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Productivity Gains from Labour Churning in Economic Crisis: Do Foreign Firms Gain More?

Liis Roosaar
Urmas Varblane
Jaan Masso
School of Economics and Business Administration, University of Tartu, Estonia

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ABSTRACT

The purpose of this paper is to clarify whether domestic or foreign firms gained more from labour churning while adjusting to the Great Recession in Estonia. During times of high unemployment, all firms can raise their requirements for new employees, but in times of crisis foreign firms may have more resources available for restructuring. We analysed matched employee-employer data from Estonian firms from 2006 to 2013, and show that an increase in labour churning is related to a positive change in labour productivity during economic crisis. During boom years churning is related to a negative change in labour productivity. In both cases a slightly upward convex pattern can be noticed. Only in services during the crisis did foreign firms have a stronger positive relationship between labour churning and labour productivity changes than domestic firms. However, our analysis at the individual level does not confirm that during a crisis foreign firms hire more employees with characteristics that have been found to be related to productivity increases. We also show empirically that hiring employees who relatively often change jobs is negatively related to changes in labour productivity. In light of the world-wide virus-related crisis of 2020, this paper proves that economic downturns can be a good opportunity to restructure the pool of employees.

JEL Classification: J24, J63, L60, L80, M51

Keywords: labour productivity, labour churning, economic recession/crisis, Estonia

[1] Liis Roosaar, PhD Student, Junior Research Fellow, University of Tartu, School of Economics and Business Administration, Narva mnt 18, Tartu, 51009, Estonia. E-mail: Liis.Roosaar@ut.ee

Urmas Varblane, Professor of International Business, Head of the Chair of International Business and Innovation, School of Economics and Business Administration, University of Tartu, Estonia; E-mail: Urmas.Varblane@ut.ee

Jaan Masso, Senior Research Fellow, University of Tartu, School of Economics and Business Administration, Estonia. E-mail: Jaan.Masso@ut.ee

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1. INTRODUCTION

Labour flows can be one of the sources of a firm's productivity growth. It has been shown that employee movements from foreign firms increase productivity in the receiving domestic firms (Görg and Strobl, 2005; Masso & Vahter, 2019). In general, hiring employees from more productive firms also increases productivity in the receiving firms (Stoyanov & Zubanov, 2012). The effect appears to be larger if the moving employees have higher levels of human capital; for example, they are managers and high-wage employees (Masso & Vahter, 2016) or highly skilled workers (as in Stoyanov & Zubanov, 2012). Additionally, the timing of the labour flows is important because in a crisis resources are usually shifted away from low-productivity producers towards high-productivity producers in accelerated productivity-enhancing reallocation (Foster et al. 2014). Foreign firms have been shown to be more productive than domestic firms in CEE countries (Meriküll & Rõõm, 2014). Moreover, in some cases during an economic crisis foreign firms have been shown to slow down the country's general output decline and employment contraction (e.g. in Athukorala, 2003 and Lipsey, 2001). In order to clarify the role of foreign firms in the host country during a crisis, we investigate whether during economic recession human resources (through labour flows) may shift to foreign firms due to foreign firms' ability to hire more productive employees from the labour market. That would leave domestic firms (that more often represent low-productivity firms) in a less favourable position in terms of labour.

In this paper we analyse data from Estonia. The case of Estonia for such a study is especially interesting, as it is a small country with an open economy that experienced one of the deepest declines in GDP in the EU (and in the whole word) during the recession of 2008–2009. In 2009, the unemployment rate in Estonia was the third largest in the EU: according to Eurostat, the unemployment rate in Estonia was 13.5 per cent in 2009 and the decline of GDP valued at 14.7 per cent. However, already in 2011, Estonia was the fastest in the whole EU in increasing the number of employed people and decreasing the unemployment rate (Marksoo, 2012). Unlike many other countries, public expenditure was not increased in Estonia and fiscal consolidation was chosen instead (Raudla & Kattel, 2011). Moreover, due to the application of a currency board system, the role of monetary policy as an adjustment tool during the economic crises was limited in Estonia (Varblane 2017). Therefore, most of the adjustment had to take place in the labour market. The adjustment strategy was also affected by labour market institutions: as in 2009, the adjusted collective bargaining coverage rate was only 24% in Estonia (Visser 2015), thus lowering individual wages was possible. The cost of terminating an employment relationship was also reduced in the labour legislation reform of 2009 (Malk, 2014), though most of the lay-offs had already taken place before that. With the separation rate increasing by 10 per cent and hiring rate decreasing by only about one per cent in the period 2008–2010 (Masso & Krillo, 2011), employment changes may have played an important role in firms recovering from the crisis. The rather large share of foreign owned firms in Estonia makes the crisis years in Estonia a perfect example for analysing the differences between foreign and domestic firms. In 2013, the stock of FDI in Estonia reached 85% of GDP, one of the three highest shares in CEE countries (Jude & Silaghi, 2016). In 2017, according to the OECD (2017), foreign owned firms directly supported 38% of private sector jobs in Estonia and 41% of value added.

The aim of this paper is to find out whether labour churning – labour flows in excess of employment change – could have had a role in firms adjusting during the crisis and whether (in terms of labour churning) foreign owned firms (hereafter foreign firms for simplicity) have

had advantages in the crisis compared to domestic firms. First, we check whether labour flows in excess of the level needed for employment change (measured using labour churning) were related to productivity growth in the Great Recession in Estonia. Second, we compare foreign firms and domestic firms to find out differences in the relation between productivity growth and labour churning between the two types of firms. We also compare the manufacturing and services sectors. We measure labour flows on the basis of labour churning rates. Churning is the difference between worker flows and job reallocation including only hirings and separations that compensate each other. This enables us to analyse whether the change in firm productivity could be related to hiring more productive employees instead of less productive ones, those who left or were fired by the previous employer. Finally, we move from firm-level analysis to the level of individuals to ascertain whether foreign and domestic firms hire different employees in an economic crisis.

Churning in a crisis has been analysed before (e.g. in Askenazy & Erhel, 2015), but without specific attention on the differences between foreign and domestic firms. Many papers exploring foreign and domestic firms in times of crisis have been written comparing, for example, performance (Alfaro & Chen, 2012; Bykova & Jardon, 2017; Georgopoulos & Glaister, 2017; C.-C. Lee, Chen, & Ning, 2017), employment growth (Alvarez & Gorg, 2007), firm survival (see extensive overview in Wagner & Gelübcke, 2012) and so on, but their focus has not been on churning. Yet another strand of literature deals with employment effects related to acquisitions of domestic firms by foreign firms. Usually, the effect of crises is omitted in these papers, while employment is analysed in more detail, for example, in terms of skills and education (Bandick & Karpaty, 2011 or Jude & Silaghi 2016). To the best of our knowledge the current paper is the first to compare churning of employees in foreign and domestic firms. We are also not aware of other research that compares churning in different business cycle phases in services as well as manufacturing.

Foreign firms in this paper are defined as firms where the sum of shares held by Estonian shareholders is less than 50% to ensure that the foreign owners fully control the company. Data from the Estonian Tax and Customs Office on employee payroll taxes for 2006–2013 have been matched with Estonian Commercial Registry financial data from the annual reports of all firms in Estonia. The period 2006–2013 includes all the phases of a business cycle – rapid economic growth (2006-2007), deep recession (2008-2009) and a recovery phase (2010-2013). Ordinary least squares (OLS) models are used to show the relationship between churning rate and changes in labour productivity. To check the robustness, a new sample is formed with propensity score matching to create a pool of domestic firms similar to foreign firms. In addition to firm-level analysis, we also analyse data on individual employees. We compare the characteristics of employees hired in foreign firms and in domestic firms during the three phases of the business cycle. Probit models are constructed for the three periods representing different phases of the business cycle in manufacturing and services to estimate the employee's probability of being hired by a foreign firm versus being hired by a domestic firm.

We show that labour churning in a crisis is related to gains in labour productivity, while labour churning during boom years is related to negative changes in the labour productivity indicator. However, only in services is labour churning during a crisis more beneficial for foreign firms compared to domestic firms. At the same time, we cannot show that foreign firms in services have the chance to hire potentially more productive employees. The latter can be shown rather in manufacturing, where the relationship between churning and productivity is not statistically significantly different between foreign and domestic firms.

The rest of the paper is organised as follows. The theoretical framework and hypotheses are introduced in the next section. Section 3 presents background, data and methodology. Section 4 describes the empirical results and the last section concludes.

2. HYPOTHESES FORMULATION

Labour churning, according to the most general definition, is the difference between worker flows (sum of hiring and separations) and job reallocation (absolute value of the difference between hiring and separations) (see Figure 1) (Burgess et al. 2000). As an advantage, compared to the simple labour turnover indicator (hirings minus separations), labour churning only considers replacement hirings that do not change the total number of employees in the firm. Churning can be positively or negatively related to labour productivity. On the one hand, firms may initiate churning to improve the quality of their workforce. On the other hand, labour churning may be initiated by employees if they search for better employment opportunities (Bachmann et al. 2017). While churning initiated by the firm presumably increases the labour productivity of the firm, churning initiated by employees may more often result in rather productive employees leaving the firm. In both cases, the most important question is whether the employees who leave the firm are on average less productive or more productive than the new recruits. The productivity of new recruits is partly related to the labour market situation and the number of candidates who are interested in the vacancy. Hochmuth et al. (2016) have shown that the number of suitable applicants is negatively correlated with GDP and positively correlated with unemployment. Hence, the phases of the economic cycle should have an effect on the relationship between churning and labour productivity.

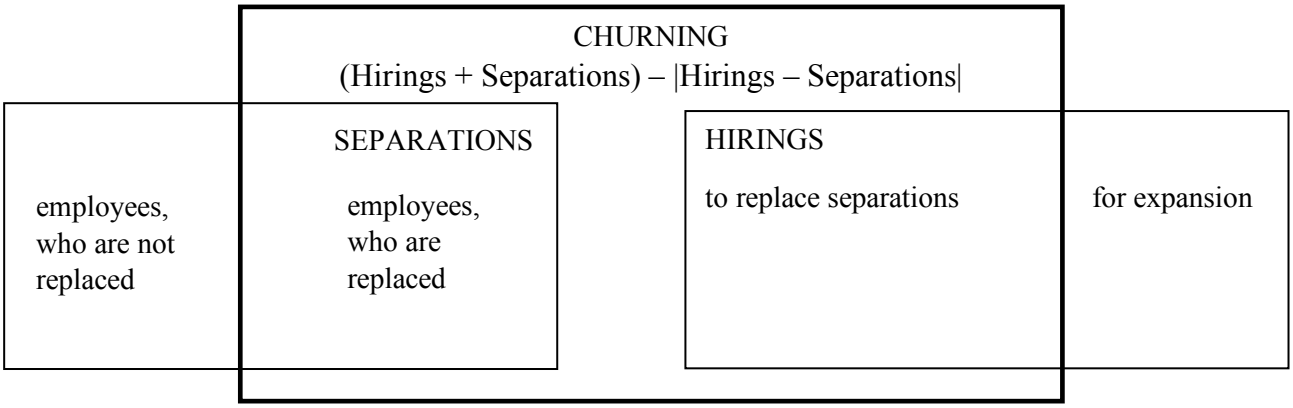

Figure 1. Labour churning, separations and hirings

Source: own elaboration based Burgess et al. (2000)

The excessive mobility of employees has been deemed disruptive in all cases because it is costly for the firm and stressful for the people who churn (Ettlie, 1985). Therefore, the relation between churning and productivity is assumed to take on an inverse U shape. The positive relationship between churning and change in total factor productivity[2] has been shown by

[2] In the current paper we have chosen to use labour productivity growth as a productivity measure instead of the total factor productivity growth. According to Sargent and Rodriguez (2001) labour productivity is a better indicator of the two if the analysis includes shorter periods (less than ten years), and we have seven years in the whole sample. The authors also indicate that the changes in the capital capacity utilisation usually cannot be

Ilmakunnas et al. (2005), but they did not include the squared term of churning in their model. Furthermore, the upward convex (or in other words downward concave) relationship between innovation and churning of R&D employees has been established by Müller and Peters (2010), while the relationship between any type of innovation and productivity has been shown to be positive (Mohnen & Hall, 2013). Therefore, based on these two results a similarly convex (curving upward) relationship could be expected to exist between churning of employees in general and labour productivity. Due to the pervasiveness and persistence within employers, Burgess et al. (2000) have suggested that labour churning is related to an equilibrium personnel policy. Ilmakunnas and Maliranta (2005) have shown that the churning rate increases with plant size and high-wage plants seem to be more able to limit excessive turnover compared to low-wage plants.

In an economic crisis, the relationship between churning and productivity can change because of changes in the environment. In general, an economic crisis can be defined as an unanticipated significant downturn in the economy (S.-H. Lee & Makhija, 2009). Different types of financial crises include for example sovereign defaults, banking crises and exchange rate crises (Reinhart & Rogoff 2009). As a consequence, firms have to adjust to unpredictable shifts in the level of demand as well as in the relative costs of inputs (Kogut, 1991). Firms can adjust through different mechanisms. It has been shown that 25% of innovation projects were stopped because of the crisis in eight Latin American countries in 2008–2009 (Paunov, 2012). Furthermore, decisions related to capital structure can be influenced by an economic crisis (Iqbal & Kume, 2014). Similarly, labour adjustments can be initiated in a crisis. On the one hand, labour adjustments may include internal flexibility measures (redeployment, working-time adjustments and changes in wage systems) that retain skill, but on the other hand, there are external flexibility measures that involve the labour market outside the firm and changes in the number of employees (Svalund, 2015). External labour adjustments are also likely to change the skill composition of employees in the firm.

During periods of economic crisis, the volume of the labour market outside the firm increases due to higher unemployment, and consequently firms can increase their skill requirements (Reder, 1955). Loose labour markets have been shown empirically to raise employer requirements in terms of education and experience (e.g. in Modestino et al., 2015). Devereux (2002) has found that increases in unemployment are related to rising education levels among new recruits, although he specifies that the effect is more noticeable in lower-paying occupations. This may mean that firms deliberately fire employees to hire more productive employees instead. In recessions, the reorganisation of work processes is relatively cheaper because demand and production are low. As a result, the opportunity cost related to the profit that remains unearned is lower due to using capital or labour resources in productivity-enhancing activities (Hall, 1991). Therefore, churning labour during an economic recession could be one such productivity-enhancing activity.

H1: Labour churning during an economic crisis has a stronger positive relationship with the productivity of firms than during boom or recovery periods.

During recessions there are more job destructions and a larger flow of employees into unemployment (Pissarides, 2000). According to the cleansing effect, this is the moment where labour market creative destruction cleanses the economy from the most inferior matches

adjusted for and this results in a procyclical bias in TFP. The current paper aims to compare different business cycle phases and such a bias might lead us to wrong conclusions.

(Schumpeter, [1943] 2003). However, empirical results have indicated that cleansing does not always take place in times of crisis. By comparing labour reallocation in the manufacturing sector in several crises, Foster et al. (2016) conclude that the intensity of reallocation in the Great Recession was lower than during previous crises. At firm level, Hallward-Driemeier and Rijkers (2013) have shown that the East Asian crisis in 1997 also did not improve the reallocation process in Indonesia. Domini and Moschella (2018) indicated results inconsistent with the cleansing hypothesis in the recent global crisis. The cleansing effect has been shown to compete with and to be dominated by sullying and scarring effects in crisis periods (Barlevy, 2002; Ouyang, 2009). Sullying means that the relatively smaller number of vacancies created in a crisis lead to more employees staying in mediocre matches and the number of high-quality matches remains relatively smaller (Barlevy, 2002). Scarring may take place in a crisis because potentially productive firms do not have time to learn about their full potential and they exit the market, although without the crisis the firms would have been successful (Ouyang, 2009).

Foreign firms in this context are of interest because they are usually more productive than domestic firms within the same industry (Meriküll and Rõõm, 2014). If cleansing takes place during a recessionary period, resources should move to foreign firms. In economic recessions, foreign firms also have the option of transferring production facilities internationally and simply exiting the host economy in case of difficulty (Alvarez and Görg, 2007). However, such behaviour is rather unlikely as sunk costs related to investing abroad may hinder acting aggressively to short-term changes in economic conditions (Varum and Rocha 2011). To start international production, firms must perceive advantages that compensate for the (sunk) costs of setting up and operating a foreign operation (Dunning, 1988). As foreign firms are active on international markets, they may be less reliant on local markets (Alvarez and Görg, 2007). Foreign firms can have market information, distribution channels and international marketing skills that help them switch markets in turbulent times. When foreign firms experience a credit crunch in the host country they may obtain financing from international capital markets or receive credit from affiliated firms (Athukorala, 2003). In the economic crisis of 2009, the negative demand shock was indeed accompanied by a remarkable credit crunch (Fabiani et al. 2015). While these advantages can help foreign firms overcome the crisis more easily, they also make foreign firms more likely to restructure their labour and hire new employees during recessionary periods.

H2: The positive relationship between labour churning and labour productivity is more evident in foreign firms than domestic firms.

Many papers only analyse resilience in a crisis for the manufacturing sector (e. g. Alvarez & Gorg, 2007), but in the current paper the relations between productivity and labour churning in services and manufacturing will be compared. Burger et al. (2014) have shown that in the first year of a recession the employment cuts in services were greater than in manufacturing in the nine CEE countries that formed their sample. In manufacturing, imports and exports have been shown to help overcome the difficulties in recessions (e.g. Wagner & Gelübcke, 2012), but they may be less important in services. Traditionally, services have been believed to not have physical substance – services are intangible, their consumption and production cannot be separated and they cannot be stored for periods of higher demand (Zeithaml et al. 1985). This means that in the services sector, multinational enterprises have to deliver their activities close to their consumers, and their home-region orientation is stronger than in manufacturing (Rugman & Verbeke, 2008). Nevertheless, foreign-tradable services can be distinguished – their product is separable from the production process and it is transportable across national boundaries (Boddewyn et al., 1986). Information and communications technology (ICT), for example, makes it possible to trade services across telecommunication networks and store the

services in a tangible form such as a computer disk; services that are produced in the home country may also be delivered via subsidiaries in the host countries (Roberts, 2018). Therefore, in services, foreign firms can have advantages in an economic crisis as their service is probably more often foreign-tradable than that of smaller domestic firms. Such a quality of the service of foreign firms may be one reason why the firm can move to the host country in the first place.

H3: During an economic crisis, foreign firms in services as well as in manufacturing have advantages compared to domestic firms, and these advantages also appear in the relationship between labour churning and labour productivity.

Foreign firms and domestic firms compete for skilled employees in the labour market (Hale, Long 2011). Based on data from 1991 to 2000, the higher wage level in foreign firms in Portugal has been shown to be related to a selection effect; employees that were hired to foreign firms already earned higher wages, on average, in the domestic firms compared to other "similar" employees (Martins, 2011). In addition to hiring *ex ante* better employees, better training has been shown to partially explain the wage difference in the two types of firms. Positive gains for employees from working in the foreign firms may more specifically result from new know-how and competencies, higher-quality services and best practices internationally (Mariotti et al. 2015). Poole (2013) indicates that foreign firms may also have superior managerial practices, process innovations, and use high-quality intermediate inputs. These advantages may attract a relatively larger pool of unemployed people to apply for the positions in foreign firms. The larger the pool of applicants, the better the match is expected to be. In addition, the criteria for the new recruits can be stricter. As a result, the foreign firms may be able to hire more productive employees from the labour market.

The relative productivity level of newly hired employees can be evaluated based on their characteristics. Hiring employees with greater human capital is related to larger productivity gains (shown e.g. in the case of managers vs lower ranking occupations in Mion & Opromolla 2014). Due to the ageing population, the age-productivity curve of employees has gained a lot of attention in most countries (for an overview, see Skirbekk, 2004). Hiring employees aged 31–50 has been shown to have a larger positive effect on labour productivity than hiring younger or older employees (Roosaar et al., 2019). Higher gains may also result from the experience that the hired employees have had in other firms. For example, employees who have been exposed to educationally diverse workforces significantly increases the productivity of the hiring firms (Marino et al 2016). Masso and Vahter (2019) indicated that the prior work experience of high-waged employees in multinational enterprises was related to increases in productivity for their new domestically-owned employer. Similarly, the share of employees with MNE experience was positively related to the productivity of firms in Balsvik (2011) and the gain at the individual level was smaller than the firm-level gain. According to Stoyanov and Zubanov (2012), hiring from more productive firms is related to the productivity gains of the hiring company. In exporting firms, employees can gain knowledge of specific international markets and export operations that may be helpful in the firm that hires the employee next (at managerial level, the positive relation is shown in Sala & Yalcin, 2015)

H4a: Employees with characteristics that have been shown previously to be related to the higher productivity of firms have a higher probability of being hired by a foreign firm compared to a domestic firm.

H4b: For employees with characteristics that have been shown previously to be related to the higher productivity of firms, the probability of being hired by a foreign firm increases in an economic crisis compared to other phases of the business cycle.

3. DATA AND METHODOLOGY

3.1 Background: the boom-bust cycle in Estonia

In our sample, 2006 and 2007 are boom years with economic growth of 10.3% and 7.7% respectively. Joining the European Union in 2004 brought better access to the EU market for Estonia as well as the other new EU member states, increasing investment activity among foreign investors as well as access to EU structural funds (Varblane, 2017). EU accession also brought a lending boom among Scandinavian banks that under-estimated the risks of loans to Estonian branches while assessing the country's growth prospects too optimistically (Brixiova et al. 2010). Based on Reinhart and Rogoff (2009), no crisis is essentially different to any others, and there are classic symptoms referring to an upcoming crisis. For the crisis in Estonia, one of these symptoms could have been the fact that the rapid growth of GDP in Estonia was mainly caused by an increase in Estonian domestic demand fuelled by growing external debt (Varblane, 2017).

When the Nordic banks tightened lending conditions in late-2007, the credit crunch led to a slump in real estate prices, which first caused a decline in output and jobs in construction, but later spilled over to other sectors (Brixiova et al., 2010). Jannsen (2010) has shown, based on data from 12 European countries from 1970–2004 that housing crises usually initiate an enduring recession with a significant loss in output. In Estonia, the housing crisis was followed by the global recession. In 2008, the decline in GDP in Estonia was 5.4%, but in 2009, the decline was even deeper reaching 14.7%. According to World Bank data (2020), the GDP decline was only greater than 14% in six countries in the world in 2009. Therefore, 2008 and 2009 represent years of crisis in our sample. The number of employed decreased, and the unemployment rate rose to 13.5% in 2009. The decrease in demand had a greater effect on manufacturing, construction and trade. Survey results reveal that significant reductions in labour inputs or alterations in the labour composition were needed in approximately 54% of firms in general. On average, 16% of firms had to freeze wages and 33% of firms had to cut wages in the period 2008–2013 (Malk, 2015). The reduction in working hours and wages partly helped to avoid an even greater decrease in the labour force (Viilmann and Soosaar 2012).

During the period 2010–2013, GDP growth was positive again but compared to the economic boom years, the positive level was lower (about 4% on average). Therefore, in our sample, this is considered a recovery period. In addition, a strong fiscal position helped to restore financial market confidence (Varblane, 2017). On 1 January 2011, Estonia adopted the euro – compliance with all the Maastricht criteria had been achieved at the end of 2009.

3.2 Data

Data on the wages of individual employees from the Estonian Tax and Customs Office have been matched with firm-level information from the Estonian Commercial Registry for the period of 2006–2013. We only consider monthly wage data from January each year and only the wage from each employee's main job. In addition, information on employee education has been taken from The Estonian Population and Housing Census 2011 at Statistics Estonia. Detailed data on ownership (e.g. country of origin of foreign owners) are taken from Statistics Estonia's Statistical Profile for Enterprises 2006–2013. Based on quarterly wage data from Statistics Estonia in the first quarter of each year for 2006–2013, the nominal wage was the lowest compared to the average wage in other quarters of the same year (only 2009 is exceptional).

The second and third quarter of the year include the summer months and the wage data would be distorted by holiday payments or the wages of seasonal workers. January is a "full month" of 31 days and all new regulations usually enter into force in this month (e.g. minimum wage, changes in individual taxation etc).

Foreign firms in this paper are defined as firms where the sum of shares held by Estonian shareholders is less than 50%. We analyse firms in services and manufacturing separately to compare the results of the two sectors. Firms in agriculture, real estate and financial intermediation are excluded from the analysis. According to the theory of the multinational enterprise (MNE), performance gaps that are usually attributed to foreign ownership are due to being multinational rather than the nationality of the firm (Bellak, 2004). Therefore, a large share of domestic multinationals among the group of Estonian firms might result in biased estimators. Unfortunately, it is not possible to identify domestic MNEs in the Estonian Business Registry data that we use for our study. Nevertheless, the number of domestic multinationals in Estonia is small. In 2016, the percentage of firms with outward foreign direct investment was only 0.9 in manufacturing and 0.6 in business services, yet as they are larger than average firms, their employment share was 9.8% in manufacturing and 8.4% in business services (own calculations from Estonian firm-level datasets).

Figure 2 indicates that during the crisis the number of employees decreased in manufacturing and by 2013 had not returned to the initial level of 2006. Real wages decreased slightly in 2010 (below the level of 2008 only in domestic firms) but continued growing in 2012 compared to the year before. Value added decreased during the crisis in 2008 and 2009, but as opposed to wages, there was a slight decrease also in 2012. While value added for foreign firms in manufacturing returned to the level of 2006 at the end of the period, the average value added for domestic firms remained below the initial level.

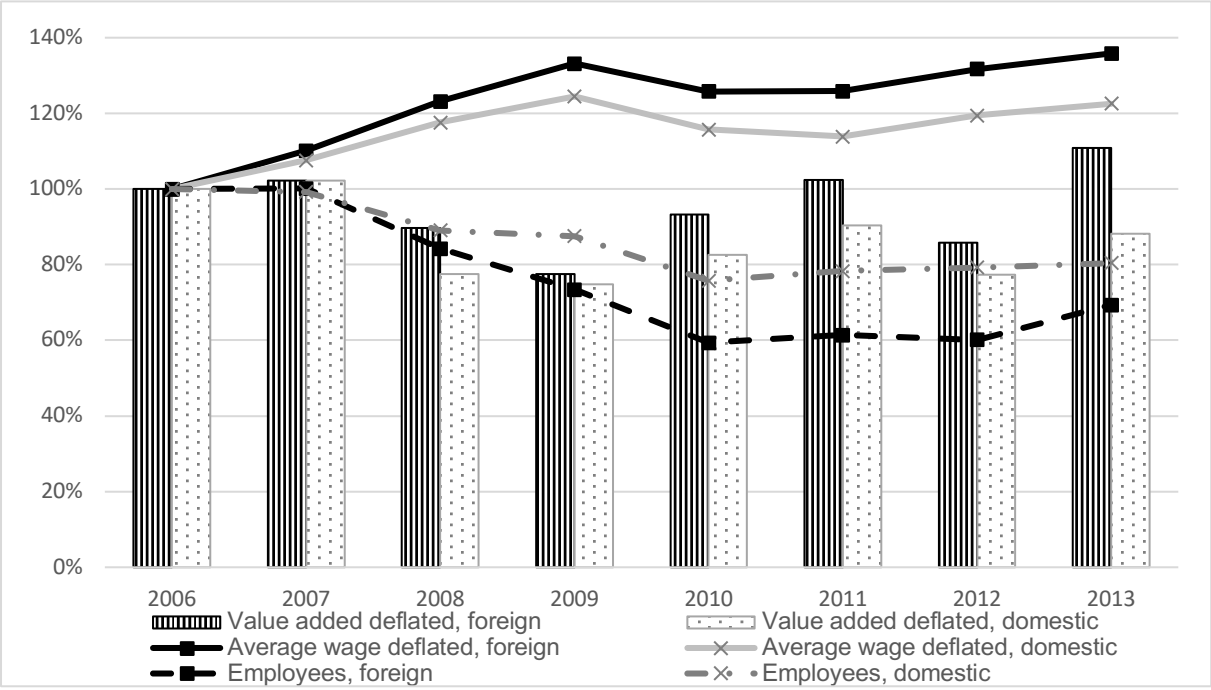

Figure 2. Total employment, real value added and average real wage, foreign and domestic firms, manufacturing (year 2006=100%)

Note: The graph does not show the differences between the real level of wages, employment and value added. The number of employees in foreign firms forms only about 50.8% of all the employees in domestic firms, the average wage in domestic firms is only about 66.6% of the average wage in foreign firms and the value added in domestic firms is only 25.9% of the value added for foreign firms.

Figure 3 shows the changes in the number of employees, wage levels and value added in services. The wage increase in services during the whole period was smaller than in manufacturing. Only in domestic firms did the number of employees fall below the 2006 level and remain below it until the end of the period; in foreign firms, the number of employees was higher than in 2006 throughout all years. The wage increase was slower in services compared to the manufacturing sector. In services, value added for foreign firms dropped to 90% in 2009 and returned to its initial level by the end of the period. In manufacturing, the drop in 2009 was more severe reaching 77% and in 2012 there was another notable decline. In services, a similar decline in value added is only visible for domestic firms.

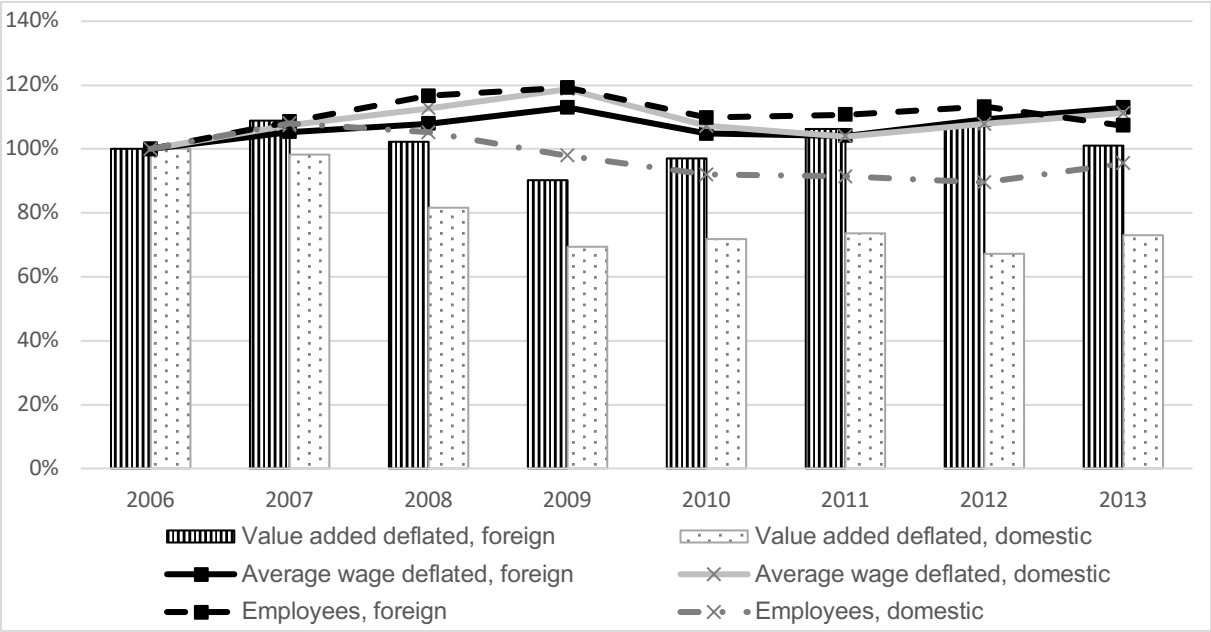

Figure 3. Total employment, real value added and average real wage for foreign and domestic firms, services (year 2006=100%).

Note: The graph does not show the differences between the real level of wages, employment and value added. The number of employees in foreign firms forms only about 29% of all the employees in domestic firms, the average wage in domestic firms is only about 47.7% of the average wage in foreign firms and the value added in domestic firms is only 23.3% of the value added of foreign firms.

The labour churning rate is defined as the difference between worker flows and job reallocation divided by the number of employees in the firm. Labour churning as a flow variable can be measured for a period of time. The number of employees in the calculation is the average for the beginning and the end of the same period. At the beginning of the analysed period (2006-2007) the churning flow rate was valued at 35% in foreign firms in manufacturing and 32% in foreign firms in services, in domestic firms the rate was slightly slower (30.1% and 29.1% respectively) (see Figure 4 below). In the years 2009–2010, the churning rate declined below 20% in manufacturing as well as in services for both foreign and domestic firms. In foreign manufacturing firms the churning rate even dropped below 15%. After the crisis, the rate increased again but did not reach the level of the economic boom period in either of the sectors. The difference between the beginning and the end of the period was greatest in foreign manufacturing firms with a churning rate of 21.7% for 2012–2013 (the decrease from 35% was about 13 pp). At the same time, the difference was the smallest in foreign services firms (churning rate 28.2 for 2012–2013). According to the Mann-Whitney *U* test, the differences

between foreign and domestic firms in both sectors are statistically significantly different. As one limitation of the analysis, our data does not allow us to observe the reason for the discontinuation of the particular employment spell, whether it was initiated by the employee or the employer (e.g. due to layoff or voluntary quits), and thus we cannot know the reason for the observed churning.

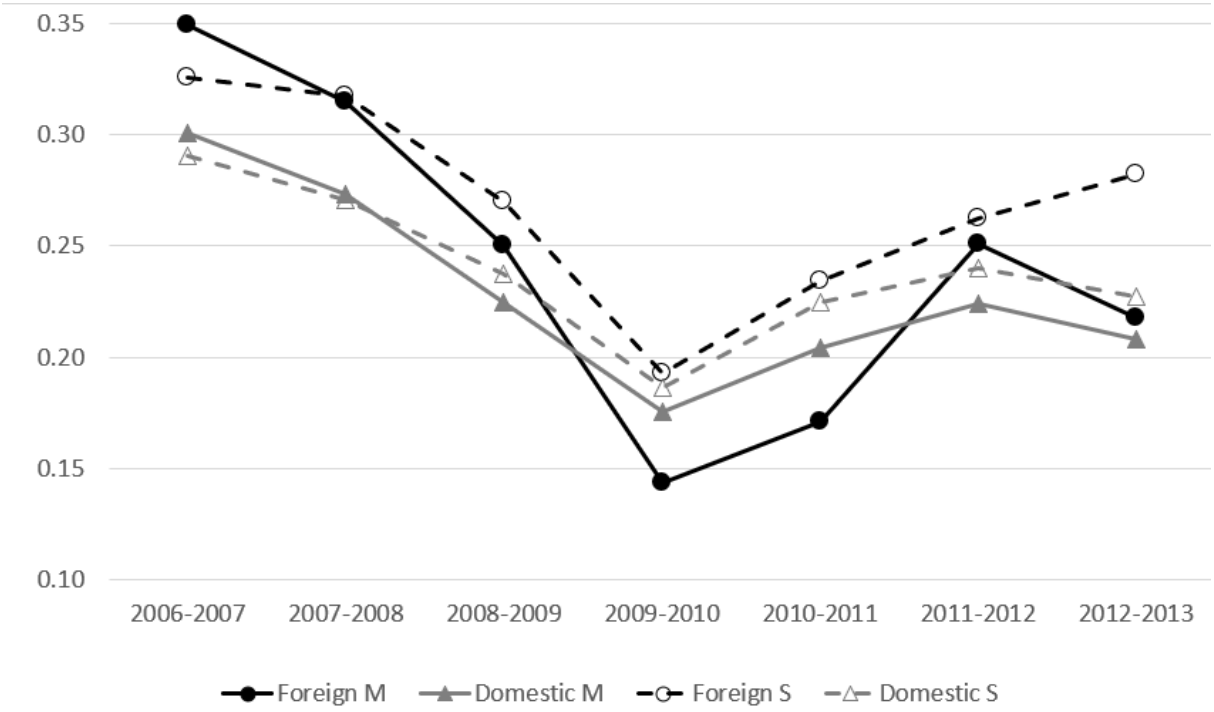

Figure 4. Churning rate in domestic and foreign firms in manufacturing (M) and services (S).

Note. Churning rate has been calculated as the ratio of the churning flows to the average number of employees in the firm over the period.

3.3 Variables and method

We construct the following models to estimate the relationship between change in labour productivity (our dependent variable) and churning rate as follows:

$$CHANGE\ IN\ LN(LABOUR\ PRODUCTIVITY)_{it} =$$
$$= \alpha_{it} + \beta_{it}\, Z_{it} + \gamma_1\, PERIOD + \gamma_2\, CHURNING\ RATE_{it-1} + \gamma_3 CHURNING\ RATE_{it-1}^2 +$$
$$+ \gamma_4 PERIOD \times CHURNING\ RATE_{it-1} + \varepsilon_{it} \qquad (1)$$

where our main variable of interest is the churning rate, but other explanatory variables Z_{it} have also been included. Ilmakunnas et al. (2006) have also used productivity change as the dependent variable, but their productivity indicator is total factor productivity. For independent variables we use a strategy similar to Mueller and Peters (2010). We use the same indicator for churning and based on their statistically significant negative coefficient for the squared churn rate, we also include the squared term of churning into our equation. In the first specification, we add the interaction of the period and the churning rate to see whether the relationship between change in labour productivity and churning varies with phases of the economic cycle to test our first hypothesis (H1).

The decision to prefer ordinary least squares method with robust standard errors to estimate the models instead of adding fixed effects estimator or random effects estimator is based on formal tests. The Hausman test indicated that a fixed effects model should be preferred to random effects model (Prob>chi2 = 0.0000). At the same time, ordinary least squares method were shown to be preferred to the fixed effects model (F-test at the end of STATA output showed that all u_i=0, Prob> F=1.000). However, the result of the OLS with fixed effects estimator and OLS with clustered standard errors are also presented as an appendix to test the robustness of the results.

In the second specification, we use the same dependent variable change in labour productivity and still use ordinary least squares method to estimate the model, but we replace the interaction of period and churning rate with the interaction of firm ownership and churning rate to test our second hypothesis (H2). In addition, we divide the whole sample into three smaller sub-samples to compare the relationship between three different phases of the economic cycle.

$$CHANGE\ IN\ LN(LABOUR\ PRODUCTIVITY)_{it} = \\ = \alpha_{it} + \beta_{it} Z_{it} + \gamma_1 FOREIGN_{it} + \gamma_2 CHURNING\ RATE_{it-1} + \gamma_3 CHURNING\ RATE^2_{it-1} + \\ \gamma_4 FOREIGN_{it} \times CHURNING\ RATE_{it-1} + \varepsilon_{it} \qquad (2)$$

In both specifications (equations 1 and 2), the control variables Z include the size of the (log of employment), log of firm's age in years, log of the capital stock at the beginning of the one-year-period, log of average wage level in the firm at the beginning of the same period, two-digit NACE industry code of the firm and the location code of the firm. Following the example of Müller and Peters (2010), lagged values of employee-related control variables have been used where appropriate to reduce the chance of inverse causality (high productivity may also attract new employees). Boom years indicate the relationship in 2007–2008 and 2008–2009, whereas the churning rate for this line is computed based on boom years 2006–2007 and 2007–2008. Crisis years show the relationship in 2009–2010 and 2010–2011 with the churning rate based on crisis years 2007–2008 and 2009–2010. The recovery years are 2011–2012 and 2012–2013 while the churning rate is calculated based on employee movements in 2010–2011 and 2011–2012. The location variable is based on five NUTS (level 3) regions in Estonia and captures the different economic conditions in the regions. Northern Estonia for example includes the capital city and the county surrounding the city; more than 50% of the firms of the sample are situated in this region.[3] In the first specification (eq. 1), dummies for three phases of the economic cycle are included. For the second specification (eq. 2), the sample is divided into three phases of the economic cycle and in each equation yearly dummies are included instead of the dummies for the phases of the business cycle.

The general churning rate lacks information on the characteristics of the moving employees, but previous research indicates that the hiring of a certain type of employee is related to a larger increase in productivity for the hiring firm (see also section 2). Therefore, based on available information concerning the employees and their mobility between firms, we have added control variables that describe the hired employees. First, we have a variable that shows for each firm the percentage of employees (among all the hired employees) whose wage was among the highest 25% in the same NACE two-digit industry in the previous job. The second variable indicates the percentage of newly hired employees with higher education. As this indicator is based on Census (2011) data, it cannot be considered very accurate (education data is available

[3] We note that the actual regional allocation of the economic activities may differ from that as companies may operate in a region different from their place of registration and some companies may operate in more than one region, especially in certain industries like retail.

just for a single year: 2011); for example, our assumption that individuals during the study period of 2006–2013 had the education level they had in 2011 is naturally not correct in many cases. The third variable shows the percentage of middle-aged employees among newly hired employees, and the fourth variable indicates the percentage of employees who have moved to a higher wage decile compared to the wage decile of their previous job. The wage deciles here are calculated for each period separately and for the whole economy. We assume that moving up in the wage distribution increases the work effort of the employee. The rationale for this assumption can be found from the efficiency-wage theory that predicts higher productivity in companies that increase their wages (Levine, 1992). Moreover, a job change that is accompanied by a wage decrease may be an indication of underemployment in terms of relative deprivation (as explained in McKee-Ryan & Harvey, 2011) if the employee uses his/her previous wage as a reference standard. Underemployment is related to lower job satisfaction, but higher job satisfaction has been shown to be related to higher productivity (Böckermann & Ilmakunnas, 2012).

The fifth variable shows the percentage of newly hired employees who come from 25% of the most productive firms each year. Whereas foreign firms in general are more productive than domestic firms, the distributions that describe the productivity of firms are calculated for domestic and foreign firms separately. Additionally, for a certain period of time we could check the employee movements between firms, and we could sort out the employees who changed firms more often than the average employee in the sample. We expected the share of such rather frequent movers to be negatively related to the labour productivity of firms because for an employee each change of jobs acts as an interruption in the process of creating tacit knowledge (not only know-how, but also its cognitive dimension) and firm-specific human capital. The positive relationship between tacit knowledge and firm performance has been indicated by Harlow (2008) as well as López-Cabarcos et al. (2019). According to Harlow's (2008: 149) definition, "the knowledge is a continuum and the interplay of tacit and explicit knowledge creates ever more knowledge." For such a continuum many interruptions may have a detrimental effect at firm level, but also at individual level.

Finally, we move to the individual level and construct probit models based on employee-level indicators of new recruits to investigate if the crisis-related changes in the labour market are related to what kind of employees the foreign and domestic firms are able to hire. Note that all newly hired employees are included in the sample independent of their previous working status. The following probit models are constructed for three periods (boom, crisis and recovery):

$$Y_i = \beta_0 + \beta_i Z_i + \varepsilon_i, \qquad (3)$$

where Y_i equals 1 if an individual is hired to a foreign firm and 0 if an individual is hired to a domestic firm. Additionally,

$$P(Y = 1|Z_i) = \Phi(\beta_0 + \beta_i Z_i), \qquad (4)$$

where $\Phi(.)$ is the cumulative standard normal distribution function. The exogenous variables Z_{it} include some control variables like gender, five region dummies (NUTS level 3) and two-digit NACE industry dummies. At the individual level we do not have panel data, three () models are specified and yearly period dummies included. The variables of interest are mainly the variables that research has shown to be related to the productivity of the receiving firm (age, education, experience from exporting firm, experience from a firm with high labour productivity, rather high wage). However, we have added two new variables that are

theoretically related to employee productivity and could potentially be related to the productivity of the firm – moving to a higher wage decile and being more mobile than average. The exact description of all variables in all models can be found in Table 1. The descriptive statistics of variables are indicated in tables A1 and A2 in Appendix A.

Table 1. Description of variables

Firm-level variables	**Description**
Ln(labour productivity)	Ln(deflated value added/[(N_t+N_{t+1})/2])
Change in ln(labour productivity)	Ln(labour productivity)$_t$-Ln(labour productivity) $_{(t-1)}$
Churning rate	[(Hired + separated) – |hired-separated|]/[(N_t+N_{t+1})/2]
(Churning rate)^2	Churning rate squared
Ln(age of firm)	Age of firm calculated as the year of the observation – the year of the
Ln(number of employees)	Ln[(N_t+N_{t+1})/2]
Ln(capital stock)	Ln(capital stock at the beginning of the period).
Ln(wage level)	Ln(wage level at the beginning of the period).
Foreign firm (dummy)	1 if at least 50% of shares are owned by a foreign firm, 0 if at least 50% of shares are owned by a domestic firm.
High wage (% of hired)	The share of hired whose wage is among 25% of the highest of wages at the beginning of the period.
Middle-aged (% of hired)	Share of hired who are 31–50 years old.
Higher education (% of hired)	Share of hired who have tertiary education.
To upper wage decile (% of hired)	Share of hired who moved to a higher wage decile.
From exporting firm (% of hired)	Share of hired who moved from exporting firm.
From high labour productivity firm (% of hired)	Share of hired who moved from the firm with labour productivity among 25% of the highest values, domestic and foreign firms in separate distribution.
More mobile (% of hired)	Share of hired who are more mobile than the average employees in that year (% of hired)
Location	The region of the location of the firm in the survey year. 1 = Harju region; 2 = Central region; 3 = Ida-Viru region; 4 = Western region, 5 = South region.
Industry	NACE two-digit industry codes
One-year periods	2006-2007, 2007-2008, 2008-2009, 2009-2010, 2010-2011, 2011-2012, 2012-2013
Individual-level variables	**Description**
Male	1 = male; 0 = female
Age group	1 = up to 30 years old; 2 = 31-50 years old; 3 = more than 50 years old
Education level	1 = primary education; 2 = secondary education and post-secondary education; 3 = tertiary education; 4 = no information about education
Last firm was exporting	1 = in January one year before the current year, the individual was employed in an exporting firm; 0 = the firm was not exporting
Last firm was high labour productivity firm	1 = in January one year before the current year the employee was hired in a firm with labour productivity among 25% of the highest values, domestic and foreign firms in separate distribution; 0 = the firm was not among the 25% of the firms with the highest labour productivity
Moved to a higher wage decile	1 = the job change from January to January included a wage increase that moved the employee from a lower wage decile at the beginning of the period to a higher wage decile at the end of the one-year period; 0 = the job change did not involve such a wage increase.
More mobile than the average	1 = during the whole period of 2006-2013 the number of jobs they have had is higher than the average in the sample, job changes have been recorded only in January each year; 0 = the number of jobs during the whole period of 2006-2013 remains below the average.
Wage among 25% of the highest wages	1 = at the beginning of the one-year period the wage is among the 25% of the highest wages in the sample; 0 = the wage at the beginning of the one-year period is not among the 25% of the highest wages in the sample.

Note. In the table, N_t denotes the company's number of employees in January of year t.

At industry level we also conduct a robustness check by reducing the observed differences between foreign and domestic firms. The propensity score matching technique was used to create a sample of foreign and domestic firms that are more similar in terms of number of employees (variable ln(number of employees)), capital stock (ln(capital stock)), wage level (ln(wage level)) and the location (variable location) at the beginning of the period (the variables that were included to the probit models to calculate propensity scores). The command *teffects psmatch* in STATA 14 was used for propensity score matching. The propensity scores were calculated for each year separately and the nearest neighbour technique was used. Frequency weights were used in the group of domestic firms based on the number of matches with observations from the foreign firms[4].

4. EMPIRICAL RESULTS

First, we investigated whether the relationship between labour churning and change in labour productivity varies over different phases of the economic cycle. We expected the period of economic crisis to stand out with a statistically significantly different and positive relationship between the two factors. Table 2 below indicates the ordinary least squares estimation results that next to control variables include churning, squared churning indicator as well as the interactions of churning and three different two-year periods. We omit the explicit correlation tables showing that churning variables and control variables are not correlated with each other. We address this concern by presenting the models with omitted variables. The coefficients for the remaining variables do not change significantly.

Table 2. Ordinary least squares regression estimates, dependent variable change in labour productivity

	Services		Manufacturing	
VARIABLES	(1)	(2)	(3)	(4)
Churning rate (lagged)	0.062***	0.074***	0.120***	0.139***
	(0.02)	(0.01)	(0.04)	(0.04)
(Churning rate)^2 (lagged)	-0.043***	-0.049	-0.059**	-0.068**
	(0.01)	(0.01)	(0.03)	(0.03)
Period 1#lagged churning rate	Ref.	Ref.	Ref.	Ref.
Period 2#lagged churning rate	-0.024*	-0.021	-0.046	-0.038
	(0.01)	(0.01)	(0.04)	(0.04)
Period 3#lagged churning rate	-0.038***	-0.036***	-0.055	-0.053
	(0.01)	(0.01)	(0.04)	(0.04)
Foreign firm (dummy)	0.023***	0.024***	0.003	0.001
	(0.01)	(0.01)	(0.01)	(0.01)
2 period dummies for 3 periods	Yes	Yes	Yes	Yes
4 location dummies for 5 locations	Yes	Yes	Yes	Yes
High wage (% of hired)	-0.008	No	0.020	No
	(0.01)		(0.02)	
Tertiary education (% of hired), lagged	0.021***	No	0.038*	No
	(0.01)		(0.02)	
Middle-aged (% of hired), lagged	0.026***	No	0.029**	No
	(0.01)		(0.01)	
To higher wage decile (% of hired), lagged	-0.001	No	-0.014	No
	(0.01)		(0.02)	
From exporting firm, (% of hired), lagged	0.013	No	0.008	No
	(0.01)		(0.02)	
From high labour productivity firm (% of hired)	-0.010	No	0.040	No

[4] More detailed results on matching are available from authors upon request.

	(0.01)		(0.03)	
More mobile (% of hired), lagged	-0.013*	No	-0.001	No
	(0.01)		(0.01)	
NACE two-digit codes	Yes	Yes	Yes	Yes
Dummies for 3 periods	Yes	Yes	Yes	Yes
Location dummies	Yes	Yes	Yes	Yes
Constant	0.223***	0.228***	0.301***	0.266**
	(0.03)	(0.03)	(0.11)	(0.11)
Observations	49,973	49,973	13,196	13,196
R-squared	0.047	0.046	0.039	0.038

Notes: Columns with even numbers do not include the characteristics of new recruits.* p <0.05, ** p<0.01 and *** p<0.001, robust standard errors in parenthesis. Variables ln(age of firm), ln(number of employees), ln(capital stock) and ln(wage level) are included, but not shown here.

In services and in manufacturing the coefficients of labour churning are positive and statistically significantly different from zero (as in Ilmakunnas et al., 2005 despite their different productivity indicator). The statistically significant negative coefficient of squared churning rate indicates that the relationship between churning and labour productivity is an inverse U shape (as could be expected based on Müller & Peters, 2010). In Figure 5 below, the relationship is shown in three different periods and it is positive only during the crisis. Due to the slightly upward convex shape of the curves in Figure 5, high levels of churning (starting from 1.6 in services and 1.8 in manufacturing) are negatively related to change in labour productivity. The differences between the three lines (crisis, boom and recovery) are of similar magnitude in the services and in the manufacturing sector. The results concerning individual characteristics of newly hired employees are also similar in both economic sectors. The statistically significant positive coefficients for the share of highly educated and middle-aged employees indicate that if these shares increase by 1 percentage point, the labour productivity change increases on average by about two to four per cent in both sectors *ceteris paribus*.

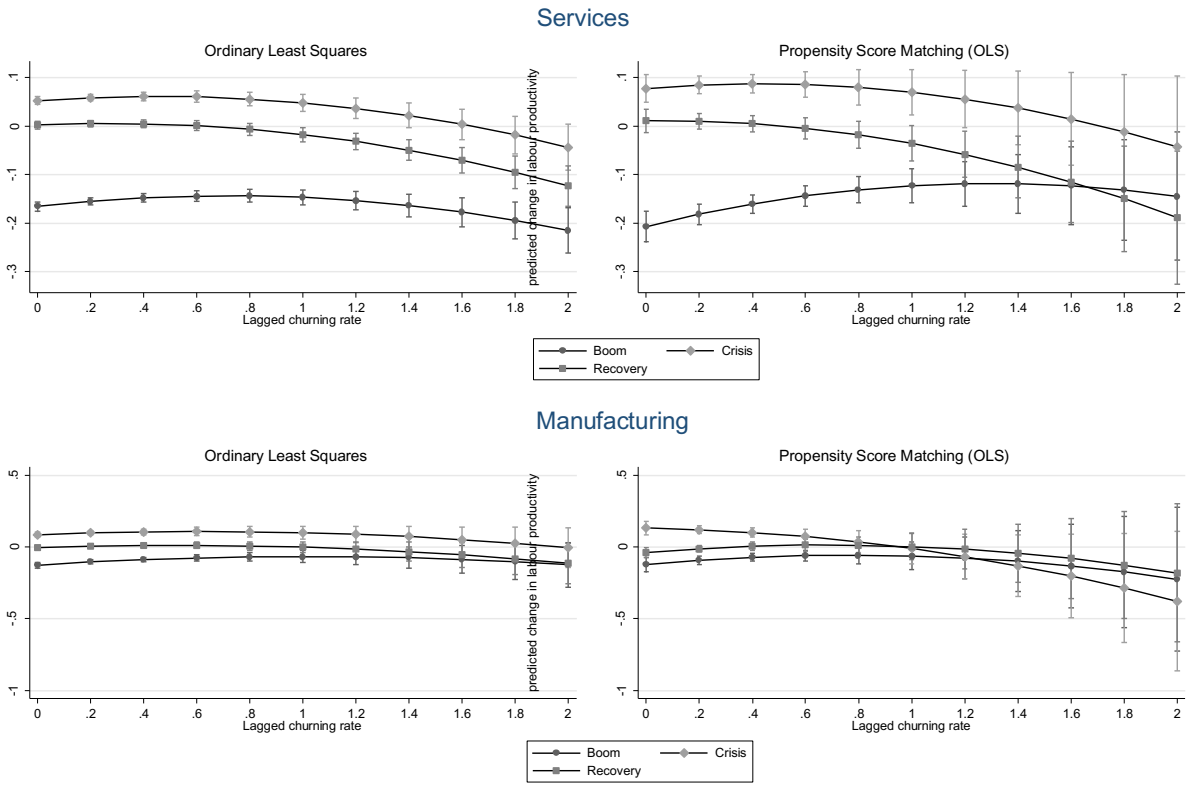

Figure 5. Marginal effects of the lagged labour churn rate and labour productivity change in boom, crisis and recovery (based on coefficients in Table 2).

Next, we compared the relationship between labour productivity change and churning in foreign and domestic firms. The statistically significant coefficient for the foreign ownership dummy (1 if the firm is foreign and 0 if domestic) equals 0.02 in the regressions for services in Table 2 above. This indicates that in services the effect of churning on the labour productivity change is stronger for foreign firms compared to domestic firms. More detailed analysis includes dividing the whole sample into three periods and estimating a separate regression for each. This statistically significant positive effect is repeated in Table 3 (see full results in Appendix B), but only in services during the crisis years. Due to the inclusion of the squared churning rate and the interaction of the churning rate with the foreign dummy, the marginal effects in Figures C1 and C2 show the exact difference between foreign and domestic firms (see Appendix C). In services, in the area where the churning rate is low (up to 0.6) in the crisis, the predicted positive change in labour productivity is higher for foreign firms (around 10 percentage points higher productivity growth rate if the churning rate equals 0.2) compared to domestic firms (around 5 percentage points if the churn rate equals 0.2). However, similarly for foreign and domestic firms, the relationship between churning and labour productivity change turns negative when the churn rate is approximately 1.4. In manufacturing, there is no such statistically significant difference in any of the periods.

Table 3. Ordinary least squares regression estimates, dependent variable change in labour productivity

	Services			Manufacturing		
	Boom	Crisis	Recovery	Boom	Crisis	Recovery
Churning rate (lagged)	0.067***	0.034	0.040*	0.019	0.175***	0.027
	(0.025)	(0.025)	(0.021)	(0.067)	(0.060)	(0.051)
(Churning rate)^2 (lagged)	-0.052***	-0.040**	-0.046***	0.035	-0.158***	-0.031
	(0.019)	(0.018)	(0.015)	(0.062)	(0.041)	(0.044)
Domestic firm # churning rate (lagged)	Ref	Ref	Ref	Ref	Ref	Ref
Foreign firm # churning rate (lagged)	0.022	-0.049	-0.038	-0.043	-0.070	0.129
	(0.037)	(0.039)	(0.034)	(0.086)	(0.081)	(0.085)
Foreign firm (dummy)	0.009	0.066***	0.001	0.050	0.004	-0.053**
	(0.017)	(0.016)	(0.013)	(0.032)	(0.026)	(0.023)
NACE two-digit codes	Yes	Yes	Yes	Yes	Yes	Yes
Location dummies	Yes	Yes	Yes	Yes	Yes	Yes
Characteristics of new recruits	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.352***	0.371***	0.258***	1.090	0.736***	0.156
	(0.059)	(0.062)	(0.051)	(0.981)	(0.146)	(0.143)
Observations	15,873	16,414	17,686	4,308	4,320	4,568
R-squared	0.042	0.012	0.015	0.052	0.040	0.020

Notes: * p <0.05, ** p<0.01 and *** p<0.001, standard errors in parenthesis. Variables ln(age of firm), ln(number of employees), ln(capital stock) and ln(wage level) are included, but not shown here, see full results in Appendix B.

In manufacturing, the coefficients for the characteristics of hired employees are only statistically significant in the crisis period. The most important of the characteristics is higher education. If the percentage of newly hired employees with higher education increases by one per cent, the average labour productivity change increases by 10.8 per cent *ceteris paribus*. A one percentage point increase in the share of middle-aged employees among newly hired is related to a 5 per cent increase of the change in labour productivity and an increase in the share of relatively mobile employees is related to a 3.9 percentage points lower productivity growth rate.

In services, the patterns related to characteristics of newly hired employees are different compared to manufacturing. Only the negative coefficient of hiring relatively mobile employees in a crisis is statistically significant. Similar to manufacturing, hiring middle-aged employees is also related to productivity gains in services, but in services the relation is also statistically significant in the boom and recovery phases of the economy. In a crisis, the related productivity change is 3.2%, this is about a 1 pp increase compared to the relationship in the other two economic phases. The most important factor in a crisis in services, unlike in manufacturing, is the share of new employees coming from exporting firms with the productivity change of 6.4% *ceteris paribus*.

Our third hypothesis stated that foreign firms are more resilient to the economic crisis than domestic firms independent of the economic sector. The results in the tables in Appendix B and the Figures in Appendix C indicate that this is not true. In a crisis, the foreign firms in services managed to have higher productivity gains than domestic firms, while in manufacturing there

was no statistically significant difference between foreign and domestic firms in any of the business cycle phases. Therefore, we have shown the importance of analysing the services sector next to manufacturing. In both sectors, exporting may have helped to overcome economic difficulties in the host country (see section 2), but services based on ICT may be able to travel longer distances without (considerable) increased costs.

The robustness of the OLS estimates has been checked based on a smaller sample and comparing foreign firms with only the most similar of the domestic firms (using the propensity score matching technique). The results of the robustness check concerning our first hypothesis are shown in Appendix D. These figures confirm our main results in the area where the churning rate values are less than 0.6. Figure 4 in section 3.1. indicates that the churn rate did not increase above 0.4 during the seven years that form our total sample period. The robustness check also confirms the main results of the three regressions, one for each phase of the business cycle (see appendices B and C). There is only a statistically significant difference between domestic and foreign firms in crisis in services. Nevertheless, the robustness check cannot confirm all of the most detailed results concerning the characteristics of newly hired employees. In services, the robust result is that the share of the relatively mobile employees is negatively related to labour productivity change (in the model for the whole period as well as in crisis years). In manufacturing, the robust result is the positive correlation between the share of highly educated (tertiary education) newly hired employees and labour productivity change (in crisis). Additional robustness tests for hypothesis 1 are presented in the Appendix E (Table E1, figures E1 and E2). The fixed effect model and OLS model with clustered standard errors indicate smaller differences between the crisis and recovery phases, but the difference compared to the boom period remains statistically significant. As the marginal effects of the boom period remain negative, it is still relatively more useful to churn labour during crisis or recovery periods of the business cycle.

Finally, we moved from firm-level analysis to individual level. Foreign firms may be able to hire more productive employees from the labour market and based on our result in services even more so during an economic crisis. Three cross-section probit models (one for each phase of the business cycle) were constructed to analyse whether the probability of being hired to a foreign firm is higher for employees with certain characteristics and also if the correlation between these characteristics and hiring to a foreign firm changes with the phase of the economic cycle. The results of the probit models are shown in Table 3 below. First, we check whether foreign firms are significantly more likely to hire employees whose characteristics appear to be positively and statistically significantly related to a labour productivity change in Table 2 above. In services as well as in manufacturing, hiring employees with higher education and also hiring middle-aged employees is related to labour productivity increases. In addition, hiring relatively more mobile employees is statistically significantly related to a labour productivity change for firms in services, but in this case the correlation is negative.

According to the probit models (see Table 3 below) for manufacturing in boom years, the group of employees aged 50 years and up have 7.2 percentage points lower probability of being hired to a foreign firm than the group of employees up to 30 years old; in a crisis the same moves to -5.6 percentage points and in recovery the probability change is even larger than in the boom period at -10.9 percentage points. In services, the probability of hiring employees follows exactly the same pattern across different characteristics but at smaller amplitudes. Employees in the oldest age group have 1.7 percentage points less probability of being hired to a foreign firm in services in boom years than employees in the youngest age group; in a crisis the coefficient is not significant and in recovery the probability is again smaller by 1.9 percentage points. Therefore, in both manufacturing and services foreign firms can profit from hiring

younger employees. However, a comparison of the magnitude of the correlation shows that the advantage for foreign firms is smaller in services.

Concerning the education of newly hired employees, in services there are no differences between the different education groups, and therefore foreign firms cannot profit from highly educated employees to a larger extent than domestic firms. Foreign manufacturing firms in the crisis phase have 4.3 percentage points higher probability of hiring employees with secondary education than employees with primary education. Although the education of employees cannot be considered accurate (it is based on Census 2011 data), the bias should not depend on the industry or education level of the employees.

Hiring employees who are more mobile than average is similarly statistically significant in both manufacturing as well as services. In services, the coefficient for hiring relatively more mobile employees is not statistically significant in the recovery period, while in the boom and crisis phases, the probability of hiring relatively more mobile employees is nearly 5 percentage points higher in foreign firms compared to domestic firms *ceteris paribus*. In manufacturing, the positive coefficients are statistically significant during all three periods; the change in the probability is 4.8, 7.3 and 3.5 percentage points, respectively. Based on education and age characteristics, in manufacturing the foreign firms appear to hire more productive employees. At the same time, foreign firms also tend to hire relatively more mobile employees (that have a negative correlation with labour productivity). As the result of the countervailing effects is not clear from our analysis, this question needs further research.

We hypothesised that in addition to profiting from hiring employees with more favourable characteristics the probability of hiring these employees increases in a crisis for foreign firms. In services, the positive effect of only one variable (last employer exporting) increases in a crisis, but the difference between the marginal effect in boom years and a crisis is only 0.5 percentage points. In manufacturing, there are altogether three variables that show the predicted change during a crisis. In a crisis, employees with secondary and post-secondary education had 4.3 percentage points higher probability of being hired to a foreign firm compared to employees with primary education, but during other periods, this variable has no effect. This result is partly related to the finding from Devereux (2002). We find that the education level of new recruits increases during a crisis (in our case for new recruits in foreign firms compared to domestic firms), but it is more noticeable at the level below tertiary education. In a crisis, employees who have come from an exporting firm have 8.6 percentage points higher probability of being hired to a foreign firm than employees who do not come from an exporting firm. The probability is about 3.6 percentage points higher than in boom or recovery phases. However, we have not been able to show in our paper that this factor is statistically significantly related to the labour productivity of firms. Therefore, we cannot exclude the possibility that the change in the characteristic “more mobile than the average” neutralises the positive effect of education. The magnitude of the change for mobile employees is 2.5 percentage points.

Table 3. Regression results from the probit model, dependent variable equals 1 if at the end of one-year period the employee was hired by a foreign firm and 0 if by a domestic firm

	Services			Manufacturing		
	Boom	Crisis	Recovery	Boom	Crisis	Recovery
Male (ref: Female)	-0.043***	-0.031***	-0.032***	-0.053***	-0.012	-0.038**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)
31-50 years old (ref: Up to 30 years old)	-0.014**	-0.007	-0.012	-0.015	-0.030	-0.054***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)
More than 50 years old (ref: Up to 30 years)	-0.017*	0.000	-0.019*	-0.072***	-0.056**	-0.109***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)
Secondary education (ref: Primary education)	-0.008	-0.010	0.002	-0.003	0.043*	0.019
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)
Tertiary education (ref: Primary education)	-0.005	-0.011	0.002	-0.014	0.055	0.034
	(0.01)	(0.01)	(0.01)	(0.02)	(0.03)	(0.02)
Last firm was exporting (dummy)	0.044***	0.049***	0.041***	0.062***	0.056***	0.070***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Last firm high labour productivity firm (dummy)	-0.042***	-0.069***	-0.018**	0.033**	-0.037**	-0.060***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Moved to a higher wage decile (dummy)	0.041***	0.041***	0.050***	0.049***	0.086***	0.050***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
More mobile than the average employee (dummy)	0.049***	0.047***	-0.003	0.048***	0.073***	0.035**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Wage among 25% of the highest wages (dummy)	0.029***	-0.003	0.038***	0.015	-0.016	0.055***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
Observations	28,608	18,338	22,618	13,104	5,169	9,012

Notes: Boom period includes 2006–2007 and 2007–2008, crisis includes 2008–2009 and 2009–2010 and recovery includes 2010–2011, 2011–2012 and 2012–2013.
* p <0.05, ** p<0.01 and *** p<0.001, standard errors in parenthesis. NACE two-digit industry codes and 5 location variables included as controls, but not shown here. All newly hired employees independent of their previous working status.

5. DISCUSSION

Based on the exceptional example of Estonia, we have analysed how labour churning is related to changes in labour productivity and whether this relationship is different in a crisis compared to other phases of the business cycle. The historical and institutional setting in Estonia poses little hindrances for labour churning; in addition, during the Great Recession of 2008–2009, the decline in GDP was one of the deepest in the EU and the whole world. In such an extreme situation, we expected firms to deal with the workforce composition (inter alia through churning) in order to increase labour productivity. Due to the high unemployment rate in the labour market, we expected firms to be able to hire more productive employees and thus profit from churning.

The marginal effects of OLS models indicate that the relationship between labour churning and labour productivity is indeed positive in a crisis and negative in an economic boom. However, in both cases, the relationship is slightly convex and high levels of churning are less useful in any phase of the business cycle. The differences between the manufacturing and services sectors are very small according to these models. It would be too simplistic to advise firms not to churn labour during boom years and conversely to churn in a crisis. In boom years, more often the employees initiate churning themselves and firms may have only finite means to control it. In a crisis, firms may not have any resources available to deal with excessive labour churning and there might be more urgent problems that need attention. Although the causes of the virus-related crisis of 2020 are different compared to the crisis of 2009, the higher unemployment and economic difficulties in some sectors are similar. Therefore, our paper emphasizes the opportunities that firms can use in any kind of economic crisis.

We expected foreign firms to profit more from churning compared to domestic firms because they could have more resources available for employment changes during a crisis (due to higher productivity, higher profits, better financial situation etc). Moreover, the cleansing effect could have shifted labour from low-productivity domestic firms to high-productivity foreign firms. Our OLS models (one for each phase of the business cycle) show that the relationship between labour productivity and churning is more positive for foreign firms compared to domestic ones only in services and only during a crisis. Robustness check using the propensity score matching technique confirms the difference between foreign and domestic firms in services. Therefore, we show that this difference does not result only from the size or productivity differences between foreign and domestic firms.

Nevertheless, a difference in results for the two economic sectors was not expected. The comparison of changes in value added as well as in the number of employees in manufacturing and services somewhat explains this. In manufacturing, the changes in value added in foreign and domestic firms were rather similar until the crisis (in both groups, the value added in 2009 was less than 80% of the initial level of 2006). After the crisis, the foreign firms reduced the number of employees more than domestic firms compared to the initial level, and the increase in value added was thereafter faster in foreign firms compared to domestic firms. At the same time, in foreign firms in services (even during the crisis years) the value added never decreased below 80% of the level of 2006 and the number of employees never decreased below the level of 2006. As opposed to firms in manufacturing (either domestic or foreign owned) or domestic firms in services, the average foreign firm in services never seemed to feel the gravity of the crisis.

If the difference between foreign and domestic firms was also present before and after the crisis, our result could refer to the existence of super-star firms and the long tail of "the rest" as brought out by Andrews, Criscuolo and Gal in 2016 (more often observed in services and especially related to ICT). As the difference is statistically significant only in a crisis, it rather implies the cleansing effect. Therefore, the results indicate it is reasonable not to treat foreign firms any differently to domestic firms (that has also been the current policy in the country of the study, Estonia). In terms of the relationship between churning and labour productivity, domestic firms are not constantly worse off than foreign firms.

At firm level, we checked whether certain characteristics of newly hired employees are related to productivity gains. In several equations we could confirm a positive relationship between hiring employees with tertiary education and labour productivity. Therefore, our results imply that general policies that aim to raise the education level of the population also help to increase labour productivity. We also show that hiring relatively mobile employees is negatively related to labour productivity. As the mobile employees are often middle-aged and with tertiary education, the employer may need to hire them despite their previous mobility path. Therefore, we show that it is important for managers to invest in loyalty programmes and organisational commitment for new employees from their first day in the new firm.

The cleansing effect could cause the flow of better labour to foreign firms from domestic firms. We therefore conducted an individual-level analysis to check whether the difference in foreign and domestic firms in services could result from foreign firms hiring more productive employees from the labour market and only the less valuable employees remaining to be hired by domestic firms. We defined the most valuable characteristics of individuals based on previous research. Our probit models indicate that in some cases more valuable employees have indeed a higher probability of being hired to a foreign firm (e.g. young and middle-aged vs older employees). Curiously, the marginal effects are nearly always higher in manufacturing, where we could not show any differences between foreign and domestic firms. At the same time, relatively more mobile employees also have a higher probability of being hired to a foreign firm. Due to contradictory effects in the models, we cannot say that foreign firms are in a better position in a crisis compared to domestic firms. In terms of policy implications, our results indicate that equal treatment of foreign and domestic firms can be advised because domestic firms do not seem to be constantly in a worse position (in terms of labour churning) compared to foreign firms.

We cannot comment on the characteristics that did not turn out to be statistically significantly related to labour productivity in our analysis, although we included all the individual characteristics that we found evidence of from the literature. Therefore, the same set of employee characteristics could be analysed in further studies in a more detailed manner to better understand the interrelationships between all these characteristics and to determine the most important ones for increasing the labour productivity of the firm. Further research (e.g. qualitative studies) is also needed to explain why the relationship between labour churning and productivity is only different for foreign and domestic firms in services in a crisis. In this respect our individual-level quantitative analysis raised new questions because of the higher marginal effects of certain characteristics (e.g. variable "More mobile than average") in manufacturing. Qualitative surveys could help to clarify inter alia whether the services offered by foreign firms are greatly different compared to domestic firms, while products in manufacturing are more similar. Foreign firms may also use the crisis phase to improve their competitive position by acquiring domestic firms in the host country. Future research might explore whether domestic firms are more often acquired by foreign firms in a crisis compared to the other phases of the business cycle.

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APPENDICES

Appendix A. Descriptive statistics

Table A1. Statistical information for the firm-level sample

	Services				Manufacturing			
	Foreign		Domestic		Foreign		Domestic	
Variable	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Change in labour productivity	-0.024	0.411	-0.034	0.427	-0.002	0.358	-0.004	0.440
Difftfp	-0.344	0.884	0.016	0.731	-0.185	0.603	0.025	0.649
Churning rate	0.251	0.331	0.218	0.358	0.226	0.237	0.208	0.296
Ln(age of firm)	2.236	0.605	2.179	0.607	2.323	0.597	2.260	0.615
Ln(number of employees)	2.250	1.447	1.467	1.069	3.172	1.414	2.043	1.241
Ln(capital stock)	11.156	2.468	10.175	2.065	12.442	2.387	11.128	2.180
Ln(wage level)	7.848	0.684	7.182	0.596	7.568	0.512	7.199	0.535
High wage (% of hired)	0.180	0.318	0.078	0.228	0.116	0.232	0.091	0.226
Tertiary education (% of hired)	0.187	0.314	0.105	0.264	0.095	0.195	0.076	0.207
Middle-aged (% of hired)	0.284	0.352	0.224	0.357	0.368	0.319	0.272	0.351
To higher wage decile (% of hired)	0.094	0.210	0.049	0.166	0.087	0.168	0.054	0.160
From exporting firm (% of hired)	0.063	0.175	0.030	0.131	0.089	0.177	0.051	0.157
From high labour productivity firm	0.079	0.199	0.047	0.168	0.058	0.146	0.046	0.154
More mobile than average (% of hired)	0.173	0.288	0.116	0.267	0.241	0.285	0.153	0.279
Observations	4462		45511		1799		11397	

Table A2. Statistical information for the individual-level sample

	Manufacturing		Services	
Variable	Mean	SD	Mean	SD
Hired in foreign firm	0.278	0.45	0.214	0.41
Male	0.569	0.50	0.434	0.50
Up to 30 years old	0.302	0.46	0.366	0.48
31-50 years old	0.479	0.50	0.429	0.49
More than 50 years old	0.219	0.41	0.205	0.40
Primary education	0.127	0.33	0.089	0.29
Secondary and post-secondary education	0.729	0.44	0.721	0.45
Tertiary education	0.122	0.33	0.166	0.37
No information about education	0.022	0.15	0.024	0.15
Last firm was exporting	0.480	0.50	0.295	0.46
Last firm was high-productivity firm	0.348	0.48	0.367	0.48
Moved to a higher wage decile	0.582	0.49	0.568	0.50
More mobile than the average employee	0.362	0.48	0.317	0.47
Wage among 25% of the highest wages	0.210	0.41	0.215	0.41
Observations	38176		94365	

Appendix B. Ordinary Least Squares regressin estimates in services and manufacturing

Table B1. Ordinary least squares regression results, full sample and propensity score matching, dependent variable change in labour productivity, robust standard errors (services)

SERVICES	Ordinary Least Squares			Propensity Score Matching		
	Boom	Crisis	Recovery	Boom	Crisis	Recovery
Churning rate (lagged)	0.067***	0.0340	0.0399*	0.0225	0.151*	0.107*
	(0.025)	(0.0252)	(0.0212)	(0.0645)	(0.0880)	(0.0614)
(Churning rate)^2 (lagged)	-0.052***	-0.0399**	-0.0463***	0.0364	-0.0940*	-0.114**
	(0.0189)	(0.0176)	(0.0148)	(0.0399)	(0.0532)	(0.0472)
Domestic firm # churning rate (lagged)	Ref	Ref	Ref	Ref	Ref	Ref
Foreign firm # churning rate (lagged)	0.022	-0.0488	-0.0378	-0.0561	-0.138**	0.000931
	(0.037)	(0.0394)	(0.0339)	(0.0477)	(0.0653)	(0.0504)
Ln(age of firm)	-0.017**	-0.0116*	0.00349	0.0244	-0.00812	-0.00549
	(0.006)	(0.00625)	(0.00518)	(0.0158)	(0.0176)	(0.0141)
Ln(number of employees)	0.031***	0.0107**	0.0205***	0.0115	-0.0161	0.0143*
	(0.004)	(0.00438)	(0.00365)	(0.0103)	(0.0107)	(0.00824)
Ln(capital stock)	-0.0127***	-0.00441*	-0.00856***	-0.00217	0.00403	-0.00844**
	(0.002)	(0.00252)	(0.00185)	(0.00563)	(0.00662)	(0.00430)
Ln(wage level)	-0.0564***	-0.0330***	-0.0255***	-0.0904***	-0.0407	0.00504
	(0.00792)	(0.00819)	(0.00654)	(0.0207)	(0.0255)	(0.0195)
Foreign firm (dummy)	0.00888	0.0655***	0.00127	0.0456*	0.102***	-0.0199
	(0.0172)	(0.0156)	(0.0134)	(0.0269)	(0.0276)	(0.0214)
Location dummies	Yes	Yes	Yes	Yes	Yes	Yes
High wage (% of hired), lagged	-0.0145	0.0153	-0.0198	-0.0406	0.0485	-0.0398
	(0.0165)	(0.0169)	(0.0137)	(0.0324)	(0.0307)	(0.0244)
Tertiary education (% of hired), lagged	0.0199	0.0212	0.0204*	-0.0164	-0.0322	-0.0192
	(0.0143)	(0.0138)	(0.0120)	(0.0285)	(0.0314)	(0.0262)
Middle-aged (% of hired), lagged	0.0235**	0.0317***	0.0220**	0.0416	0.00336	1.23e-06
	(0.0112)	(0.0108)	(0.00940)	(0.0266)	(0.0269)	(0.0225)
To higher wage decile (% of hired), lagged	0.0111	0.0107	-0.0118	0.0130	0.0237	0.00959
	(0.0171)	(0.0202)	(0.0185)	(0.0383)	(0.0400)	(0.0375)
More mobile (% of hired), lagged	-0.00849	-0.0277**	-0.0115	-0.00893	-0.0837***	-0.0250
	(0.0117)	(0.0116)	(0.0124)	(0.0265)	(0.0266)	(0.0297)
From exporting firm, (% of hired), lagged	-0.00905	0.0643**	-0.00671	-0.0481	0.0527	0.0120
	(0.0236)	(0.0268)	(0.0249)	(0.0429)	(0.0406)	(0.0452)
From high labour productivity firm (% of hired)	-0.0403**	-0.00131	0.0369*	-0.0593	-0.0125	0.0748
	(0.0197)	(0.0205)	(0.0200)	(0.0403)	(0.0371)	(0.0465)
Constant	0.352***	0.371***	0.258***	0.354**	0.490**	0.0565
	(0.0591)	(0.0624)	(0.0507)	(0.168)	(0.206)	(0.157)
Observations	15,873	16,414	17,686	2,229	1,928	2,087
R-squared	0.042	0.012	0.015	0.102	0.061	0.060

Notes: * p <0.05, ** p<0.01 and *** p<0.001, standard errors in parenthesis.

Appendix B (continued)

Table B2. Ordinary least squares regression results, full sample and propensity score matching, dependent variable change in labour productivity, robust standard errors (manufacturing)

MANUFACTURING	Ordinary Least Squares			Propensity Score Matching		
	Crisis	Boom	Recovery	Crisis	Boom	Recovery
Churning rate (lagged)	0.0187	0.175***	0.0268	0.0938	-0.111	0.00703
	(0.0670)	(0.0597)	(0.0507)	(0.209)	(0.141)	(0.114)
(Churning rate)^2 (lagged)	0.0349	-0.158***	-0.0305	-0.00594	-0.0941	0.00395
	(0.0616)	(0.0414)	(0.0444)	(0.210)	(0.114)	(0.0996)
Domestic firm # churning rate (lagged)	Ref	Ref	Ref	Ref	Ref	Ref
Foreign firm # churning rate (lagged)	-0.0425	-0.0701	0.129	-0.0930	0.0837	0.0947
	(0.0862)	(0.0809)	(0.0846)	(0.112)	(0.123)	(0.107)
Ln(age of firm)	-0.00185	-0.00750	0.0103	-0.00973	-0.0126	-0.0208
	(0.0132)	(0.0132)	(0.0104)	(0.0258)	(0.0261)	(0.0166)
Ln(number of employees)	0.0154	0.0113	0.0199***	0.00671	-0.00594	-0.0171
	(0.00949)	(0.00990)	(0.00741)	(0.0152)	(0.0225)	(0.0129)
Ln(capital stock)	0.00114	-0.00296	-0.0112***	-0.00148	0.00207	-0.00695
	(0.00502)	(0.00607)	(0.00383)	(0.00888)	(0.0144)	(0.00732)
Ln(wage level)	-0.0510***	-0.0594***	-0.0296*	-0.0252	-0.0273	0.0784**
	(0.0197)	(0.0183)	(0.0160)	(0.0452)	(0.0452)	(0.0350)
Foreign firm (dummy)	0.0504	0.00363	-0.0528**	0.0757*	-0.00509	-0.0228
	(0.0316)	(0.0262)	(0.0225)	(0.0450)	(0.0385)	(0.0340)
Location dummies	Yes	Yes	Yes	Yes	Yes	Yes
High wage (% of hired), lagged	0.0294	0.00822	0.0172	-0.0452	0.00909	-0.0628
	(0.0399)	(0.0335)	(0.0259)	(0.0663)	(0.0498)	(0.0422)
Tertiary education (% of hired), lagged	-0.0374	0.108***	0.0408	-0.0285	0.222***	0.0137
	(0.0397)	(0.0331)	(0.0308)	(0.0749)	(0.0658)	(0.0542)
Middle-aged (% of hired), lagged	0.0264	0.0506**	0.0247	-0.00135	-0.0267	-0.00594
	(0.0238)	(0.0228)	(0.0193)	(0.0530)	(0.0439)	(0.0393)
To higher wage decile (% of hired), lagged	-0.0154	-0.0496	0.00655	-0.0287	-0.0597	-0.139**
	(0.0377)	(0.0414)	(0.0487)	(0.0682)	(0.0679)	(0.0708)
More mobile (% of hired), lagged	0.0181	-0.0386*	-0.0202	-0.0401	0.0143	0.0318
	(0.0242)	(0.0231)	(0.0242)	(0.0463)	(0.0426)	(0.0364)
From exporting firm, (% of hired), lagged	-0.0248	0.0547	0.000855	0.0723	-0.0566	-0.0360
	(0.0408)	(0.0441)	(0.0415)	(0.0882)	(0.0638)	(0.0650)
From high labour productivity firm (% of hired), lagged	0.0540	0.00518	0.0439	-0.153*	0.0402	0.189**
Constant	1.090	0.736***	0.156	0.0955	0.739**	-0.285
	(0.981)	(0.146)	(0.143)	(0.328)	(0.336)	(0.288)
Observations	4,308	4,320	4,568	1,101	939	1,032
R-squared	0.052	0.040	0.020	0.115	0.163	0.102

Notes: * p <0.05, ** p<0.01 and *** p<0.001, standard errors in parenthesis.

Appendix C. Marginal effects of lagged churning rate in foreign and domestic firms

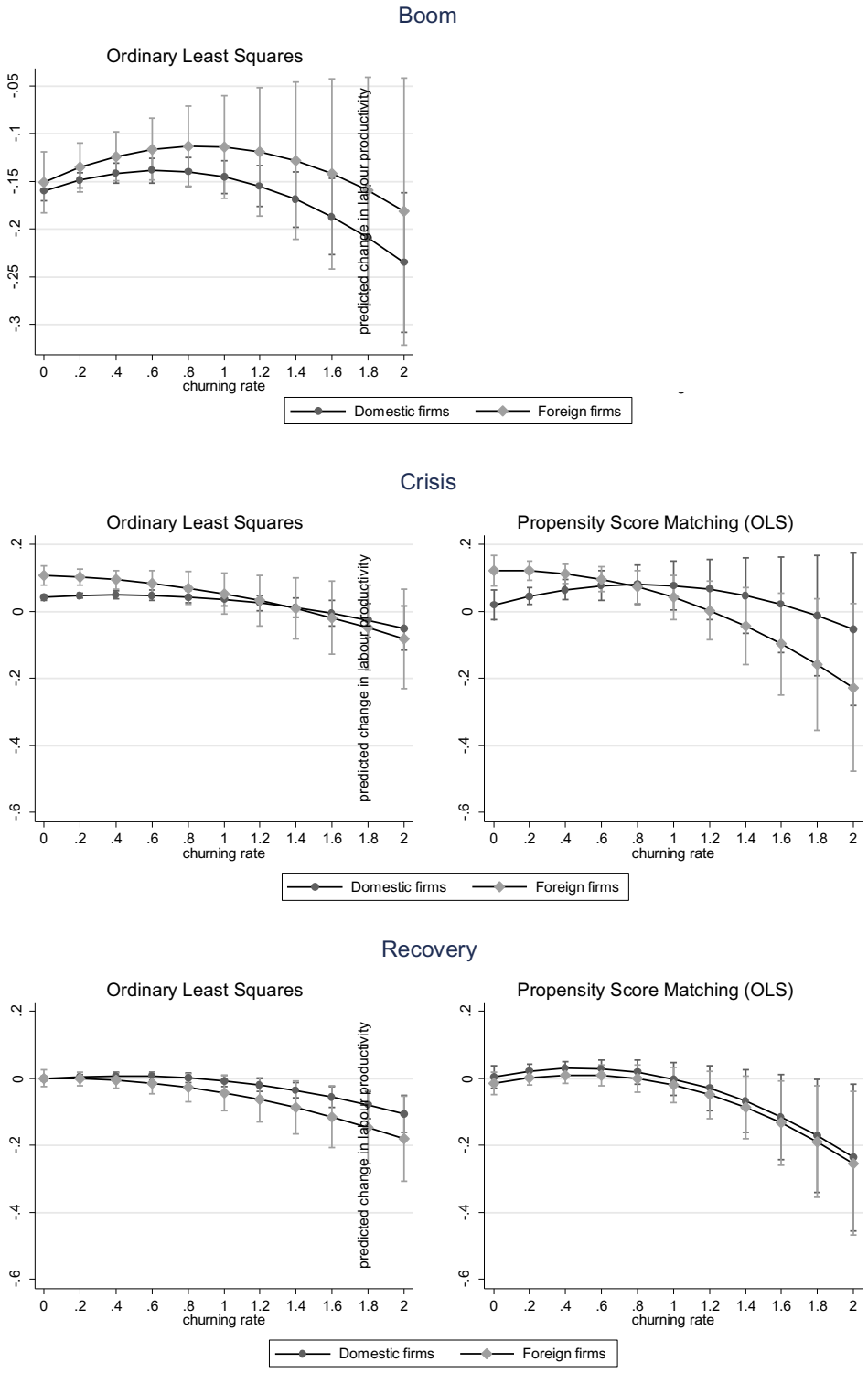


Figure C1. Marginal effects of lagged labour churning rate and labour productivity change in services

Appendix C (continued)

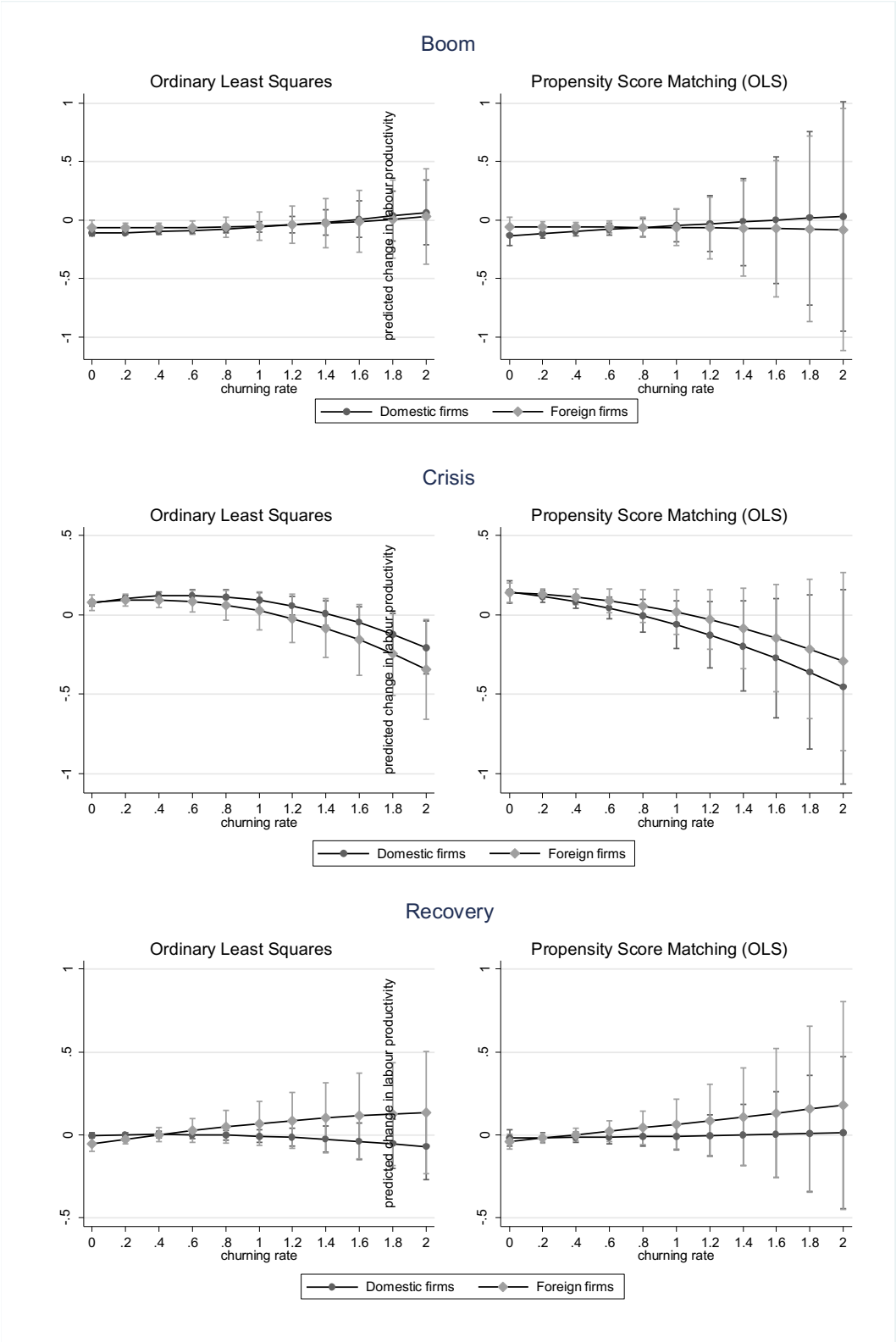


Figure C2. Marginal effects of lagged labour churning rate and labour productivity change in manufacturing

Appendix D. Robustness Check with Ordinary Least Squares estimates after using Propensity Score Matching technique

Robustness check, OLS estimations after propensity score matching technique, dependent variable change in labour productivity – services and manufacturing

	Services		Manufacturing	
VARIABLES	(1)	(2)	(3)	(4)
Churning rate (lagged)	0.137***	0.148***	0.173*	0.171*
	(0.04)	(0.04)	(0.10)	(0.10)
(Churning rate)^2 (lagged)	-0.053*	-0.059**	-0.112	-0.113
	(0.03)	(0.03)	(0.09)	(0.09)
Period 1#lagged churning rate	Ref. cat	Ref. cat	Ref. cat	Ref. cat
Period 2#lagged churning rate	-0.092**	-0.090**	-0.204**	-0.207**
	(0.04)	(0.04)	(0.09)	(0.09)
Period 3#lagged churning rate	-0.131***	-0.135***	-0.020	-0.028
	(0.04)	(0.04)	(0.08)	(0.08)
Ln(age of firm)	0.003	0.003	-0.013	-0.011
	(0.01)	(0.01)	(0.01)	(0.01)
Ln(number of employees)	0.003	0.003	-0.006	-0.007
	(0.01)	(0.01)	(0.01)	(0.01)
Ln(capital stock)	-0.002	-0.002	-0.003	-0.003
	(0.00)	(0.00)	(0.01)	(0.01)
Ln(wage level)	-0.046***	-0.054***	-0.011	-0.021
	(0.01)	(0.01)	(0.02)	(0.02)
Foreign firm (dummy)	0.023**	0.024**	0.016	0.018
	(0.01)	(0.01)	(0.01)	(0.01)
High wage (% of hired)	-0.013	No	-0.025	No
	(0.02)		(0.03)	
Tertiary education (% of hired), lagged	-0.023	No	0.060	No
	(0.02)		(0.04)	
Middle-aged (% of hired), lagged	0.017	No	-0.012	No
	(0.02)		(0.03)	
To higher wage decile (% of hired), lagged	0.016	No	-0.036	No
	(0.02)		(0.04)	
From exporting firm, (% of hired), lagged	0.004	No	-0.004	No
	(0.03)		(0.04)	
From high labour productivity firm (% of hired)	-0.009	No	0.011	No
	(0.02)		(0.05)	
More mobile (% of hired), lagged	-0.038**	No	0.008	No
	(0.02)		(0.02)	
NACE two-digit codes	Yes	Yes	Yes	Yes
Dummies for 3 periods	Yes	Yes	Yes	Yes
Location dummies	Yes	Yes	Yes	Yes
Constant	0.156	0.203**	0.199	0.267
	(0.10)	(0.09)	(0.19)	(0.17)
Observations	6,244	6,244	3,072	3,072
R-squared	0.096	0.094	0.079	0.077

Notes: Columns (1) to (4) indicate the results of the OLS models that have been calculated after Propensity Score Matching technique. Results with even numbers do not include the characteristics of newly hired employees.

* p <0.05, ** p<0.01 and *** p<0.001, robust standard errors in parenthesis.

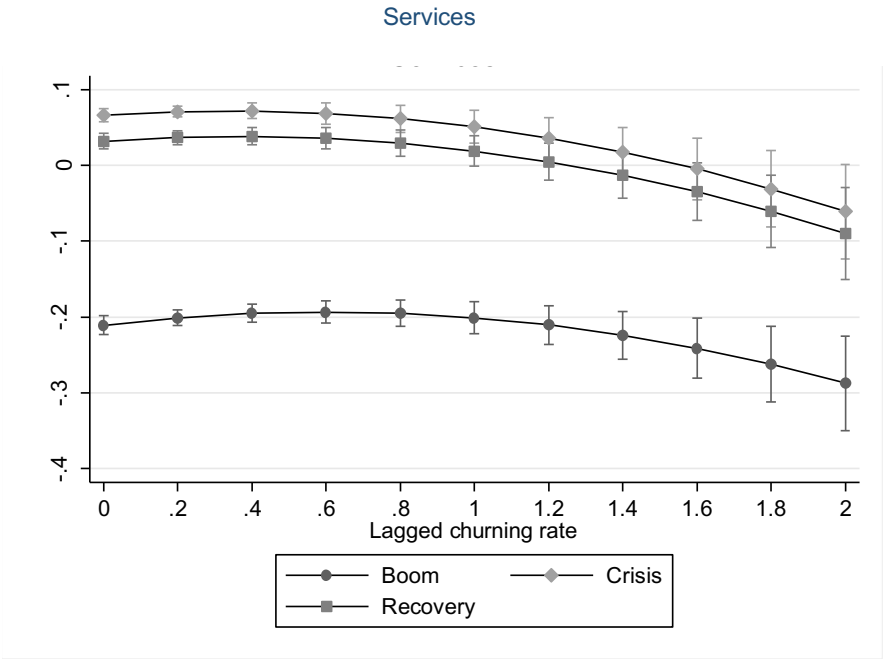
Appendix E. Robustness Check, panel data with Fixed Effects estimator and Ordinary Least Squares estimates with clustered standard errors

Table E1. Robustness check, dependent variable change in labour productivity, clustered standard errors ordinary least squares estimations services and manufacturing

	Fixed Effects				OLS with clustered standard errors			
	Services		Manufacturing		Services		Manufacturing	
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Churning rate (lagged)	0.062***	0.074***	0.058	0.139***	0.062***	0.074***	0.070**	0.139***
	(0.02)	(0.01)	(0.04)	(0.04)	(0.01)	(0.01)	(0.03)	(0.04)
(Churning rate)^2 (lagged)	-0.043***	-0.049***	-0.025	-0.068***	-0.043***	-0.049***	-0.028	-0.068***
	(0.01)	(0.01)	(0.03)	(0.03)	(0.01)	(0.01)	(0.02)	(0.03)
Period 1#lagged churning rate	Ref.	Ref.	Ref.	Ref.	Ref	Ref	Ref	Ref
Period 2#lagged churning rate	-0.024*	-0.021	-0.027	-0.038	-0.024*	-0.021	-0.034	-0.038
	(0.01)	(0.01)	(0.04)	(0.04)	(0.01)	(0.01)	(0.04)	(0.04)
Period 3#lagged churning rate	-0.038***	-0.035***	-0.052	-0.053	-0.038***	-0.036***	-0.058*	-0.053
	(0.01)	(0.01)	(0.03)	(0.04)	(0.01)	(0.01)	(0.03)	(0.04)
Ln(age of firm)	-0.010***	-0.011***	-0.053***	-0.004	-0.009***	-0.010***	-0.039***	-0.004
	(0.00)	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)	(0.01)	(0.01)
Ln(number of employees)	0.023***	0.024***	-0.048***	0.019***	0.021***	0.023***	-0.041***	0.019***
	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Ln(capital stock)	-0.008***	-0.008***	0.056***	-0.004*	-0.008***	-0.008***	0.044***	-0.004*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Ln(wage level)	-0.047***	-0.047***	0.125***	-0.050***	-0.044***	-0.045***	0.112***	-0.050***
	(0.00)	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)	(0.01)	(0.01)
Foreign firm (dummy)	0.024***	0.024***	0.045***	0.001	0.023***	0.024***	0.032***	0.001
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
High wage (% of hired)	-0.008	No	0.029	No	-0.008	No	0.030*	No
	(0.01)		(0.02)		(0.01)		(0.02)	
Tertiary education (% of hired), lagged	0.023***	No	0.051***	No	0.021***	No	0.046**	No
	(0.01)		(0.02)		(0.01)		(0.02)	
Middle-aged (% of hired), lagged	0.027***	No	0.034***	No	0.026***	No	0.037***	No
	(0.01)		(0.01)		(0.01)		(0.01)	
To higher wage decile (% of hired), lagged	-0.000	No	-0.006	No	-0.001	No	-0.005	No
	(0.01)		(0.02)		(0.01)		(0.02)	
From exporting firm, (% of hired), lagged	0.013	No	0.012	No	0.013	No	0.015	No
	(0.01)		(0.02)		(0.01)		(0.02)	
From high labour productivity firm (% of hired)	-0.010	No	0.038	No	-0.010	No	0.041*	No
	(0.01)		(0.02)		(0.01)		(0.02)	
More mobile (% of hired), lagged	-0.013*	No	0.008	No	-0.013*	No	0.005	No
	(0.01)		(0.01)		(0.01)		(0.01)	
NACE two-digit codes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dummies for 3 periods	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Location dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.472**	0.254**	2.418***	0.204***	0.223***	0.228***	1.583***	0.266***
	(0.23)	(0.10)	(0.10)	(0.06)	(0.03)	(0.03)	(0.10)	(0.08)
Observations	49,973	49,973	13,196	13,196	49,973	49,973	13,196	13,196
R-squared					0.047	0.046	0.170	0.038

Notes: Columns (1) to (4) indicate the OLS estimates that have been calculated after Propensity Score Matching technique. Results with even numbers do not include the characteristics of newly hired employees.
* p <0.05, ** p<0.01 and *** p<0.001, robust standard errors in parenthesis.

Appendix E. (continued)



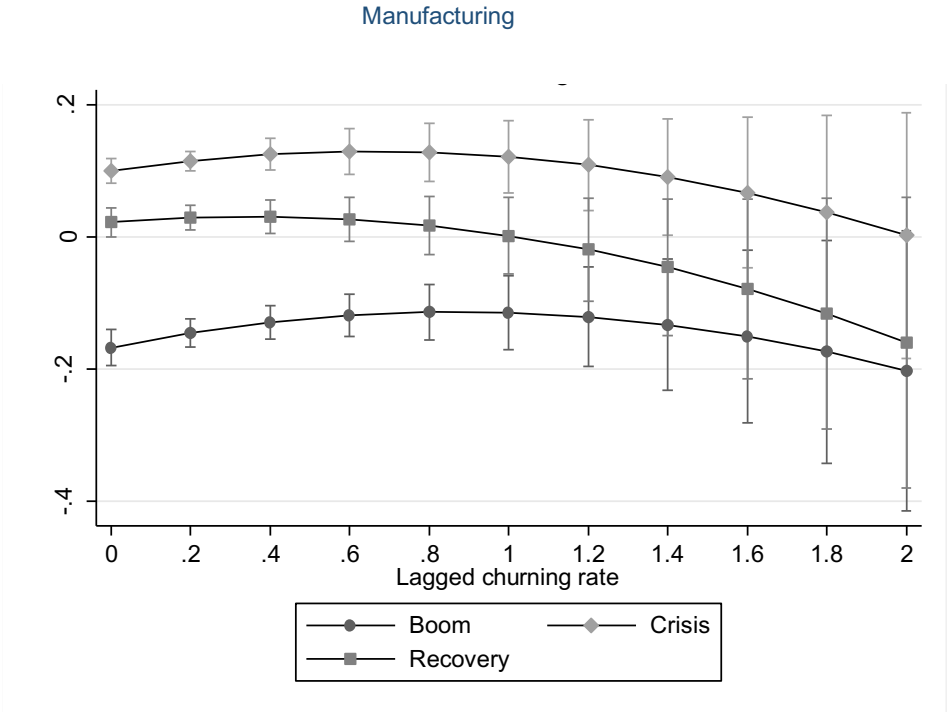
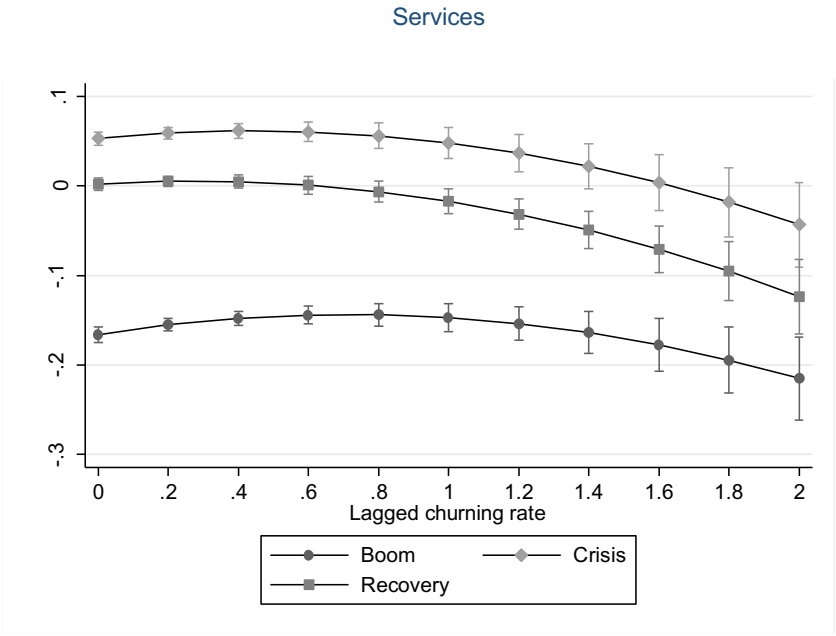


Figure E1. Equation 1, panel data model with Fixed Effects estimator. Marginal effects of lagged labour churning rate and labour productivity change in services and manufacturing

Appendix E. (continued)



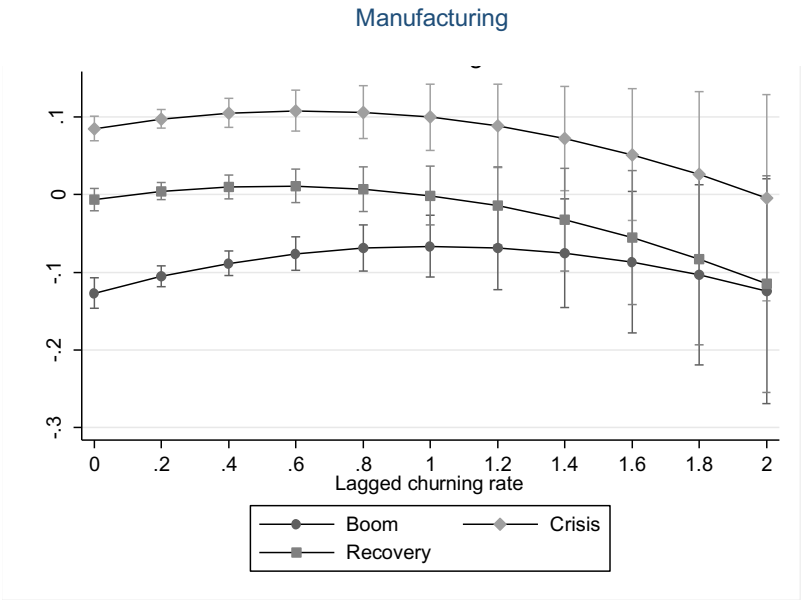


Figure E2. Equation 1, OLS estimation with clustered standard errors. Marginal effects of lagged labour churning rate and labour productivity change in services and manufacturing.