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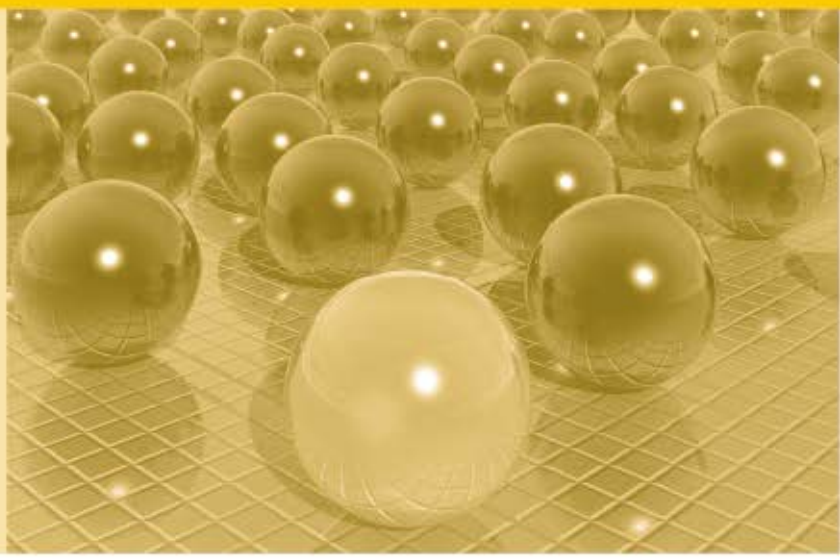

How to define an enterprise and assign trade declarations to the right one: Exploration of German traders' micro transaction data

Claudia Stirböck

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Claudia Stirböck[*]

Abstract

This paper presents a novel approach to associating Intrastat trade declarations for the year 2004 at the firm level. matching them with the German business register. In theory, by using the VAT number, this should be fairly straightforward. In actual fact, however, there are quite a number of problems that have to be tackled. Among these are changes in the turnover tax number and systematic non-availability in the business register (especially of enterprises declaring by using a foreign address). Moreover, 2004 was marked by EU enlargement during the year and a number of temporary declaration failures. Although it is necessary to control for all these biases in any analyses, the big advantage of these matched data is that they allow in-depth investigations (at least in terms of intra-EU trade) not only of foreign trade turnover, but also of the number, kind, value, and range of goods imported and exported.

Zusammenfassung

In diesem Papier wird ein neuer Versuch präsentiert, Intrastat-Außenhandels-Meldedaten des Jahres 2004 auf Firmenebene mit dem deutschen Unternehmensregister zusammenzuführen. Theoretisch sollte ein Match anhand der Steuernummer ein einfaches Unterfangen sein. Tatsächlich stellen sich jedoch eine Reihe von Herausforderungen, darunter Steuernummernwechsel und systematische Nichtverfügbarkeit von Einheiten im Unternehmensregister (insbesondere von mit einer ausländischen Adresse meldenden Unternehmen). Zudem war das Jahr 2004 durch die EU-Erweiterung und hieraus resultierende vorübergehende Meldeausfälle geprägt. Obgleich diese Verzerrungen bei einer Analyse berücksichtigt werden müssen, liegt der analytische Vorteil von

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Auswertungen dieser zusammengeführten Informationen darin, dass vielschichtige Untersuchungen des Intra-EU-Handels möglich sind - nicht nur der Außenhandelsumsatz, sondern auch Anzahl, Art, Wert und Tiefe an im- und exportierten Gütern können betrachtet werden.

How to define an enterprise and assign trade declarations to the right one: Exploration of micro transaction data of German traders

1 Introduction

This paper assesses the potential and the limits of scientific analyses using micro transaction data of German traders for 2004. It describes the contents of the transaction data and a novel approach to associating trade declarations at the firm-level so as to be in a position to explore enterprises' trading activity. Until recently, analyses of international trading by German enterprises were few due to the lack of adequate and comprehensive micro data. Up to now, research has tried to exploit data sources other than the official German foreign trade statistics. In doing so, research until very recently was restricted, first, to exports, second, to only a sample and not a complete population of exporting firms, and, third, to the analysis of turnover rather than product ranges or varieties.

So far two samples of exporting enterprises, including information on enterprises' export turnovers, have, at times, been used for scientific purposes. Wagner (eg 1995, 2002, 2004, 2006) and Wagner/Fryges (2007) study data on foreign sales of Lower Saxonian manufacturing enterprises since 1978 using survey data from the "monthly report on local units in manufacturing and mining".[1] This survey covers, for instance, a total of 6,000 different Lower Saxonian enterprises over the time span from 1995 to 2002, of which almost 3,000 exporters. Arnold/Hussinger (2005) use the firm-level data from the Mannheim Innovation Panel (MIP) of the Centre for European Economic Research (ZEW) which contains information on the enterprises' export value. The authors thus refer to an unbalanced panel of 2,149 enterprises for the years 1992 to 2000 with 1,260 selling more than 5% of their turnover abroad.

Some further studies analyse databases that include information on an enterprise's status, ie whether it is an exporter or a non-exporter. Schank/Schnabel/Wagner (2007) exploit the IAB Establishment Panel's information on the exporting status of 1,262 employers and combine it with the respective employees' data (eg on wages) from the employment statistics. Kleinert/Toubal (2005) make use of the Bundesbank's micro database on direct investments (MiDi) covering all German direct investments abroad. They include 53,715 parent-affiliate-year combinations of manufacturing enterprises between 1996 and 1999 and simply assume that the pure wholesale classification (as

[1] The data are collected in an exhaustive survey covering all manufacturing enterprises with at least 20 employees. This amounts to almost 50,000 enterprises throughout Germany (see Krockow, 2003).

opposed to production or wholesale plus production classification) of affiliates in a foreign country implies export activity of the parent (manufacturing) enterprise in Germany. Buch/Lipponer (2007) combine the MiDi database with information from the commercial Dafne database, for example, on the exporting status of an enterprise. Their database includes 2,500 enterprises over eight years (8,600 enterprise observations) among those almost 300 pure exporters and 500 multinationals (mostly also exporting). Buch et al. (2006) use data from the Bundesbank's corporate balance sheet statistics matched with information on the exporting status of an enterprise from the "monthly report on local units in manufacturing and mining" from Baden-Württemberg. Like Wagner (1995, 2002, 2004), the authors are restricted to data from one German Federal State.

The German Federal Statistical Office is constantly working on improving the availability of micro databases.[2] With respect to German traders, an initial feasibility study was conducted grouping the official intra-community trade data according to enterprise categories (eg turnover or number of employees) with data for 2002. This meant that for a first time results of a descriptive analysis of German traders differentiated at sectoral level could be published (see Loschky, 2004). In addition, since the end of 2006, data from the "monthly report on local units in manufacturing and mining" are available for Germany as a whole for 1995 to 2004. Although it is not part of the official foreign trade statistics, information on sales abroad is provided. Wagner (2007a, 2007b, 2007c) are exhaustive scientific investigations using this survey data covering all (nearly 50,000) manufacturing enterprises of a certain size. A detailed comparison of "exports" provided by the foreign trade statistics and of "sales abroad" resulting from the monthly reports is given by Krockow (2003). Finally, since mid-2009 trade turnover data from the tax statistics linked to the business register has been available as a panel from 2001 to 2006. This means that it has only very recently been possible to undertake an analysis of trade activity and dynamics (Vogel/Wagner 2009).

In the following, I describe a novel attempt to comprehensively assign transaction data from the official foreign trade statistics for the 2004 reporting year to enterprises.[3] In doing so, sectorally and regionally differentiated firm-level trade activity is obtained and combinable with the German business register.[4] The micro transaction data on trade cover all German enterprises engaging in intra-community trade that surpass a defined turnover threshold; they thus encompass a complete panel of traders. In addition, by using these data, we might analyse *imports and exports* of German enterprises simultaneously. This is all the more the case as investigations are not restricted to foreign trade *turnover*, but give insights into the number, kind, value, and range of goods traded by one firm – up to

[2] The research data centre of the Federal Statistical Office and the statistical offices of the Länder, which was established in 2001, aims at making micro data of the official statistics usable for scientific purposes (www.forschungsdatenzentrum.de).
[3] These micro level data are strictly confidential and for use inside the research data centre of the Federal Statistical Office and the statistical offices of the Länder only.
[4] Although trade declarations for 2005 have already been revised and finalised at the time of matching, they can be processed and linked only once the business register for the adequate reporting year is available. However, at the time of matching (ie 2007), the business register for 2006 was not yet available.

the eight-digit product level of the trade nomenclature. We might thus focus on the specificity of the products traded, firms' product diversity and regional diversification or specialisation in EU-wide trade. In addition, we might compare import and export activity as well as analyse simultaneous import-export activity of trading firms.

2 Major information on the micro transaction data on trade

2.1 Intra-community trade statistics at micro transaction level

Germany's special trade data[5] are published as the result of extra- and intra-community trade statistics. Since the completion of the Single European Market on 1 January 1993 and the subsequent abolishment of customs commodity control at the internal borders of the member states of the European Union (EU), foreign trade data are compiled using two different sources, namely intra- and extra-community trade statistics. Intra-community trade statistics ("Intrastat") cover the trade in goods with EU member countries while extra-community trade statistics cover the cross-border trading of goods between Germany and states outside the European Union, ie the non-member countries. Extra-community trade data are collected in the traditional way via the customs authorities.[6]

To compile intra-community trade data, any enterprise above a certain threshold is obliged to report precise information on the foreign trade activity of its enterprise, ie the exact kind of goods traded and the countries imported from or exported to. We thus theoretically have a 100%-coverage of this enterprise group.[7] Businesses engaged in foreign trade submit their declarations directly to the Federal Statistical Office on standardised forms when they exceed the threshold defined in the current or previous year for the amount of either dispatches to other member states or of arrivals from those countries. This threshold amounted to €200,000 up to 2004 and €300,000 thereafter. Enterprises are obliged to submit a declaration on their trade activity once they surpass the threshold or if they surpassed the threshold the year before. Therefore, theoretically, the trade activity of shrinking enterprises is well covered when analysing Intrastat transaction data while growing enterprises' foreign trade turnover might be downward biased. However, without any enterprise demography, we cannot easily differentiate between arising enterprises, growing enterprises, short-living enterprises, and status-changing entities (from the status of single enterprise to the status of local unit or VAT group member and vice versa).

Aggregating (comparable) monthly notifications to the annual level led to no fewer than 9.17 (6.45) million single differentiated transactions for dispatches to other member states and arrivals from those

[5] This database covers trade according to the special trade statistics published by the Federal Statistical Office, not general trade (including imports into stocks/exports from stocks, ie customs and free zone warehouses) or merchandise trade (including supplementary trade items) as published by the Deutsche Bundesbank in the current account statistics. Basically, special trade covers goods that are imported into Germany for use, consumption, treatment or processing, and goods exported that were produced, treated or processed inside Germany. Until the end of 2006, goods temporarily imported or exported for repair were also included.

[6] A customs declaration must be submitted for any consignment of goods whose value is above €1,000 However, consignments whose value is below that threshold, but whose total weight exceeds 1,000 kg must be declared as well.

[7] Instructions on how to complete the Intrastat forms are available on: http://www.destatis.de.

countries for 2005 (2004) as a whole.[8] Technically, these "arrivals" are imports consigned by another EU country. Since the origin of a good is important for analytical purposes, economic analyses usually focus on foreign trade according to the country of origin principle.[9] The intra-community trade survey principally encompasses all imports consigned within the EU. Given that the information on the country of origin is available in each declaration in addition to the country of consignment, I decided to keep notifications only for imports originating in other EU countries. Besides the information on the partner country, these declarations are differentiated by product as well as by the German Federal State which is the region of origin or of final destination.[10]

On the basis of these differentiated declarations for 2004, it is possible to investigate foreign trade activity with other EU member states. It was possible to exploit some information on data for 2005 at the time of matching[11], but only at a more aggregated level. At the time of matching,, the (VAT) tax number, which would have been necessary for linking any extra EU trade declaration either to the business register (see section 2.2) or the intra-community trade statistics was not available from the customs authorities owing to legal restrictions.[12] This means that, for the 2004 data, micro-transactions level analyses are restricted to intra-community trade. But intra-community trade already covers a large share of German enterprises' foreign trade activity. According to the special trade statistics, 59% (59.5%) of imports and 63.4% (63.7%) of German exports came from or went to the 24 other EU member countries in 2005 (2004).

The total number of enterprises engaged in intra-community foreign trade in the course of a year is known from the turnover tax statistics and is specified by the Federal Statistical Office each year. In 2004, almost 3 million enterprises were obliged to pay turnover taxes in Germany (Statistisches Bundesamt, 2006). Of those, almost 470,000 received commodities from or delivered commodities to other EU member countries. The number of mere exporters (importers) amounted to some 90,000 (265,000), while around 115,000 enterprises accounted for both imports from and exports to other states of the EU.[13] In 2005, nearly 510,000 enterprises in Germany received commodities from or delivered commodities to other EU member countries. The number of enterprises involved in imports (about 413,000 pure importers plus exporting importers) was almost twice the number of exporting enterprises (some 219,000).[14]

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[8] The Statistical Office's trade department provided us with raw declarations data checked for plausibility and aggregated to the monthly level.
produ[9] In this context, we have to differentiate between the two international concepts of recording trade: firstly, the country of origin principle and, secondly, the country of consignment principle. The first focuses on the partner country which actually ced, treated or substantially processed the good imported by Germany. According to the country of consignment principle, trade is recorded by the partner country which eventually, eg after some customs treatment, consigned a commodity to Germany, eg by air, ship or road, without the good being subject to a special transit treatment.
[10] Declarations of trade in goods in the special trade statistics are at market value. Exports are on a f.o.b. basis (free on board at the German border) and imports on a c.i.f. basis (including costs for insurance and freight up to the German border).
[11] At the time of matching (ie 2007), the business register for 2006 was not yet available.
[12] The Federal Statistics Office is working on implementing new technical features. Together with legal changes concerning the use of tax numbers, these might provide a much better starting point for future more comprehensive matches of trade statistics and business register starting with the 2010 transaction data once finalised.
[13] See press release from 14 September 2005 on http://www.destatis.de.
[14] See press release from 9 August 2006 on http://www.destatis.de.

The number of enterprises submitting a declaration of intra-community trade, however, is much smaller than the number of enterprises that trade with other EU member countries. Since only a few enterprises generate the bulk of the aggregated German trade value, there is no need to demand declarations from all trading enterprises to have sufficient information on the crucial, precise breakdown of trade activity by region and by commodity. Foreign trade below the threshold as well as the value of non-declarations are added as estimates to represent total trade. These estimates are higher for imports than for exports. Naturally, they are not enterprise-related, so I have eliminated them from the raw data. In addition, I have excluded invalid or inconsistent tax numbers. Thus, the foreign trade declarations' data, with which I start, do not cover 100% of published foreign trade values. Overall, trade transaction declarations available thus refer to a little less than 15% of German enterprises that traded in 2004 and 2005, but amount to more than 97% of the *export value* given by the (aggregate) special trade statistics. The coverage of the *value of imports* originating in other EU member states by our declarations-based database is somewhat lower than the coverage for exports. Altogether, the sum of imports in our micro database accounts for about 93% of the value of total EU country of origin imports for 2004 and 2005.

In this context, recording principles matter to some extent. However, most imports originating in other EU countries are consigned by this same country and move throughout other EU partner countries without or only with transport-related stops, country of origin and country of consignment thus do not differ. This is also the case if goods imported from other EU countries pass through an extra-community country such as Switzerland.[15] Referring to the preliminary data, we can conclude that about 1% of imports *originating* in EU partner countries are generally not covered when relating to the consignment-based Intrastat data. Consequently, intra-community imports according to the country of origin principle are thus quite well covered by the firm-level declarations in the Intrastat trade statistics.[16]

Table 1: Coverage of German intra-community trade by proper firm-level declarations; country of origin principle

	Imports	Exports
2004 [1]	92.7 %	97.5 %

[15] These temporary imports and exports are admitted under special customs procedures that allow the goods to pass through the territory of transit.
[16] This, however, is different concerning imports originating in non-EU countries due to legal transactions, eg customs declarations, in other EU countries. Therefore, German intra-community imports rate much higher according to the country of consignment principle than according to the country of origin principle (about €32 (35) billion for 2004 (2005)).

2005	93.5 %	97.4 %

Note: The 100%-level is defined by the value of imports originating in other EU member states and the value of exports designated to these countries.
[1] Figures refer to 2004 as a whole as long as the former EU member states are concerned and to the last eight months of 2004 for the ten new member countries.

2004 was marked by EU enlargement which took place on 1 May. As a consequence, foreign trade with the ten new member countries changed from extra-community to intra-community status over the course of the year. In the intra-community trade statistics, we thus have data for 12 months for trade with the previous EU partner countries, but data for only 8 months for trade with the new ones. In addition, declarations of trade with the new member countries are less reliable and less comprehensive for the first months after EU enlargement.[17] This has to be taken into account when analysing 2004.

Regarding product categories, declarations are based on the German version of the EC's Combined Nomenclature (CN) which is the "*Warenverzeichnis für die Außenhandelsstatistik*" (WA).[18] This is broken down into 98 sections, each including quite a number of specific product categories at the 8-digit level. Converting this nomenclature's product categories to the 5-digit level of the Standard International Trade Classification (SITC) Rev.3, it leads to 3,118 differentiated product categories at the 5-digit level and to 1,033 product categories at the 4-digit level (see Hoeppner 2005).

2.2 The German business register: concept and consistency with trade declarations

The German business register includes any active resident enterprises with employees liable to pay social insurance contributions and/or with taxable turnover, ie the total population of German firms with at least one employee or turnover of at least €17,500.[19] Work on establishing this register has been ongoing for a number of years and is discussed among others by Nahm/Stock (2004), Wagner (2004), Nahm/Philipp (2005), Sturm/Tümmler (2006), and Mödinger/Philipp (2007).

For our purpose, the German business register is not only a source of valuable additional firm-specific information (eg turnover and employment figures), it is also a helpful basis to identify active enterprises and to combine enterprises over time (see section 3). It covers almost all branches of economic activity with the exception of agriculture and forestry, fishing, and public administration – sectors that are actually not very important in German trade, which therefore does not pose a problem for our match. However, it focuses on "resident" enterprises which proves to be rather restrictive and will be discussed in detail below.

[17] Although enterprises were explicitly advised that as of May 2004 trade in goods with the new EU countries would be subject to the reporting requirement for intra-trade statistics, it cannot be ruled out that, at least temporarily, many enterprises have failed to report these figures (see Deutsche Bundesbank, 2005: 28).
[18] For further information see "Warenverzeichnis für die Außenhandelsstatistik" on http://www.destatis.de.
[19] The sources used for maintaining and updating the business register are, on the one hand, administrative data files as they are produced by the German Federal Employment Agency and the tax authorities and, on the other, individual statistics such as statistical returns from surveys carried out in industry, trade, the services sector, etc. The business register is maintained by the statistical offices of the Länder. For further information see http://www.destatis.de.

Any enterprise with a turnover of at least €17,500 (and thus subject to VAT declarations) is included in the business register. Since the threshold for trade declarations is much higher, all internationally trading and declaring enterprises should generally be covered. It is important to note that the business register comprises single enterprises as well as VAT groups ("*umsatzsteuerliche Organschaften*"[20]) and their respective taxable turnover. Fortunately, this is the same enterprise level as in intra-community trade declarations since the same unit that is subject to turnover taxes is also responsible for providing information on the trade activity. This means that enterprises have to declare taxable turnover (including intra-community trade turnover) and intra-community trade at the very same enterprise level. Thus, any match should give us consistent attributions of total and trade turnover.

VAT groups contribute to the bulk of taxable turnover. For the 2003 reporting year, about 45% of total taxable turnover in the tax turnover statistics can be related to only 3% of business register enterprises, which all belong to such VAT groups (see Sturm/Tümmler, 2006: 1025). Depending on the kind of analysis, the association of a certain turnover to the producing economic entity and not only to the controlling company filing the turnover tax reports might be of importance (for the description of an estimated turnover variable see Wagner, 2004). Furthermore, VAT groups are not uniformly distributed across sectors, but are more widespread in some sectors. They are more important in economic sectors such as "manufacturing" and "trade, maintenance and repair of automobiles and other commodities". For example, they are especially frequent for (administrative) holdings (see Wagner, 2004: 1006). The same is relevant with respect to international traders. Loschky (2004) recounts that a large part of trade is declared by such holdings. In the case of a sector-related analysis, a re-classification such as that by Loschky (2004) would be preferable. If an investigation, however, is only goods-related, we can neglect this aspect.

3 Linking Intrastat transaction data to the business register

Essentially, trade transaction data are associated with enterprises by linking Intrastat declarations for 2004 to the business register for the 2004 reporting year. This was achieved via a number of steps which are described below.[21] The business register is not only consistent with the intra-community trade statistics, in principle both are also based on the turnover tax number. To be precise, the intra-community trade statistics use the turnover tax number ("VAT number as stated in the advance turnover tax return") as an identifier or sequence number while the business register has, in addition to this, introduced a specific identifier which is consistent and fixed over time. In theory, matching trade data and the business register should be fairly straightforward. De facto, there are some

[20] "Umsatzsteuerliche Organschaft" is a special construction resulting from the German tax legislation to avoid financial disadvantages. Intra-group trade does not lead to taxable turnovers and tax payments, but only the group's consolidated turnover (Wagner, 2004).

[21] Typically, the time lag between the reference date and the time when the relevant data of the business register become available to users amounts to two years. This means that trade data for 2005 can only be matched with the respective business register at a later point of time. Any match so far would be provisional and not based on the appropriate reporting year's structure.

problems to be tackled. Among these are changes in the turnover tax number and systematic non-availability in the business register. These will be described later on.

One big advantage of the business register identifier is that it allows enterprises to be linked over time and thus enables us to exploit the enterprises' history and to overcome changes in turnover tax numbers to a large extent. Structural changes are incorporated in the business register with respect to formation, continuation and closing down of a company. Mergers or acquisitions and the splitting up of companies as well as asset stripping are, however, more difficult to deal with statistically. Nahm/Philipp (2005) describe the respective identification procedure of real and false closures as well as real and false formations of enterprises. In any panel analysis, two main cases of unreal closures/formations of enterprises will have to be taken into account. First, at least one of two enterprises involved in a merger or acquisition will appear to have died while the other one might be marked by an upward turnover shift. A split of one enterprise into parts, on the other hand, appears as a formation of, at least, one new one and a downward turnover shift of the other one. These difficulties and specificities might affect our annual declarations-enterprise link, and will become especially problematic when constructing a panel of trading enterprises.

The principal problem concerning the association of trade declarations to business register enterprises is that enterprises change their turnover tax number to a non-negligible extent. Such changes in turnover tax numbers occur in several cases, some of which might affect our linkage. First, if the enterprise changes its main activity or legal form. Second, if the respective fiscal authorities structurally reorganise tax numbers or restructure fiscal authority districts. Third, if the structural change in an enterprise mentioned above, ie a merger, acquisition or the division of a company etc as well as if insolvency proceedings are instigated. In addition, relocating headquarters to a different Federal State implies a change in turnover tax number which the business register has just started to record additionally.

Unfortunately, turnover tax numbers also change over the course of one year. In these cases, the main difficulty is to associate intra-community trade declarations to genuine enterprises. Since enterprises report trade activity by means of their contemporary turnover tax number, declarations by means of the new as well as the former numbers have to be linked over the years, but also within one year.[22] Associating declarations incorrectly to enterprises will lead to biased results in any analysis especially in the case of mergers and acquisitions as well as insolvencies.

[22] If two consecutive tax number changes occur within one year, the attribution of ALL declarations will be impossible. However, this effect should be negligible, but systematic, for example, if insolvency treatment and enterprise survival is started.

To tackle all these problems, the business register forms my starting point to link intra-trade statistic declarations and to identify trading enterprises.[23] By exploiting or matching business registers of several reporting years over time, in addition to the contemporary turnover tax number, I gain information on former tax numbers.

In a number of cases, I had to exclude duplicates from the business register while matching. In most of these cases, one turnover tax number was attributed to two different business register IDs - one comprising the information on taxable turnover and the other the information on employees. This led to the exclusion of the latter since I attached priority to obtaining turnover figures over employment figures - although we need both to construct productivity measures. In some rare cases, taxable turnover referred to different reporting years. And, in this case, the observation with the reference years' taxable turnover was used for the link. In all cases with ambiguous duplicates, both observations were removed from the match. I applied this procedure consecutively to all three different business register matches where the trade declarations' tax number matches produced doublets. However, for reasons of consistency and simplicity I removed the same business register identifiers from any match described below.

The business register not only covers quite a large number of enterprises, it also distinguishes which of these were active in the reporting year and includes information on inactive enterprises. This is important to control for to not inadvertently associate a declaration to an inactive (ie not genuine) enterprise via a tax number which was in use some time ago by an enterprise that is now inactive. Any enterprise having declared turnover taxes or employing employees subject to social insurance contribution (at any time or in at least one month of the reporting year) can be considered to have been *active* (over the whole year or at least some period of the year). Concentrating on active enterprises is important since a previous tax number is only blocked for two full calendar years before it can be given to a new enterprise; hence it is not a unique identifier. On the basis of the business register for the 2004 reporting year (mostly called "URS 2006"), trade declarations attributable to any active enterprise can be accepted in the analysis of transaction data on trade.

In a second step, additional information is taken from the intra-community trade register as of the end of 2006.[24] From this data source, we discover whether an enterprise declared intra-community trade flows in its turnover tax declaration in 2004. We would thus also consider it to be an *active* enterprise in the respective year and a valid enterprise attribution of trade declarations. The problem, however, is that the intra-community trade register as of the end of 2006 (our snapshot) only gives us the tax

[23] It is difficult to use the Intrastat register for this purpose since no historical snapshots are available. The Intrastat register could be very helpful since it documents the current tax number of each enterprise in addition to the previous one. However, further (older) numbers are not documented. Therefore, the latest status of the Intrastat register (we refer to a snapshot of enterprises at the end of 2006 below) is only helpful to a limited extent and we use it as an additional source of information below.

[24] Trade statistics provided a snapshot as of the end of 2006. The register, however, is updated monthly, at the time of this project overwriting information on more than two VAT numbers.

number effective at the end of 2006 and, if one former exists, the former one. Finally, I check the VAT group attribution and regroup trade declarations if necessary in a third and a fourth step.

To associate trade declarations to the right enterprise, I apply the following procedure in step I. I first take trade declarations by any (VAT) tax number used and link them to active enterprises in the business register. If declarations' tax numbers cannot be linked to the turnover tax numbers displayed in the 2004 business register, I refer to turnover tax numbers documented in former business registers and assign them to the respective reporting years. For the year in focus, 2004, it is possible to directly link 86.2% of all tax numbers used in trade declarations (60,887 of 70,635 turnover tax numbers). In addition, I find another 6.4% of tax numbers used in 2004 trade declarations in the business registers from 2003 and 2002.

In this context, it is important to note that the different business registers for the reporting years 2004, 2003, and 2002 use VAT numbers as of June 2005, June 2004, and June 2003. The "former" turnover tax number of any enterprise that changed its tax number between January and July 2004, is only documented in the business register for the 2002 reporting year. On the other hand, any 2004 trade declaration where a (former) tax number changed between July 2004 and June 2005 cannot be linked to the corresponding enterprise directly, but only indirectly by use of the 2003 business register. Since any tax number is blocked for two full calendar years (ie at least 24 months) after having been in use, we can rule out the possibility that it might have been attributed to another enterprise within these two years and we can be sure of reaching the genuine enterprise. Linking these tax numbers by use of the respective business registers, 1,410 further trading enterprises can be identified while the largest part of tax numbers belongs to traders already identified in our direct link (declarations to be accumulated to those declarations or assigned to those enterprises identified by use of the more recent tax number). I find more than two-thirds of these further 4,534 tax numbers in the business register for the 2003 reporting year which can be ascribed to tax number changes between July 2004 and June 2005. Consistently, the significantly smaller part of those can be detected by use of the business register for the 2002 reporting year since these only refer to tax number changes between January and June 2004.

For the missing matches between the turnover tax numbers of declaring traders and enterprises covered by the business register, there are a number of possible systematic reasons. First of all (case 1), the business register not only excludes enterprises engaged in agriculture and forestry, fishing, and public administration, it also solely concentrates on *resident* enterprises, while trade activity is

declared by any business entity active in Germany.[25] This case seems to explain the largest part of the non-matches.

Table 2a: Associating trade declarations to genuine enterprises: steps I and II

		2004
Number of turnover tax numbers…		
…in declarations	**70,635**	
…directly linked to business register	*60,887*	
…linked to business register of respective year via tax numbers of previous business registers to same or additional enterprises	*4,534*	
Number of trading enterprises in business register…		**62,297**
…with turnover data for 2004 ("active enterprise")		*60,220*
…with employment data for 2004 (though without turnover data)for 2004 ("active enterprise")		*1,659*
Defined as active enterprise in step I		**61,879**
Number of remaining tax numbers…	**6,448**	
…linked to Intrastat register via newest or former tax number while registered as active tax payer	*3,897*	
Defined as active trading enterprise in step II		**3,848**
Preliminary number of active trading enterprises		**65,727**

In addition (case 2), for reporting years 2002 and 2003, the business registers only include entities documented to have been active on 31 December 2004 and 2005 respectively. Thus trade declarations submitted by means of former VAT numbers of any enterprise adequately documented to have exited the market in the course of 2004 or 2005 cannot be linked to the genuine enterprise. Theoretically, this should only concern very special cases of enterprises marked by a change in their tax numbers shortly before exiting. However, this specifically applies to all enterprises undergoing insolvency proceedings. Although we might attach a minor importance to trade activity of insolvent enterprises, their trade activity before the start of the insolvency proceedings (and thus the tax

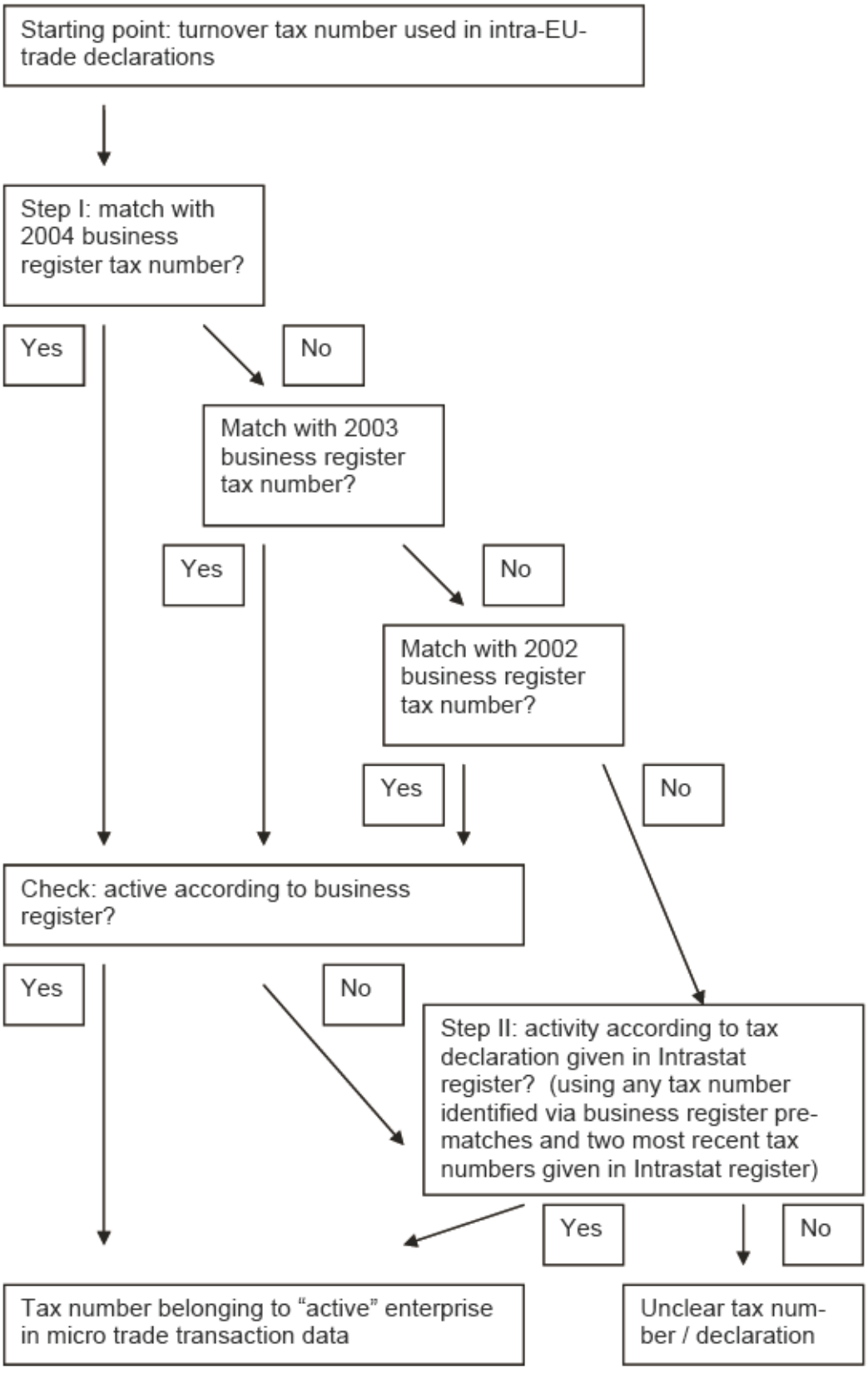
[25] To overcome this restriction, one could additionally refer to the turnover tax statistics covering all firms declaring turnover taxes of which trading enterprises are a subgroup. For legal reasons, this was not possible in mid-2007. In any case, information on the number of employees would not be available or necessary for any productivity analyses as well.

number effective at that time) cannot be linked with genuine enterprises and we omit a subgroup of specific enterprises. Fortunately, a large part of these declarations should be linkable via step II.

Furthermore (case 3), any two or more tax number changes within one 12-month period (July to June) will lead to a non-match. This also might be especially relevant for enterprises undergoing insolvency treatment (for example, being acquired during this procedure etc).

In case 1, we can be sure of failing to match ALL declarations of specific enterprises, ie we do not underestimate declarations of some enterprises, but reduce the enterprise panel. While in cases 2 and 3, we lose part (supposedly the important part) of these enterprises' declarations and underestimate their trade turnover.

Graph 1: Matching concept and enterprise definition (steps I and II)



Summarising, in this first step, I thus manage to associate trade declarations to a total of 61,879 enterprises documented in the business register. In a second step, I then refer to the Intrastat register snapshot as at the end of 2006 (although including the activity information from 2004). As explained above, we only dispose of the tax number effective at the end of 2006 and of one previous tax number for each enterprise. Since a tax number is only blocked for two years, I have to restrict the tax numbers accepted to those having definitely been active in 2004 to be sure to include the genuine enterprise.[26] The criterion I use is that the respective enterprise was documented to have paid turnover taxes due to intra-community trading.

In this second step, trade declarations by means of 3,897 different tax numbers belonging to 3,848 enterprises are finally identified. About three-quarters of these additional, evidently *active* enterprises are non-resident enterprises. Since the business register only covers resident enterprises, I could not associate these declarations to business register entities in the first step.

Also, by applying step II, we should be able to reduce the bias of non-matching cases 2 and 3, described above, to some or even to a large extent. Any enterprise having exited the market during the course of 2004 or shortly thereafter should theoretically be covered by the Intrastat register with its last PLUS its former tax number. Therefore, we might now have recorded most of their activity.

In a next step, I conduct a post-check of consistency using business register information on VAT group membership from the reference year 2004.[27] Any entity with the status of single enterprise for at least some period of time in the reference year, ie any entity with a change over the course of the year from enterprise to VAT group member status or vice versa, is accepted as an active trading enterprise (concerning its respective turnover declaration plus trade declarations). It is thus comparable to any enterprise newly founded or that exited the market over the course of the year.

In a last step, I re-checked formerly excluded tax numbers (due to the unavailability of both, employment and turnover figures for 2004) and could identify another 19 entities belonging to an active VAT group and associated the respective trade declarations to those VAT groups ("step IV").

[26] The end of 2006 is not only two years later than 2004. We also have to take into account that the intra-community trade register stores any tax number of any trade declaration since the establishment of the intra-trade statistics. This would be a possible source of error if we were simply to link the numbers without checking the status of a firm. In addition, we are faced with a few doublets, ie matches with combinations of either new or old tax number being doublet. I removed the inactive declarer (number probably used by a firm some time ago) or, in unclear cases, both numbers from the match.

[27] This status information has to be treated properly. Since the business registers include the most recent information on the VAT group for the purpose of up-to-dateness, it is important to additionally use the information at the beginning and end of this status to replicate the status of the reference year in focus. Furthermore, the existence of data on taxable turnover was accepted as an indication of (at least a temporary) tax and trade declarer of single enterprise or VAT group status. According to information from the Statistical Offices of the Länder, the 2004 business register is the first to have achieved a plausible and interpretable status concerning this information; although the enclosure of all VAT groups is not complete, we might suppose that trading enterprises are mostly well covered (see Wagner, 2004: 1025).

Table 2b: Associating trade declarations to genuine enterprises: steps III and IV (post-checks)

Preliminary number of enterprises or VAT groups after step I and II	**65,727**
Step III (post-check using URS information):	
569 cases identified as VAT group member of already included and new VAT groups	-439
Implausible cases in check	-10
Number of enterprises or VAT groups after step III	**65,298**
Step IV (post-check using URS information):	
19 cases identified as VAT group member of already included and 2 new VAT groups	2
Number of enterprises or VAT groups after step IV	**65,300**
…exclusively importing goods originating outside EU	-439
Number of enterprises or VAT groups with intra-community trade	**64,861**
Unclear tax numbers (step I and II)	2,551
Unclear tax numbers (step III)	10
Unclear tax numbers (step IV)	-19
Total number of unclear tax numbers	**2,542**
…share of all tax numbers in raw material	3.6 %
Value of intra-community trade of unclear tax numbers (% of total declared value, given in Table 1)	
…for imports	1.1 %
…for exports	1.8 %

Table 3: Availability of firm-specific information for traders in business register

	2004	% of EU-trade
Enterprises engaging in intra-community trade	Almost 470,000	
No of enterprises with micro trade transaction data	**64,861**	
matched to business register	61,398	
with (total) turnover data available for 2004	59,962	
Import side		
Raw materials		92,7
Number of trading enterprises	48,856	91,7
Enterprises with turnover data available for 2004	45,307	81,0
Export side		
Raw materials		97,5
Number of trading enterprises	45,948	95,7
Enterprises with turnover data available for 2004	42,911	86,2

% relates to share of published trade values. (Total year for trade with the 14 previous EU member countries and eight months for trade with the ten new EU member countries.)

Summarising, I apply a two-criteria matching concept (see graph 1) to be sure to associate trade declarations to the genuine enterprise. I succeed in linking most of the millions of trade declarations to 64,861 evidently active enterprises. This allows an analysis of about 95½% of the value of German intra-community exports and about 91½% of German intra-community imports (originating in another EU country) for 2004 at firm-level (again, figures always relate to eight months only for the ten new member countries). In addition, more than 61,000 of these internationally trading enterprises are covered by the business register which makes further firm-specific information available. The most important, total turnover information, is available for nearly 60,000 enterprises or VAT groups.

4 Assessment of the potential and the limits of economic analyses

As explained above, most Intrastat trade declarations were assigned to the declaring enterprise. Of those, a large part can be linked to the business register which provides us with valuable further firm-level information.

Enterprises, not covered by the business register, often declare trade by means of a non-German address.[28] We are faced with such "non-resident" enterprises reporting trade since any enterprise submitting declarations by means of a foreign address is considered as non-resident in the business register. The German tax legislation ("*Verordnung über die örtliche Zuständigkeit für die Umsatzsteuer im Ausland ansässiger Unternehmer (Umsatzsteuerzuständigkeitsverordnung - UStZustV)*"; *Abgabenordnung § 21 Umsatzsteuer*) allows entrepreneurs to make use of a foreign address in either of the following cases: the enterprise's registered office is abroad, the entrepreneur's domicile is abroad or the enterprise's management is located abroad.

Thus, the use of a foreign address instead of a domestic one when declaring trade and turnover taxes appears rather arbitrary and is not due to systematic reasons (ie ALL enterprises with a registered office abroad). However, a simple internal descriptive analysis proves that the mean import and export values of the group of those enterprises declaring intra-community trade by means of a foreign address[29] are much higher (about twice as much for imports and more than 50% stronger for exports) than one of the other declaring enterprises (the reference being the matched business register-micro trade transaction data – not the whole Intrastat register).

Since the business register concentrates on *resident enterprises*, any trade declaration of a non-resident enterprise theoretically should not be linkable and we might exclude the whole subgroup from the statistical or econometric analyses. However, in a number of cases, enterprises declare trade from abroad while being registered in the business register.[30] It is thus unclear which enterprise belongs to which subgroup and it is not possible to differentiate clearly.

These two facts, ie the arbitrariness of using a foreign address and the potential inclusion in the business register of some enterprises, however, limit the interpretability of any result drawn from the linked business register – micro trade transaction data (eg an analysis of trade turnover – total turnover relations).

A second feature, subject to critical investigation, is that the cumulated import and export values of trade transactions in the database of a certain number of traders are below the threshold of €200,000 (see Table 5). At a first glance, it thus seems that a certain number of enterprises declare trade although they are not obliged to.

[28] A comprehensive analysis of the Intrastat trade register shows that, in 2007, 6,700 (1.2%) of all Intrastat traders (more than 570,000) did so. With respect to trade turnover, their share amounted to more than 7% of exports and 10.5% of imports. See Statistisches Bundesamt (2008).
[29] In an additional match of ALL declaring enterprises identified via our matching concept in graph 1 with the Intrastat register, 63,872 of 64,861 could be merged by use of the different historical tax numbers obtained from the business register and the two tax numbers stored in the Intrastat register's snapshot as of end of 2006.
[30] To some extent, this is due to the fact that the business register has started to record such non-resident enterprises.

In this context, first and above all, it is essential to note that enterprises are obliged to start reporting once they have reached the threshold. Therefore, in theory, only those transactions need to be declared which took place after having passed the threshold. However, we cannot separate reasonably which enterprises behaved in which way. Also, enterprises having passed the threshold the year before need to submit declarations irrespective of the current year's accumulated value. Next, and very importantly, the year of focus here is marked by EU enlargement in May 2004 which, as explained before, created some specific reporting problems and enlarged the reporting group in the middle of the year. This can be assumed to have increased the number of enterprises suddenly obliged to start declaring, without reaching the threshold amount in the rest of the year. To some extent, the systematic problem of the sometimes underestimated trade activity of, first, insolvent and, then, surviving enterprises (see above) might also be relevant. All these entities are part of the group of enterprises actually obliged to declare, although not passing the threshold by accumulated declarations.

Besides this, we might be facing two further general phenomena which can be traced back to the fact that enterprises use specific software tools and declarations are subsequently executed automatically. First, a large number of enterprises over the threshold at some time might consecutively report trade. Once being able to link data over time, we should be able to analyse this further. Second, exporters, to quite some extent, also declare their imports if importing and importers their exports if exporting even if they are not obliged to report these specific flows.

As long as we cannot identify any clearly distinguishable subgroup of voluntary declarers, ie enterprises below the threshold over the whole year plus the previous one, from, say, enterprises being declaration starters,[31] it is difficult to identify and be certain to exclude only the "right" enterprises to achieve an unbiased statistical results. Although including all enterprises' declarations on hand would go along with the aim of capturing as many enterprises as possible to construct the most complete database available.

[31] Some enterprises previously not obliged to declare but reaching the declaration threshold in the course of the year are then only obliged to trade declarations for the rest of the year.

Table 4: Number of trading enterprises identifiable and declaration threshold for 2004

	2004
Declaring enterprises	64,861
Under threshold both exports and imports	2,850
Declaring importers	48,856
Under threshold (total)	15,157
Declaring exporters	45,948
Under threshold (total)	10,697

Grouping importers and exporters according to their trade value shows that the share of trade which is (seemingly) declared below the threshold is of minor importance. All declarations (for any of the reasons given above) amount to 0.2% on the export side and to 0.3% on the import side (see table 5).

Table 5: Trading enterprises in database and declaration threshold for 2004

	in €1000	No of Enterprises	Av. value of trade in €1000	Total trade in €1000	% of trade
Exports					
1-	99	7,353	34.8	255,983.4	0.1%
100-	199	3,344	147.1	491,801.7	0.1%
200-	499	6,984	338.9	2,366,956.5	0.6%
500-	999	7,264	731.3	5,311,980.9	1.2%
1,000-	4,999	13,257	2,270.8	30,104,141.4	7.1%
5,000-		7,746	50,008.8	387,367,855.0	91.0%
		45,948		425,898,719.0	
		45,948	9,272.1	426,034,313.0	
Imports					
1-	99	10,952	32.1	351,486.7	0.1%
100-	199	4,205	147.6	620,580.6	0.2%
200-	499	8,034	335.4	2,694,639.8	0.9%
500-	999	7,462	726.0	5,417,691.1	1.8%
1,000-	4,999	12,078	2,231.5	26,952,648.8	9.2%
5,000-		6,125	42,185.1	258,383,982.5	87.8%
		48,856		294,421,029.5	
		48,856	6,028.0	294,502,111.5	

Differences in the sums are due to rounding.

Concrete information on any bias might only be attained when traders are linked over time. However, the additional match with the Intrastat register gives some further information. Although, the interpretability is restricted[32], it seems that a non-negligible number of about 9,000 importing exporters did not, as they were not obliged to, declare their imports while some 7,500 exporting importers refrained from declaring their exports. The latter fact means that we can assume that quite a number of, but by far not all, enterprises declaring trade reported ALL their trading activity and not only part of it. In any analysis of the simultaneous exporting and importing behaviour of enterprises, it is thus important to construct reliable control groups of similar enterprises.

[32] The "perfect" match of trade declarations with the Intrastat register was not our aim since it was not possible without the use of historical tax numbers obtained from the business register. As a consequence, consistency of information is not perfect.

5 Conclusion

This paper presents the difficulties in analysing enterprises' micro trade transaction data which are above all due to reference period inconsistencies and changes in the enterprise identifier over time. It further discusses the contents and limits of scientific analyses of micro data available at transaction level on German enterprises' trade.

First, I present a comprehensive and unique approach to associate those trade declarations to genuine enterprises and to link information on micro trade activity with firm-level information from the business register. In doing so, 95½% of traded export value and 91½% of traded import value are interpretable at firm-level. When referring to further firm-level information available from the business register, the coverage of total trade activity is lower, although it still accounts for 81% of the intra-community import value and 86% of the export value.

However, in any analysis with further firm-level information from the business register, we have to take into account that most, although not all, traders submitting declarations by means of a foreign address are excluded. Also, a large number of exporting importers and importing exporters declare all their trading activity; however, we cannot clearly differentiate between voluntary or mandatory declarers (ie enterprises above and below the declaration threshold). Finally, 2004 was marked by EU enlargement which affects data quality of this year to some extent.

Insofar as restrictions imposed by the business registers' composition, by inaccessible tax number change documentation, by the inaccessibility of further information from, for example, the turnover tax statistics and by special reporting problems, are overcome, the quality of statistical analysis of trade transaction data will improve. The Federal Statistics Office has been working on implementing new technical features. Together with legal changes concerning the use of tax numbers, these now provide a much better starting point for future more comprehensive matches of trade statistics and business register, starting with the 2010 transaction data once finalised.

Nonetheless, the analysis of micro trade transaction data for 2004 enables us to undertake comprehensive economic analyses of German traders. First, it allows the *imports and exports* of German enterprises to be investigated simultaneously. Second, we are no longer restricted to foreign trade *turnover* analyses, but can focus on the amount, the kind, the value as well as the range of goods traded.

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Annex

Table A1: data management I: elimination of declarations

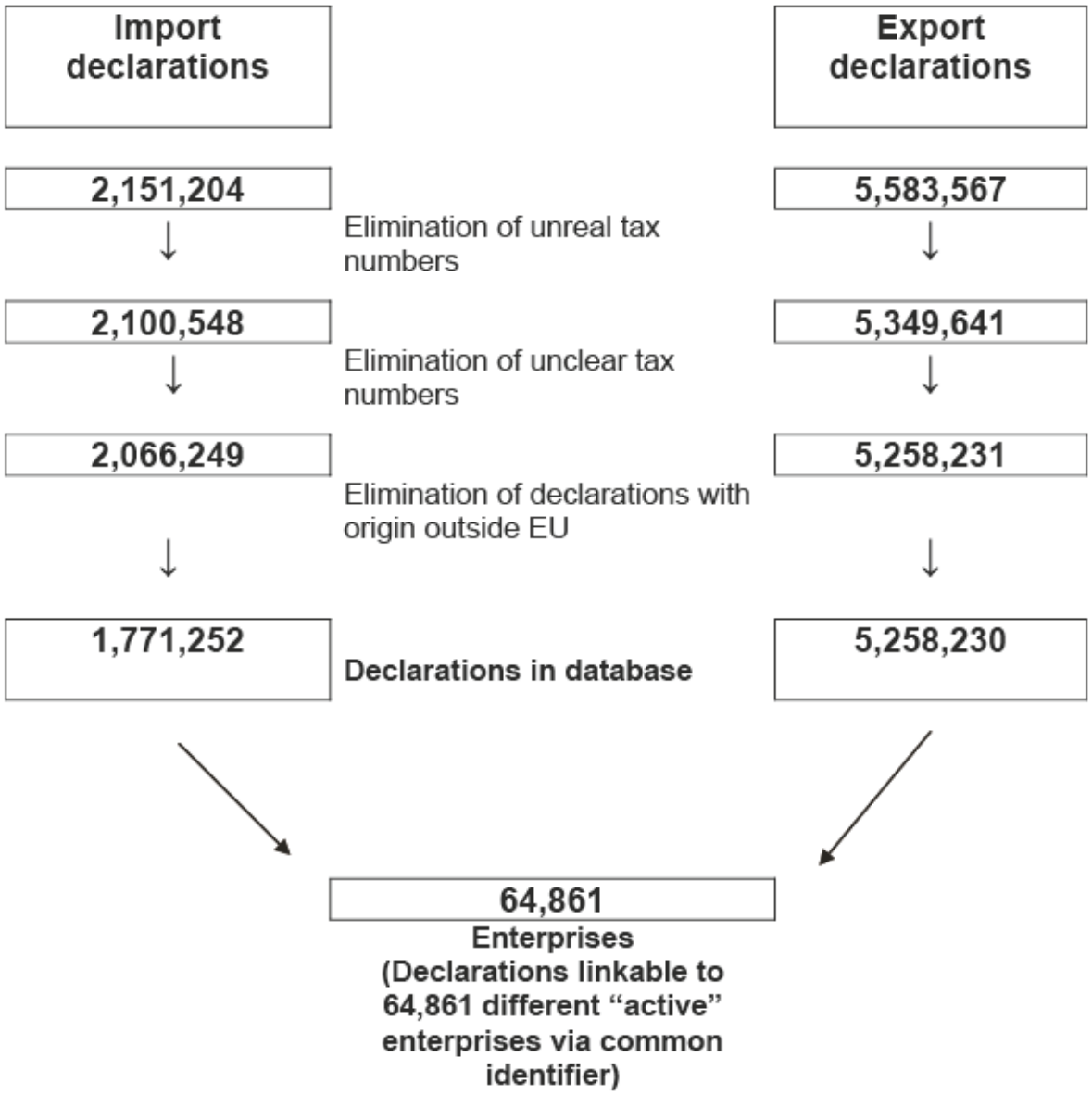
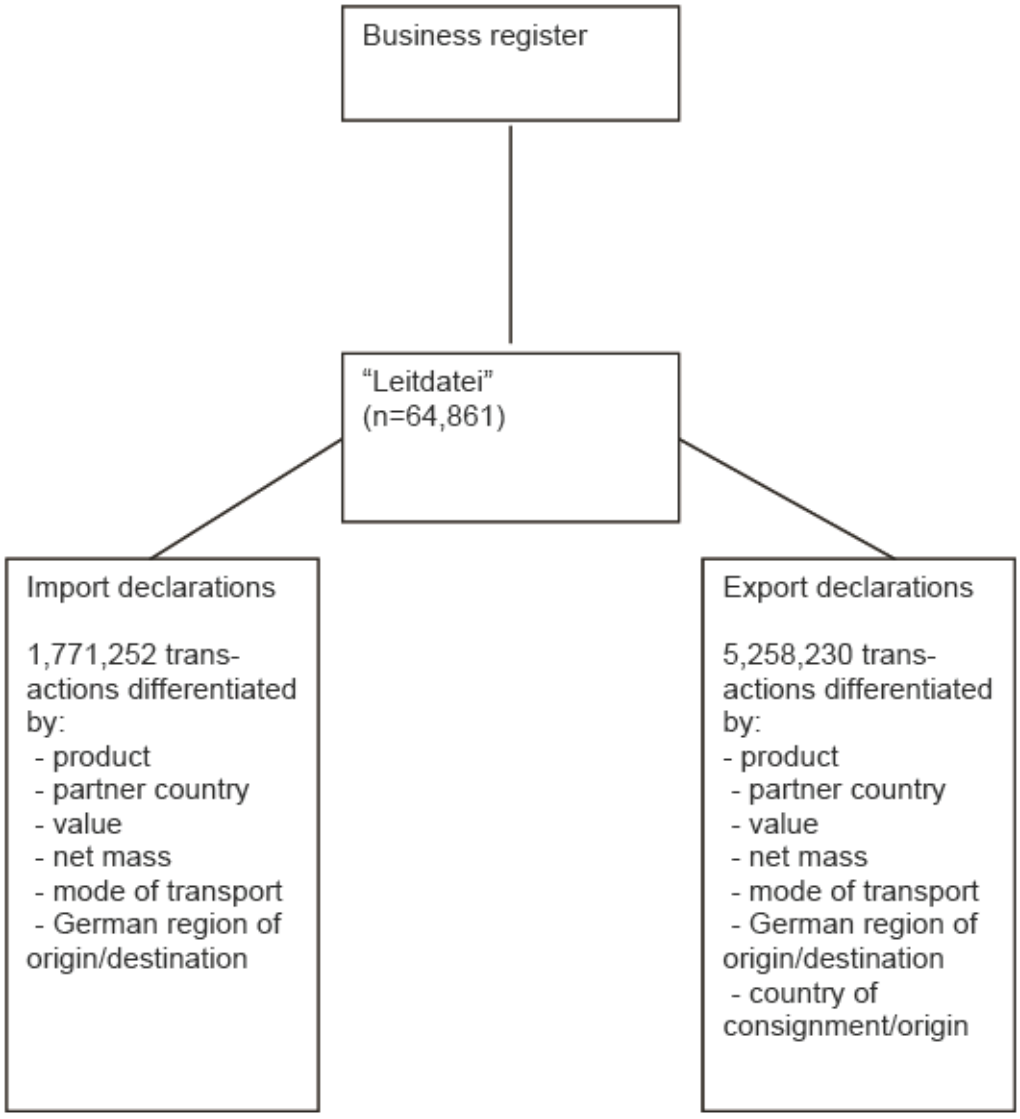


Table A2: data management II: combination of data files



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