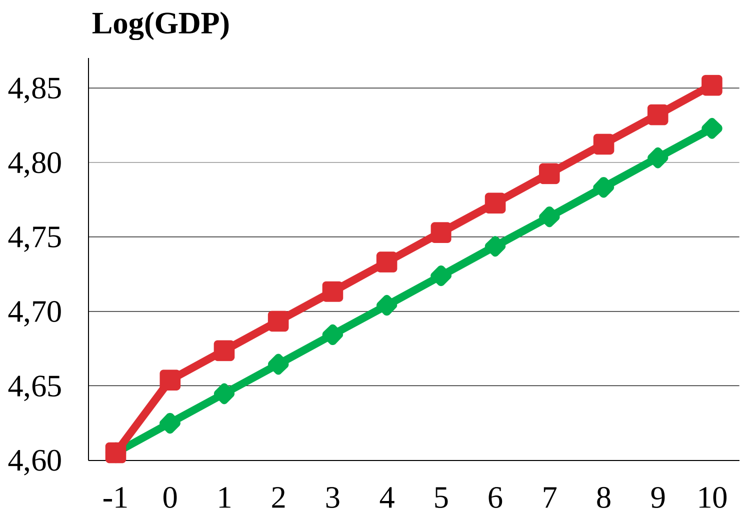
Impulse-response functions obtained through local projections. Years relative to the demand expansion on the horizontal axis. Percentage points on the vertical axis.

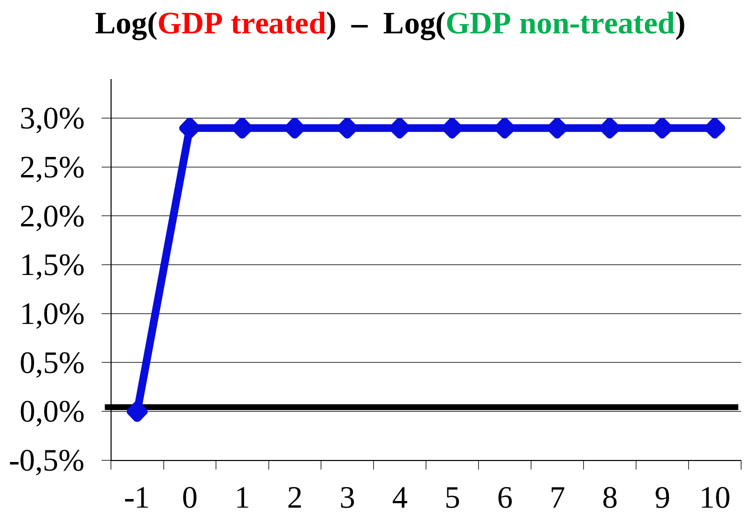
FE model = two-way fixed-effects model; IPWRA model = inverse propensity score-weighted regression adjustment.

NON-TECHNICAL ANNEX

How to look at our figures?

In order to assist in interpretation of our figures, we provide a simple numerical example. Let us consider two economies (A and B) with the same level of real income at time t=-1 ($GDP_{A,-1}$ = $GDP_{B,-1}$ = 100, and hence log[$GDP_{A,-1}$] = log[$GDP_{B,-1}$] ≈ 4,61). Then, let country A (**treated**) experience a 5% real growth in t=0 due to an autonomous demand expansion, while country B (**non-treated**) grows at 2% ($GDP_{A,0}$ = 105 and hence its log is around 4,65; $GDP_{B,0}$ = 102 and hence its log is around 4,62). Both economies then grow at 2% in each period *t+h* (with h =1, ..., 10). Accordingly, the left figure shows the dynamics of log(GDP) in **treated** and **non-treated** economies (the red and the green line, respectively), while the right figure depicts the gap in their levels (i.e., the blue line depicts the gap between the red and the green line at any time horizon).





After the autonomous demand shock, if **treated** country GDP had continued to grow at the same rate as in the **non-treated** country, a permanent shift in its GDP trajectory would have occurred. That's what we call long-term (or persistent) **level effect** on GDP of a *one-off* autonomous demand expansion. Basically, all graphs reported in this paper – also with respect to other macroeconomic outcomes – can be interpreted as the right figure above (i.e., the blue line).